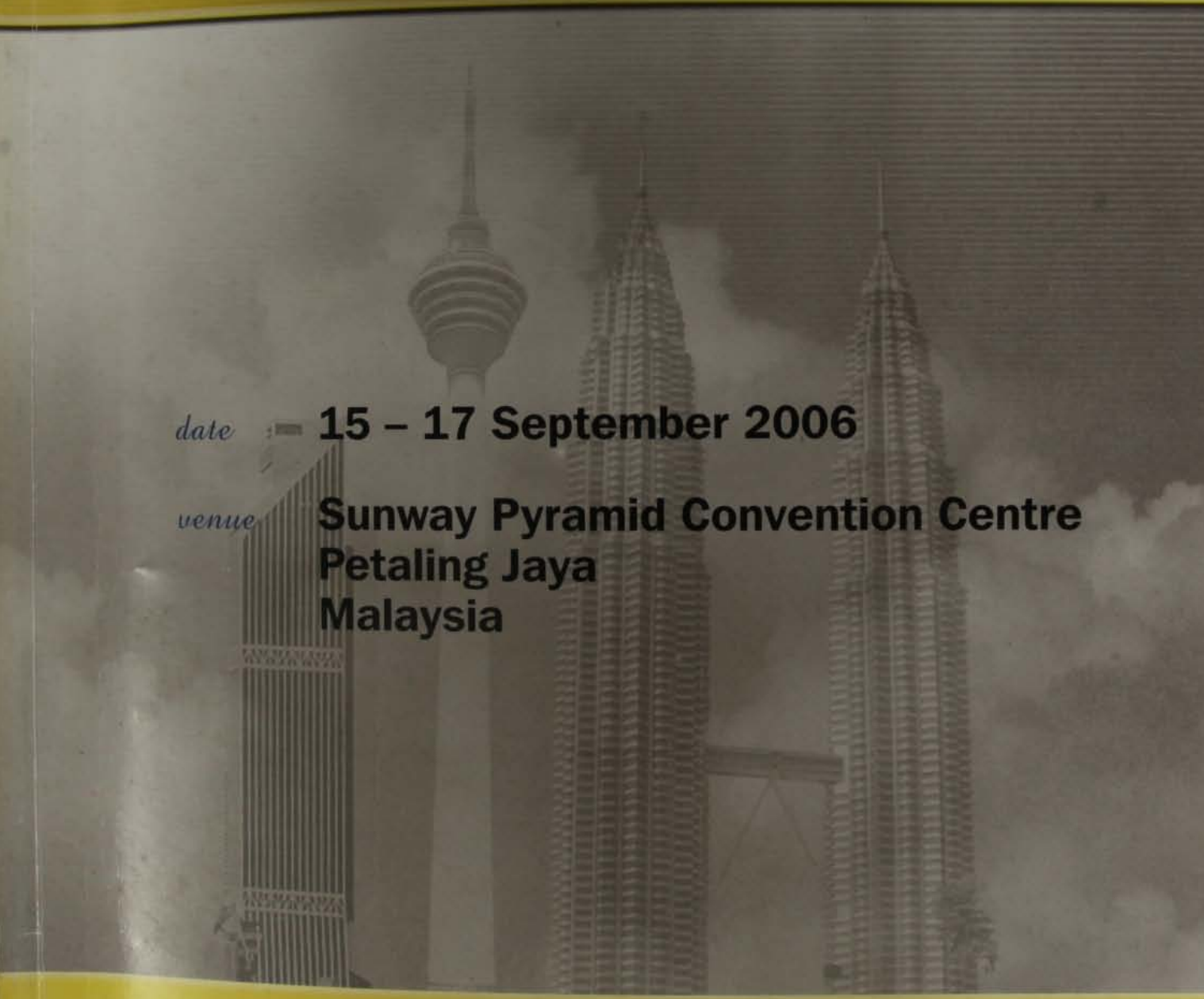
4th NATIONAL CONFERENCE ON INTENSIVE CARE



date : **15 – 17 September 2006**

venue : **Sunway Pyramid Convention Centre**
Petaling Jaya
Malaysia

Souvenir Programme & Abstract Book

Organised by

Intensive Care Section
Malaysian Society of Anaesthesiologists

In conjunction with

Ministry of Health Malaysia
(Anaesthetic and Intensive Care Services)

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Message from the President, Malaysian Society of Anaesthesiologists & Organising Chairperson, 4th NCIC

I welcome you to the National Conference on Intensive Care (NCIC) which is now in its fourth year. As in previous years, we have meticulously put together a scientific programme which covers current issues pertinent to the practitioners. We hope this yearly update on intensive care helps you keep abreast with current development and provide the best care for your patients in the ICU.

As we strive to make the NCIC better each year, we have made some changes to the way we organized our conference this year. The number of pre-conference workshops is increased to three to cater to the needs of the different categories of participants. We have planned an official opening which is simple, yet meaningful – by listening to our patients through a video presentation. Poster presentation is introduced to encourage greater participation especially among the junior doctors. For some of the lectures, we have compiled full lecture text with the hope that these notes can be used as clinical guides for those who have little access to current literature.

We are privileged and grateful that in spite of their busy schedule, world-renowned speakers from Australia, Hong Kong and Singapore have accepted our invitation to participate in this conference. Their participation along with our increasingly confident local speakers will ensure that this conference fulfils its primary function as an educational meeting to advance the practice of intensive care in Malaysia.

Each year the NCIC trade exhibition attracts favorable response from the healthcare industry and delegates are treated to a display of a wide range of healthcare products and new technologies. The overwhelming support of the industry has been instrumental in ensuring the success of NCIC and we would like to record our thanks to our trade exhibitors. Special thanks to – Gambro, Fresenius Kabi and Philips Medical System – for their participation as major sponsors of this conference. Their commitment to support continuing medical education in the field of intensive care is much appreciated.

Last but not least, I thank you for being with us. I hope you find this a fruitful and pleasant meeting.

DR NG SIEW HIAN

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- Jeffrey Lipman
- Carlos Scheinkestel
- Balasubramaniam Venkatesh

HONG KONG
- Gavin M Joynt

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Thank You

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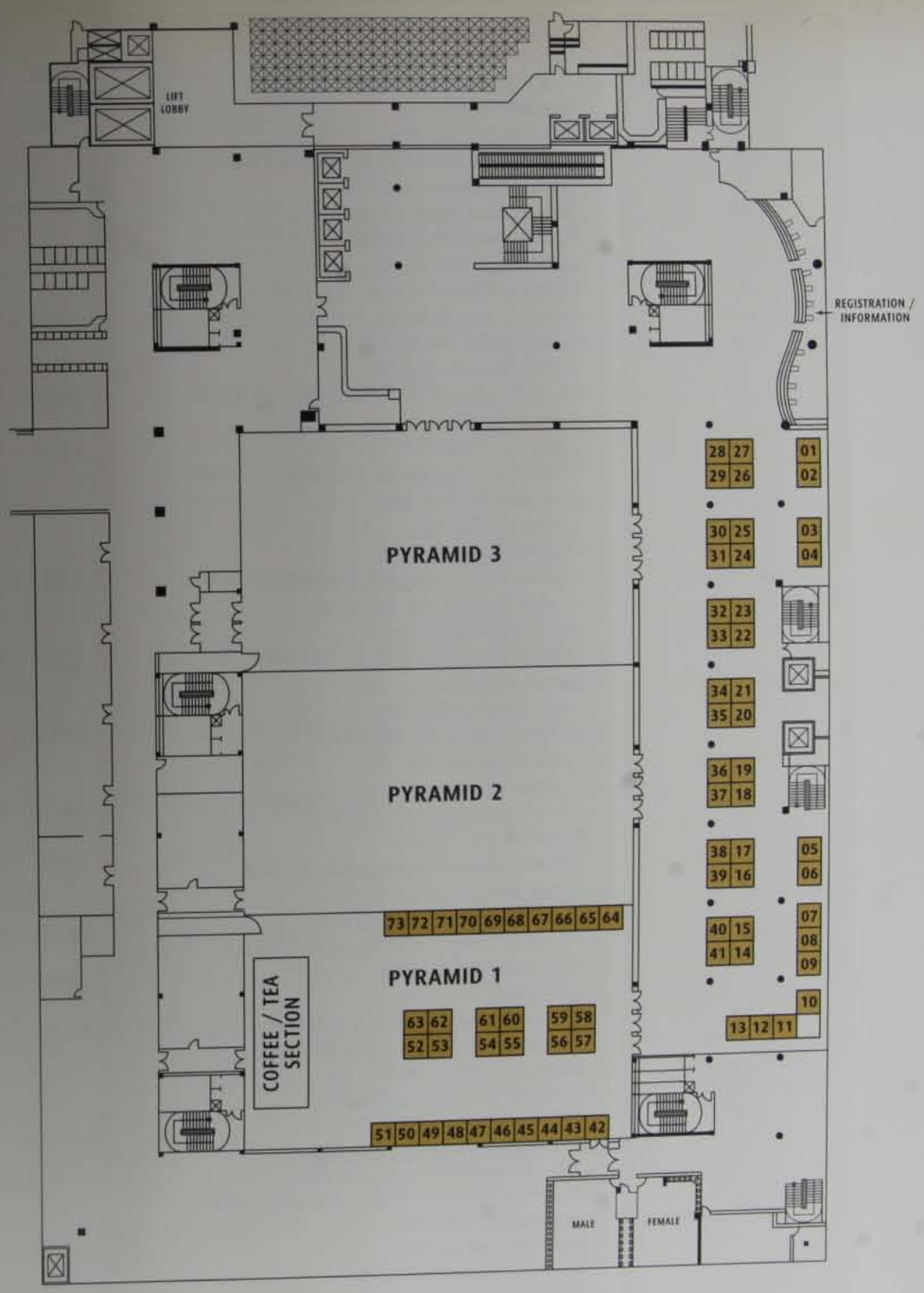
Floor Plan & Trade Exhibition



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Pre-Conference Workshop 1
Intensive Care Clinical Nutrition Workshop
14 September 2006, Thursday

CAYMANS 3 & 4, LEVEL 10
SUNWAY LAGOON RESORT HOTEL

0830 – 0900	**REGISTRATION**
0900 – 0905	Opening Speech *Ng Siew Hian*
0905 – 0950	Role of Nutrition • Nutritional Assesment • How to Feed *Melor Mansor*
0950 – 1020	Dual Energy Concept *Staffan Bark*
1020 – 1035	**COFFEE**
1035 – 1115	Nutrition in different clinical situations • Liver • Kidney *Staffan Bark*
1115 – 1145	Role of immunonutrition *Melor Mansor*
1145 – 1215	Clinical development in Glutamine Therapy *Staffan Bark*
1215 – 1245	Feeding the ICU patient *Jenny Tong*
1245 – 1345	**LUNCH BREAK**
1345 – 1415	AIO Concept *Harbans Dhillon*
1415 – 1530	Case Studies
1530 – 1600	**TEA**
1600 – 1700	Summary and Panel Discussion *Faculty Members*

Supported by Fresenius Kabi Malaysia

Pre-Conference Workshop 2
Bronchoscopy in ICU
14 September 2006, Thursday

KAY WEST, LEVEL 10
SUNWAY LAGOON RESORT HOTEL

1300 - 1400	**REGISTRATION**
1400 - 1700	**WORKSHOP** (Candidates divided into 3 groups with each workshop lasting 50 minutes)

Workshop 1
Richard Loh
- Anatomy of the Bronchial Tree
- Indications for Bronchoscopy
- Chest X-rays

Workshop 2
Nor'Azim b Mohd Yunos
- Preparation of the Patient
- Monitoring during Bronchoscopy
- Equipment
- Care and Cleaning of the Bronchoscope
- Safety of the Operator

Workshop 3
Toh Khay Wee
- Ventilation of the patient
- Hands on Bronchoscopies
- Monitoring of the Percutaneous Trucheostomy

Pre-Conference Workshop 3
CEBP in ICU
14 September 2006, Thursday

JAMAICA ROOM, LEVEL 10
SUNWAY LAGOON RESORT HOTEL

1400 – 1430	Registration & Video Presentation *"Discover flexibility – Prismaflex"* T-Medic Sdn Bhd
1430 – 1445	Welcome Speech by Dr Shanti Rudra Deva
1445 – 1515	Renal Recovery in Critically Ill – B.E.S.T Studies *Ian Tan*
1515 – 1600	Case Studies *Ian Tan*
1600 – 1615	**TEA**
1615 – 1645	Necessity for CEBP/CRRT Program in the Paediatric ICU *Loh Tsee Foong*
1645 – 1715	Case Studies *Loh Tsee Foong*
1715 – 1730	Q & A Session
1730	Workshop Adjourned

Scientific Programme Summary

TIME \ DATE	15 SEPTEMBER 2006 FRIDAY	16 SEPTEMBER 2006 SATURDAY	17 SEPTEMBER 2006 SUNDAY
0800 – 0830	REGISTRATION	PLENARY 2	PLENARY 4
0830 – 0900	WELCOME SPEECH		
0900 – 0930	PLENARY 1	PLENARY 3	PLENARY 5
0930 – 1000	TRADE EXHIBITION	TEA	TEA
1000 – 1030	TEA		
1030 – 1100	SYMPOSIUM 1 Hemodynamics & Monitoring / SYMPOSIUM 2 Paediatrics (1)	SYMPOSIUM 5 Sepsis / SYMPOSIUM 6 Fluids and Blood	SYMPOSIUM 8 Sedation / SYMPOSIUM 9 Paediatrics (2)
1100 – 1130			
1130 – 1200			
1200 – 1230			
1230 – 1300		LUNCH	LUNCH
1300 – 1330	LUNCH		
1330 – 1400			
1400 – 1430			
1430 – 1500	SYMPOSIUM 3 Ethics and Organization / SYMPOSIUM 4 Miscellaneous	SYMPOSIUM 7 Mechanical Ventilation / WORKSHOP TUTORIAL	
1500 – 1530			
1530 – 1600			
1600 – 1630			
1630 – 1700	TEA	TEA	
1700 – 1745	Free Papers (NCIC Award)		

Programme
15 September 2006, Friday

0830 – 0900 — **WELCOME SPEECH by Dr Ng Siew Hian, *President, MSA & Organising Chairperson, 4th NCIC***

0900 – 0930 — Venue: Pyramid 2

PLENARY 1
Chairperson: Syed Rozaidi Wafa
ICU in the New Millennium – Back to Basics *Jeffrey Lipman*

0930 – 1000 — **TRADE EXHIBITION**

1000 – 1030 — **TEA**

1030 – 1100 — Venue: Pyramid 2

SYMPOSIUM 1 • Hemodynamics & Monitoring
Chairpersons: Jahizah Hassan / Mohd Basri Mat Nor

- Cardiogenic Shock: New Insights [pg 12-13] *Chen Fun Gee*
- Invasive Hemodynamic Monitoring [pg 14-19] *Mohd Hassan Hj Mohd Ariff*
- Femoral Venous Catheter – Good versus Bad *Gavin M Joynt*
- Central Venous Oxygen Saturation: How To Use It [pg 20-23] *Tai Li Ling*
- Questions and Answers

Venue: Pyramid 3

SYMPOSIUM 2 • Paediatrics (1)
Chairperson: Adrian Goh

- Tight Glycaemic Control in Paediatric ICU Patients? [pg 24-27] *Tang Swee Fong*
- Outcome of Chronic Lung Disease [pg 28-32] *Lim Nyok Ling*
- Conflicts in the Intensive Care Unit: Dealing with Families [pg 33] *Jonathan Gillis*
- Questions and Answers

1130 – 1200

1200 – 1230

1230 – 1300

1300 – 1430 — **LUNCH**

1430 – 1500 — Venue: Pyramid 2

SYMPOSIUM 3 • Ethics and Organization
Chairpersons: Jaafar Md Zain / Sekar Shanmugam

- Triage in the Intensive Care Unit [pg 34] *Toh Khay Wee*
- Optimizing Bed Usage – Considerations for Developing Countries *Gavin M Joynt*
- Withholding, Withdrawing Life Support – Cultural Difference *Syed Rozaidi Wafa*
- Internet and Intensive Care: More Quality and Less Quantity is Required *Balasubramaniam Venkatesh*
- Questions and Answers

1500 – 1530

1530 – 1600

1600 – 1630

Venue: Pyramid 3

SYMPOSIUM 4 • Miscellaneous
Chairpersons: Aisai Abdul Rahman / Ahmad Shaltut Othman

- Acute Renal Failure: How to Avoid It [pg 35] *Carlos Scheinkestel*
- Critical Care in Obstetrics *Jenny Tong*
- How to Get the Best Outcomes from Renal Failure in Critically Ill Patients with CRRT [pg 36] *Carlos Scheinkestel*
- A Place for Hypertonic Lactate *Zurin Adnan*
- Questions and Answers

1630 – 1700 — **TEA**

1700 – 1745 — Venue: Pyramid 2

Free Papers (NCIC Award) [pg 37-42]
Chairperson: Tang Swee Fong

CARDIOGENIC SHOCK: NEW INSIGHTS

Chen Fun Gee

Department of Anaesthesia, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

Cardiogenic shock is defined as prolonged hypotension with evidence of of end-organ hypoperfusion, clinically manifested by cool extremities, altered mental status, oliguria and pulmonary edema(1). Killip and Kimball in their original series of 250 patients with myocardial infarction reported inhospital mortality of cardiogenic shock of 81%(2). The treatment recommended then was oxygen, nitrates, morphine, diuretics, digoxin, inotropic therapy and phlebotomy. Recently prospective data from 293633 patients with ST elevation myocardial infarction has shown inhospital mortality to decrease to 60.3% (1995) and 47.9% (2004)(3). This reduction may be attributed to increased use of aggressive revascularization strategies rather than improvement in therapeutics.

The mainstay of treatment today still remains as oxygen, nitrates, diuretics and inotropic support. Nitrates being a systemic and venous dilator has shown beneficial effects on the left ventricular indices. Its use in cardiogenic shock is limited due to its propensity to cause hypotension.

Loop diuretics reduce LV filling pressures and relieve pulmonary edema in patients with cardiogenic shock. Excessive use of diuretics may lead to excessive lowering of cardiac output with detrimental effects on systemic perfusion and hence its use has to be titrated and reponse carefully monitored. Its effects on mortality is disappointing with Faris et al reporting no difference in mortality in their metaanalysis of outcome studies on diuretics vs placebo(4).

Digoxin has long been used for treatment of heart failure despite uncertainty of its long term efficacy and safety. The Digitalis investigation group studied the effect of digoxin on mortality and hospitalization in a RCT and found no reduction in mortality although it did reduce rate of hospitalization(5). Their patients had EF of <0.45 and not all these patients were in cardiogenic shock. The role of digoxin in cardiogenic shock is not very clear and is more commonly used for rate control because of its lack of negative inotropic and hypotensive effects of amiodarone, beta blockers and calcium channel blockers.

Vasopressors are often required in the management of cardiogenic shock with profound hypotension to maintain perfusion to the vital organs. Dopamine, Epineprine, Norepinephrine, Dobutamine have all been used and though they may improve contractility and blood pressures, outcome studies have not shown an improvement in mortalities. Milrinone, a phosphodiesterase inhibitor with positive inotropy and vasodilatory effects have been shown to have additive effects with dobutamine on cardiac output and PCWP(6). However in the OPTIME in Chronic Heart Failure trial, patients on Milrinone were found to have higher incidence of treatment failure as well as mortality compared with placebo(7).

Levosimendan was recently introduced into clinical practice in Singapore. It is a calcium sensitizer. During systole, it binds and stabilizes the calcium initiated conformational changes of troponin C, lengthening the actin myosin cross bridge time. It activates KATP channels in the vascular smooth muscle cells causing vasodilating and anti-ischemic effects. In the LIDO study, levosimendan have been shown to improve cardiac output, PCWP and mortality in 103 patients compared with dobutamine(8).

Revascularization should be considered in patients with cardiogenic shock. The SHOCK investigators recently published outcome results of their trial comparing early revascularization vs medical treatment in patients with cardiogenic shock. Early revascularization resulted in 13.2 % absolute and 67% relative improvement in 6 year survival compared with medical stabilization(9).

REFERENCE

1. Hochman JS et al. Early revascularaization in acute myocardial reinfarction complicated by cardiogenic shock. SHOCK investigators. Should we emergently revascularize occluded coronaries for cardiogenic shock? NEJM 1999, 341: 341: 625-34
2. Killip T, Kimball JT. Treatment of myocardial infarction in a coronary care unit. A two year experience with 250 patients. Am J Cardiology 1967; 20: 457-64.
3. Babaev A et al. Trends in management and outcomes of patient with acute myocardial infarction complicated by cardiogenic shock. JAMA 2005; 294: 448-54.
4. Faris R et al. Diuretics for heart failure (Review). Cochrane Database of systemic reviews 2006.
5. Digitalis investigation group. The effect of digoxin on mortality and morbidity in patients with heart failure. NEJM 1997; 336: 525-33
6. Gage J et al. Additive effects of dobutamine and amrinone on myocardial contractility and ventricular performance in patients with severe heart failure. Circulation 1986: 74: 367-73.
7. Gheorghiade M et al. OPTIME in CHF trail: rethinking the use of inotropes in the management of worsening chronic heart failure during hospitalization. Eur J of Heart Failure 2003: 5; 9-12.
8. FIllath F et al. Efficacy and safety of IV Levosimendan compared with dobutamine in severe low output heart failure (the LIDO study): a randomized double blind trial. Lancet 2002: 360; 196-202.
9. Hochman et al. Early revascularization and long term survival in cardiogenic shock complicating acute myocardial infarction. JAMA 2006: 295: 2511-2515.

INVASIVE HEMODYNAMIC MONITORING

Mohamed Hassan M Ariff

National Heart Institute, Kuala Lumpur, Malaysia

INTRODUCTION

Invasive hemodynamic monitoring has revolutionised critical care practice. Assessment and interventions for critically ill patients have been transformed by the appropriate acquisition of hemodynamic data, the appropriate interpretation of the data obtained, and the subsequent decision making that alters therapeutic interventions. Invasive hemodynamic monitoring provides a tool to monitor cardiovascular physiology, to titrate interventions and to evaluate the response to the therapies instituted. For the results of hemodynamic monitoring to be utilized effectively, the bedside clinician must have a solid foundation in understanding the technical and physiologic implications that can impact the values obtained.

I will address the issues of invasive hemodynamic monitoring under the following headings.

Measuring Cardiac Output
Measuring Oxygen Utilisation
Continuous Monitoring
Less Invasive Monitoring
Functional Hemodynamic Monitoring

1) MEASURING CARDIAC OUTPUT

In the early 1970's when Drs Swan and Ganz brought this valuable tool (PA catheter) to assess intracardiac pressures, patients had to be transported to the cardiac catheter lab to obtain these measurements. Once the PAC becomes readily available these parameters could be obtained at the bedside and without the need for fluoroscopy. Early in the clinical use of PAC the pressures and cardiac determinations were the primary parameters obtained. Yet despite it being available the concept still required more than two decades to gain acceptability in the routine practice of most clinicians.

Changes in hemodynamic monitoring over the past 10 years have followed two paths. First, there has been a progressive decrease in invasive monitoring, most notably a reduction in the use of the pulmonary artery catheter because of a presumed lack of efficacy in its use in the management of critically ill patients, with an increased use of less monitoring requiring only central venous and arterial catheterization to derive the same data. Second, numerous clinical trials have documented improved outcome and decreased costs when early goal-directed protocolized therapies are used in appropriate patient populations.

The problem facing the clinicians when trying to evaluate the effectiveness of the PAC is an important one that goes beyond PAC use. Unlike the introduction of new medications, technologies are not required to demonstrate an impact on patient outcome prior to approval for use. Virtually none of the current technologies, ranging from noninvasive blood pressure monitoring to echocardiography, have been well studied for their impact on patient outcome. Monitoring and diagnostic technologies, of which the PAC is a member, do not directly impact patient outcomes. The outcome of the patient is based on the clinician's interpretation of the information provided by the technology.

For PAC utilization to accurately measure cardiac output using thermodilution technique there are some specific assumptions that must be taken into consideration.

- The bolus must be injected within 4 seconds;
- The amount of the solution must be accurate;
- The temperature of the injectate must be precisely measured;
- The catheter must be properly placed within the heart and pulmonary arteyr;

- The computer must have the appropriate computation constant

Another factor that can result in nonreproducible values is the timing of the injectate to the respiratory cycle. CO can differ from inspiration to expiration. Determinations that are not within a 5% to 10% range are frequently deleted from the series. Averaging strategies can produce varied CO values. For reproducibility rather than accuracy, potential physiologic events are often deleted. Apart from the inherent variables cited above the PAC is not without its detractors. In general there is a reduction in PAC utilization over the past 10 years. The decisions usually quoted for using less of invasive hemodynamic monitoring by the PAC are

1) increased risk to the patient with PAC insertion and placement
2) the ability to measure similar variables via other less invasive techniques e.g. CVP, echocardiography (TEE or TTE),
3) increased cost
4) inaccurate measurement and misuse of PAC derived variables
5) incorrect interpretation and application
6) lack of proven benefit of PAC in the overall patient management.

However if we look at each of the reasons cited, we see that they can be countered.

1) The risks of PAC insertion is not much different from that of a CVP insertion (hemorrhage, pneumothorax, large vessel damage, arrhythmias) – the only specific PAC complication is pulmonary artery rupture
2) Although CVP catheters can also give central venous saturation as a surrogate (as mixed venous saturation in PAC) and cardiac output (via other means e.g. PiCCO derived), it does not give pulmonary circulation data
3) In Malaysia cost consideration is indeed a factor to decide, but the cost of a PAC has come down in recent times
4) Inaccuracies of PAC measurement usually are seen during measurements of PCWP and PAOP rather than mixed venous saturation
5) Inaccuracies of interpretation and application can be reduced with better education and familiarization – it is more of user fault than equipment fault
6) Most of the studies that examine PAC derived data and patient outcome do not examine them with a defined treatment plan. Hence lack of proof of benefit does not equate to proof of lack of benefit.

One must also realize that there is no such thing as a normal cardiac output, and accurate measures of cardiac output are less important than measures of cardiac output changes in response to treatment and time. Thus if one wants to accurately define adequacy of cardiac output then we must also measure whether the oxygen delivery is adequate to match the oxygen demand. Hence measures of mixed venous oxygen are essential - whether one uses the PAC to obtain mixed venous saturation or one uses the CVP to obtain central venous oxygen as a surrogate of mixed venous saturation.

2) MEASURING OXYGEN UTILISATION

The primary clinical application of mixed venous oxygen (SvO2) monitoring is the assessment of tissue oxygenation. Tissue oxygenation is the key parameter that is affected by changes in cardiac output and blood pressure. Since SvO2 reflects the balance between oxygen delivery and oxygen consumption, SvO2 values are often tied to assessments of the adequacy of hemodynamic values. Questions such as 'What blood pressure or cardiac output is acceptable for a given patient?" can be better evaluated through the use of SvO2.

The benefit of the SvO2 value is that it is a reflection of the overall balance of oxygen delivery and consumption. A normal SvO2 value-about .60 to .75-indicates that the balance between oxygen delivery and consumption is adequate. If the SvO2 drops below.60, then either oxygen delivery is inadequate (as in low cardiac output states like congestive heart failure) or oxygen consumption is

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too high (as in respiratory failure). The lower the SvO2 value, the more likely a problem exists in terms of tissue oxygenation. SvO2 values in the .30 to .49 region have been associated with disruptions in the ability to produce adenosine triphosphate (ATP).

Elevated SvO2 values also are potentially dangerous, indicating an obstruction or maldistribution of blood flow to tissues in which cells are unable to use oxygen. In the case of either obstruction or maldistribution, an SvO2 value over .75 is an indicator of a threat to tissue oxygenation in that tissues are either not using or not receiving oxygen. Most of the hemoglobin (SvO2) is being returned to the lungs without having oxygen removed.

If blood pressure (BP) is considered low (eg. 80/50 mm Hg) but the SvO2 is normal, then the blood pressure is not likely to be harming tissue oxygenation. If the BP is low and the SvO2 is low, then treatment of the blood pressure is more important.

Central venous saturation (CeVOX) as a surrogate of mixed venous saturation is becoming more utilized especially when PAC utilization is not an option (e.g. pediatrics, or unstable patients).

Using pulse oximetry (SpO2) and SvO2 is termed "dual oximetry". Oxygen extraction can be obtained by simply subtracting SvO2 from SpO2. Certain monitors either provide a pulse oximeter to obtain SpO2 or have the capability to have the value slaved in. Once both SpO2 and SvO2 are available, dual oximetry parameters can be obtained and displayed.

3) CONTINUOUS MONITORING

Continuous Cardiac Output (CCO)

There are two clinically acceptable methods available to measure CO: bolus thermodilution (BTD-CO) and continuous cardiac output (CCO). The bolus method only allows intermittent measurement of cardiac output and introduces the potential for user variability. With the intermittent method, an injectate temperature cooler than blood temperature is used for the input signal.

The introduction of continuous cardiac output measurement allows for near real-time measurement of blood flow and stroke volume. Since the process is automated, it also reduces user variability. A modified pulmonary artery catheter with a 10cm thermal filament is used. The thermal filament is maintained in the right ventricle and continuously transfers heat directly into the blood according to a random pattern. A temperature change (less than 0.04°C) is detected downstream on a thermistor at the distal tip of the pulmonary artery catheter. A computer calculates CO via a thermodilution washout curve. A digital CO is displayed continuously on the CCO monitor and is updated every 30 seconds to provide an average flow over the previous 3 – 5 minutes. CCO requires no user calibration procedures.

Advantages of CCO include the ability to continuously measure blood flow (ie. cardiac output) and detect changes in cardiac output and stroke volume early and eliminate clinician error due to improper injectate solution, volume, and/or temperature. Fewer erroneous data are obtained due to dysrhythmias or respiration vatiation. Limitations of CCO include time delays in the response of the CCO catheter, need for an invasive catheter, and increased cost of the catheter.

CCO values are influenced by the same assumptions as intermittent thermodilution determinations - there must be forward flow; a steady baseline PA temperature; adequate mixing of the blood and input signal; and proper catheter placement. Many of the technique-related potentials for error are eliminated, such as amount of fluid injected, timing of the injectate, proper injectate sensing, and computation constant.

Continuous Venous Saturation (Mixed and Central)

The technology for continuous SvO2 monitoring has been in place for over 20 years. Refinements in the optical processing of reflected light has minimized problems of accuracy. However, manufacturers still recommend an in vivo calibration on a daily basis to confirm accuracy of the device.

The continuous SvO2 monitoring pulmonary artery catheter functions by using light-emitting diodes that send light (specifically along the light spectrums of red and infrared light) into the blood. This allows the detection of oxygen-carrying hemoglobin (oxyhemoglobin) and nonoxygen-carrying hemoglobin (deoxyhemoglobin) by comparing the amount of red and infrared light that is reflected. Light bounces off hemoglobin (among other things), and the reflected light is analyzed by an optical module. The ratio of red to infrared light that is reflected is a function of how much oxyhemoglobin and deoxyhemoglobin is present. Changes in hemoglobin should be monitored. Continuous monitoring of patient variables has provided the clinician with the ability to observe adverse events in a more timely fashion. Physiologic changes can be acted upon in amore timely manner than with intermittent assessment.

In its ultimate form it continuously measures temperature, heart rate, mixed venous saturate O2 (SvO2), cardiac output, right ventricular ejection fraction and end diastolic volume, central venous pressure and pulmonary arterial pressure. When coupled with non-invasive pulse oximetry, it can also give total oxygen delivery (DO2) and consumption (VO2). These measures will be made more effective if coupled with parallel measurements of tissue wellness with other techniques.

Continuous CeVOX is also available in the market now e.g. PreSep catheter by Edwards.

4) LESS INVASIVE HEMODYNAMIC MONITORING

Pulse Countour Analysis

The possibility of determining the CO using the arterial pulse wave has intrigued both scientists and clinicians for decades. Preliminary successes have been achieved using techniques involving determination of the area under the arterial pressure curve, as well as other methods involving analyses of various subtleties of the wave. The issue has been quantifying the relationship between the amount of blood flow and the pressure wave associated with it. This relationship can vary widely from one individual as clinical conditions change. Knowing this relationship for an individual patient and circumstance allows for the calculation of a constant (K), which can be used for subsequent CO assessments. Techniques using the arterial wave have thus previously required initial calibration with another method of CO assessment.

There are four devices that track stroke volume (SV) by analysis of the arterial pressure waveform

- 1) the PiCCO monitor (Pulsion, Munich, Germany)
- 2) the LiDCO plus System (LiDCO, Cambridge, UK)
- 3) the PRAM system (FIAB SpA, Florence, Italy)
- 4) the Vigileo system and Flo Trac System (Edwards Lifesciences, USA)

PICCO

The clinical validation studies for pulse contour were done with the arterial catheter in the femoral position. The accuracy of pulse contour seems to lessen when the arterial waveform analysis is obtained from a peripheral location. The PiCCO system may only be used with a cannula placed in the femoral or axillary artery. Kinking of the cannula may necessitate recalibration or even replacement of the arterial cannula followed by recalibration. As circulatory compliance changes in response to primary physiological changes or vasoactive drugs, the morphology of the arterial waveform alters. This is not problematic unless the pulse rate is particularly irregular.

The PiCCO continuous cardiac output shows good agreement with intermittent thermodilution of PAC, requiring recalibration only during major changes in systemic vascular resistance e.g. after phenyl ephrine infusion. This system also gives additional values over and above the conventional data obtained from the PAC catheter. Global end diastolic volume (GEDV) approximates intrathoracic blood volume (ITBV) and extravascular lung water (EVLW) as a surrogate for cardiac preload. ITBV and EVLW have traditionally been measured by the double indicator technique (thermodilution and indocyanine green) via a pulmonary artery catheter. Using EVLW to guide fluid management in medical intensive care patients has been suggested to reduce the duration of mechanical ventilation and

length of stay in the ICU. The ITBV has been suggested to be a better indicator of cardiac preload than pulmonary artery occlusion pressure (PAOP) and central venous pressure.

LITHIUM DILUTION CARDIAC OUTPUT (LIDCO)

A small dose of lithium chloride is injected via a central or peripheral venous line; the resulting arterial lithium concentration-time curve is recorded by withdrawing blood past a lithium sensor attached to the patient's existing arterial line. In terms of accuracy, clinical studies have demonstrated that the LiDCO method is at least as accurate as thermodilution over a wide range of cardiac outputs. It is more reliable than conventional thermodilution cardiac output measurement. The dose of lithium needed (0.15 – 0.3 mmol for an average adult) is very small and has no known pharmacological effect. Recalibration is unnecessary for at least 8 hours. This approach differs slightly from that of the PiCCO™ system; LiDCO analyses the arterial waveform throughout the cardiac cycle whereas PiCCO™ utilizes only the area under the systolic portion of the curve.

Only three studies in humans have been published in peer-reviewed journals, two in cardiac surgical patients and one in critically ill paediatric patients.

PRESSURE RECORDING ANALYTICAL METHOD (PRAM) SYSTEM

The PRAM system is based on the physics of perturbations. It analyses all of the arterial wave using a collecting signal of 100Hz. The most important points on the waveform are the diastolic pressure, the systolic pressure and the point of closure of the aortic valve. The SV is calculated from the area under the curve in the interval between the diastolic part of the curve and the dicrotic notch. In this way the system is analysed individually and does not require calibration to correct for compliance. PRAM has already been validated in cardiac surgery against the PAC.

EDWARDS VIGILEO AND FLO TRAC SYSTEM

The Edwards Vigileo system, using the FloTrac sensor attached to arterial pressure tubing, needs no such calibration and provides continuous CO measurements from the arterial pressure wave.

The system consists of a sensor (FloTrac, Edwards LLC) and a processing/display unit (Vigileo, Edwards LLC). The processing unit applies a proprietary algorithm to the digitized wave, and reports CO, cardiac index, stroke volume, stroke volume index and stroke volume variation (SVV). The system calculates the arterial pressure using arterial pulsatility (standard deviation of the pressure wave over a 20-s interval), resistance and compliance, according to the following general equation:

$$\text{Stroke volume} = K \times \text{Pulsatility}$$

where K is a constant quantifying arterial compliance and vascular resistance, and pulsatility is proportional to the standard deviation of the arterial pressure wave over a 20-s interval. K is derived from patient characteristics (gender, age, height and weight) as well as waveform characteristics (e.g., skewness and kurtosis of individual waves). This calibration constant is recalculated every 10 min. There was close correlation between the algorithm and continuous thermodilution CO.

This technology represents a highly innovative and potentially significant advance in hemodynamic assessment. The lack of necessity for calibration with a more invasive method of CO assessment provides for easy and expeditious use in a myriad of clinical venues, including the emergency room, cardiac care unit, operating room, trauma bay, medical/surgical intensive care units and intermediate care units.

This represents an advantage over the PiCCO system, which requires a centrally placed arterial catheter (femoral, axillary or long radial). To obtain information about systemic vascular resistance, a central venous catheter can be transduced and interfaced with the Vigileo. This allows the clinician to provide optimal fluid, vasodilator and inotropic therapy without the need for pulmonary artery catheterization.

The FloTrac Vigileo system also reports SVV. This is the change in SV in one respiratory cycle. Patients suffering hypovolemia exhibit an exaggerated SVV. A large SVV (>10%) thus indicates that the patient is likely to respond favorably to fluid administration.

If a central venous pressure catheter has been placed, its signal can be interfaced with the Vigileo, allowing for the calculation of systemic vascular resistance (SVR) and SVR index (SVRI). When use with a central venous oximetry catheter, the Vigileo also provides continuous central venous oxygen saturation (ScvO2). The Vigileo reports hemodynamic parameters at 20-s intervals, performing its calculations on the most recent 20s of data.

Potential weaknesses of the system include possible inaccuracy in the presence of arterial wave artifact, compromise of the arterial catheter, aortic regurgitation, intense peripheral vasoconstriction and irregular pulse.

FUNCTIONAL HEMODYNAMIC MONITORING

Specific hemodynamic variables are commonly measured and displayed at the bedside, and their values are often used in clinical decision making. However the utility of each variable as a single absolute value is questionable.

This gives rise to the concept of functional hemodynamic monitoring. It can either be viewed as a solitary value and interpreted according to its value and patternwhich may be called static functional monitoring. It can also be viewed to evaluate the effect of treatment looking at trends of change, hence implying its therapeutic application which can be looked as a dynamic functional hemodynamic monitoring. Although trends in specific variables over time are useful in defining hemodynamic stability, their rapid change in response to application of a therapy has greater clinical utility.

For example, an elevated CVP implies right ventricle pressure overload, it provides no information on the precise etiology. Assessing preload adequacy is more definitive in managing a patient with elevated CVP – e.g. volume challenge with fluids or passive leg raising (similar to a slight Trendelenberg position). Recent monitoring devices have incorporated this as part of their system e.g. SVV value in PiCCO and Flo Trac system.

One must not only look at the effect of respiration or ventilation on the CVP but one must also give close attention to CVP waveform interpretation. Examples are given.

CONCLUSION

The effectiveness of hemodynamic monitoring depends both on available technology and on our ability to diagnose and effectively treat the disease processes for which it is used. Within this context hemodynamic monitoring represents a functional tool that may be used to derive estimates of performance that may in turn direct treatment.

It must be stressed that no monitoring device, no matter how accurate or complete, could be expected to improve patient outcome, unless coupled to a treatment that itself improves outcome.

CENTRAL VENOUS OXYGEN SATURATION: HOW TO USE IT

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The aim of cardiovascular monitoring is to recognise impending tissue hypoxia. Early recognition and treatment of tissue hypoxia is important in the management of the critically ill. If untreated, global tissue hypoxia, leads to anaerobic metabolism, lactate production and oxygen debt. The magnitude and duration of oxygen debt have been implicated in the development of multi-system organ failure and increased mortality. Unfortunately, the routine continuous monitoring of the systemic blood pressure, heart rate and central venous pressure is unable to provide information about the imbalances between whole body oxygen supply and demand in these patients.

Measurement of mixed venous oxygen saturation (SvO_2) from the pulmonary artery has been advocated as an indirect indicator of the adequacy of tissue oxygenation. To enable measurement of this parameter, pulmonary artery catheterisation is necessary. Due to its inherent risks and lack of convincing data of its usefulness, pulmonary artery catheterisation is not routinely carried out as part of the cardiovascular monitoring in the critically ill patient.

Central venous catheterisation which is an easier and safer procedure is frequently performed in the critically ill patient for monitoring of the central venous pressure and administration of vasoactive drugs. In the late 1960s, Goldman studied the measurement of central venous oxygen saturation ($ScvO_2$) in patients with myocardial infarction while Scheinman investigated if the $ScvO_2$ reflects changes in SvO_2. It has always been questioned whether $ScvO_2$ exactly mirrors SvO_2 especially in the critically ill patient. Rivers in a prospective randomised trial demonstrated that there is improved survival outcome with early intervention directed by $ScvO_2$ in patients with severe sepsis and septic shock (1). Since then, there is resurgence in interest in the measurement of $ScvO_2$ in critically ill patients.

Physiology of mixed venous oxygen saturation (SvO_2)

Calculation of O_2 consumption (VO_2) according to the Fick principle is given as the product of cardiac output (CO) and arteriovenous O_2 content difference ($a\text{-}v[O_2]$).

$$VO_2 = CO \times a\text{-}vO_2$$

$a\text{-}v[O_2]$ is the difference between arterial O_2 content and venous O_2 content ($CaO_2 - CvO_2$)

Therefore $VO_2 = CO \times (CaO_2 - CvO_2)$

Rearranging the formula for O_2 consumption

$$CvO_2 = CaO_2 - \frac{VO_2}{CO}$$

O_2 content ($[O_2]$) is the sum of oxygen bound to haemoglobin [product of haemoglobin concentration (Hb) and O_2 saturation (SO_2)] and physically dissolved oxygen ($[PO_2]$).

$$[O_2] = [Hb \times 1.36 \times SO_2] + \{[PO_2 \times 0.003]\} \text{ — negligible}$$

Substituting O_2 content in the formula for O_2 consumption

$$CvO_2 = CaO_2 - \frac{VO_2}{CO}$$

$$Hb \times 1.36 \times SvO_2 = Hb \times 1.36 \times SaO_2 - \frac{VO_2}{CO}$$

$$SvO_2 = SaO_2 - \frac{VO_2}{CO}$$

SvO_2 indicates the balance between oxygen supply and demand. SvO_2 can be decreased when O_2 supply does not increase in such a way to cover for an increased O_2 demand; or due to decrease in either arterial O_2 content, cardiac output, or both. Conditions that can cause a drop in O_2 delivery are anaemia, hypoxia, hypovolemia, or heart failure while fever, pain, stress may also decrease SvO_2 by increasing whole-body O_2 demand.

Limits of mixed venous oxygen saturation (SvO_2)(2)

SVO_2 LEVEL	CONSEQUENCES
$SvO_2 > 75\%$	Normal extraction O_2 supply > O_2 demand
$75\% > SvO_2 > 50\%$	Compensatory extraction Increasing O_2 demand or decreasing O_2 supply
$50\% > SvO_2 > 30\%$	Exhaustion of extraction Beginning of lactic acidosis O_2 supply < O_2 demand
$30\% > SvO_2 > 25\%$	Severe lactic acidosis
$SvO_2 < 25\%$	Cellular death

CAN $ScvO_2$ FUNCTION AS A SURROGATE FOR SvO_2?

In healthy humans, the oxygen saturation in the inferior vena cava is higher than in the superior vena cava as the lower body extracts less O_2 than the upper body. The reason is many of the vascular circuits that drain into the inferior vena cava use blood flow for non-oxidative phosphorylation needs (e.g. renal and hepatic blood flow).

Measurement of $ScvO_2$ in the superior vena cava reflects the degree of O_2 extraction from the brain and the upper part of the body. Since the pulmonary artery contains a mixture of blood from both the superior as well as the inferior vena cava, SvO_2 is greater than the oxygen saturation ($ScvO_2$) in the superior vena cava. In non-shock states, there is a good correlation between $ScvO_2$ and SvO_2, with $ScvO_2$ being less than SvO_2 by about 2 – 3%.

If the tip of the central venous catheter is located inside the right atrium, there is mixing of blood from the inferior vena cava and measurement of $ScvO_2$ may be higher than if the tip is located in the superior vena cava.

The difference between $ScvO_2$ and SvO_2 is not constant and may be affected by changes in the regional blood flow and oxygen supply to demand ratio.

In shock states, there is a consistent reversal of the relation between $ScvO_2$ and SvO_2 where superior vena cava $ScvO_2$ is always greater than SvO_2 with the difference ranging from 5 – 18%. Redistribution of blood flow away from the splanchnic, renal, and mesenteric bed toward the cerebral and coronary circulation, including more desaturated blood (< 30%) from the coronary sinus, contributes to this observation. Thus, $ScvO_2$ consistently overestimates the true SvO_2 under shock conditions and the changes of these two parameters occur mostly in a parallel manner.

Measurements of $ScvO_2$ and SvO_2 are not equivalent i.e. the absolute values differ. It had been shown in animal studies that SvO_2 and $ScvO_2$ closely parallel each other in various pathologic states. However, studies in humans had shown conflicting results (3, 4, 5).

SCVO2 MONITORING: CONTINUOUS VS. INTERMITTENT

Central venous O_2 saturation can be measured either intermittently using central venous blood gas analysis or continuously using fibreoptic oximetry catheters. It is vital to measure central venous oxyhaemoglobin saturation using oximetry if intermittent blood gas analysis is used. $ScvO_2$ computed from partial pressure oxygen (PvO_2) will not be accurate. The PvO_2 range is within the steep section of the oxyhaemoglobin dissociation curve where a small change in PvO_2 will cause a significant change in $ScvO_2$.

When using $ScvO_2$ to make clinical decisions, it should not be based on a single measurement, but rather on trends of $ScvO_2$ to detect an imbalance between oxygen delivery and consumption. Continuous monitoring of $ScvO_2$ and SvO_2 in the framework of haemodynamic goals and treatment algorithms has resulted in improved patient outcome. However, it is unclear if intermittent measurement of $ScvO_2$ can substitute continuous monitoring of $ScvO_2$ in these algorithms.

CLINICAL USES OF $ScvO_2$ MONITORING

Septic shock

Although the blood flow to the splanchnic region is increased in septic shock, the lower ratio of O_2 supply to demand in the this region results in greater O_2 desaturation from venous blood that drains into the hepatic vein and inferior vena cava, respectively. On the other hand, cerebral blood flow is maintained causing the measurement of $ScvO_2$ to be higher than SvO_2. On average $ScvO_2$ exceeds SvO_2 by 8% in patients with septic shock (3).

Rivers et al. demonstrated that using $ScvO_2$ as a resuscitation end-point in addition to mean arterial pressure and central venous pressure provides significant outcome benefit for patients with severe sepsis and septic shock over standard therapy (1). Those in the early goal-directed therapy group were resuscitated to $ScvO_2$ greater than 70% using continuous $ScvO_2$ monitoring.

While $ScvO_2$ is an excellent tool in the early resuscitation period of shock, there is still controversy as to whether it is a suitable parameter for follow-up therapy in the intensive care unit. Varpula et al. found that the difference between these two oxygen saturation parameters varies highly in the intensive care unit treatment period and concluded that SvO_2 is not to be estimated on the basis of $ScvO_2$ (5).

Heart failure and cardiogenic shock

Heart failure is characterised by a limited cardiac output. To meet the needs during an increase in O_2 demand, the O_2 extraction in tissue is increased as these patients are unable to sufficiently increase their cardiac output. Therefore, in these patients, SvO_2 is tightly correlated with cardiac output and a drop in SvO_2 is a good and early marker of cardiac deterioration, most commonly seen in acute heart failure in acute myocardial infarction. Goldman et al. found that $ScvO_2$ less than 60% showed evidence of heart failure, shock or both.

However patients with chronic heart failure may live with SvO_2 in the low range of 30 – 40% without apparent tissue hypoxia, presumably because they have adapted to higher O_2 extraction. These patients can increase their O_2 consumption to a limited degree because O_2 extraction is close to its limits as is cardiac output. Anders examined the use of lactic acid levels and $ScvO_2$ to stratify and treat patients with acutely decompensated end-stage congestive heart failure who presented to the emergency department (6). $ScvO_2$ was significantly lower in the high lactic-acid group than in the normal lactic-acid group. There was a significant prevalence of undetected cardiogenic shock with $ScvO_2$ ranging from 26.4 to 36.8% in the presence of normal vital signs.

Cardiac arrest

Patients with cardiac arrest routinely have $ScvO_2$ values of 5 – 20% during cardiopulmonary resuscitation. Those with return of spontaneous circulation had a higher initial mean and maximal $ScvO_2$ than did those without (7). No patient attained return of spontaneous circulation without reaching a $ScvO_2$ of at least 30%. A $ScvO_2$ of greater than 72% was 100% predictive of return of spontaneous circulation. However, a very high $ScvO_2$ (> 80%) in the presence of a very low O_2 delivery after successful CPR is also an unfavorable predictor of outcome as it is indicates impairment of tissue O_2 utilisation probably due to a prolonged cardiac arrest. Continuous $ScvO_2$ monitoring can provide an objective measure to confirm the adequacy or inadequacy of cardiopulmonary resuscitation in providing O_2 delivery but its practicality is doubtful.

Trauma and haemorrhage

Scalea et al. had shown that patients presenting with trauma and hemorrhage required additional resuscitation or surgical procedures when $ScvO_2$ remained less than 65% despite stable systemic blood pressure, heart rate and central venous pressure (8). These patients had more serious injuries and significantly larger estimated blood losses and required more transfusions than those patients with $ScvO_2$ saturation > 65%. They also demonstrated prolonged cardiac dysfunctions and elevated lactate levels.

Major surgery

Pearse et al. measured $ScvO_2$ besides cardiac index and O_2 delivery index in patients after major general surgery and found that a $ScvO_2$ cut-off value of 64.4% (sensitivity 67%, specificity 56%) could be used to discriminate patients with a complicated or uncomplicated post-operative course (9). The lowest $ScvO_2$ was independently associated with post-operative complications. In the first hour after surgery, significant reductions in $ScvO_2$ were observed but there were no significant changes in cardiac index or oxygen delivery index during the same period. Reduction in $ScvO_2$ is due to increased post-operative oxygen consumption from various factors e.g. pain, emergence from anaesthesia and shivering.

LIMITATIONS OF MIXED AND CENTRAL VENOUS OXYGEN SATURATION FOR THE ASSESSMENT OF TISSUE OXYGENATION

Inadequate tissue oxygenation may exist despite normal central and mixed venous oxygen saturations. Normal or high $ScvO_2$ and SvO_2 do not rule out tissue hypoxia in the organ or at regional level. Venous oximetry can reflect the adequacy of tissue oxygenation only if the tissue is still capable of extracting O_2.

Venous oximetry should not be used alone in the assessment of the cardiovascular system but in combination with other haemodynamic parameters and indicators of organ perfusion such as serum lactate concentration and urine output.

CONCLUSION

Low values of SvO_2 or $ScvO_2$ indicate a mismatch between O_2 delivery and tissue O_2 demand. $ScvO_2$ values differ from SvO_2 values and this difference varies with cardiac ouptut and regional O_2 consumption. Much remains unknown about $ScvO_2$. Further work is needed to understand changes of $ScvO_2$ over time in assessing treatment and in different types of patients.

REFERENCES

1. Rivers E, Nguyen B, Havstad S, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med* 2001;345(19):1368-77
2. Marx G, Reinhart K. Venous oximetry. *Curr Opin Crit Care* 2006;12:263–268.
3. Reinhart K, Kuhn HJ, Hartog C, Bredle DL. Continuous central venous and pulmonary artery oxygen saturation monitoring in the critically ill. *Intensive Care Med* 2004;30(8):1572-8
4. Chawla LS, Zia H, Gutierrez G. Lack of equivalence between central and mixed venous oxygen saturation. *Chest* 2004;126:1891-96
5. Varpula M, Karlsson S, Ruokonen E. Mixed venous oxygen saturation cannot be estimated by central venous oxygen saturation in septic shock. *Intensive Care Med* 2006 (electronic reference http://dx.doi.org/10.1007/s00134-006-0270-y)
6. Ander DS, Jaggi M, Rivers E, et al. Undetected cardiogenic shock in patients with congestive heart failure presenting to the emergency department. *Am J Cardiol* 1998;82(7):888-91.
7. Rivers EP, Martin GB, Smithline H, et al.. The clinical implications of continuous central venous oxygen saturation during human CPR. *Ann Emerg Med* 1992; 21; 1094-1101
8. Scalea TM, Hartnett RW, Duncan AO, et al. Central venous oxygen saturation: a useful clinical tool in trauma patients. *J Trauma* 1990; 30:1539-43
9. Pearse R, Dawson D, Fawcett J, Rhodes A, Grounds RM, Bennett ED. Changes in central venous saturation after major surgery, and association with outcome. *Crit Care* 2005;9(6):R694-9.
10. Bloos F, Reinhart K. Venous oximetry. *Intensive Care Med* 2005;31(7):911-13.
11. Rivers E, Ander DS, Powell D. Central venous oxygen saturation monitoring in the critically ill patient. *Curr Opin Crit Care* 2001;7;204-211.

TIGHT GLYCAEMIC CONTROL IN PAEDIATRIC ICU PATIENTS?

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INTRODUCTION

Hyperglycemia occurs frequently among critically ill adults, with prevalence rates reported from 3% to 71%[1]. Mechanisms include insulin resistance, impaired glucose metabolism, and the effect of medications such as corticosteroids and densely caloric enteral and parenteral nutritional supplements. However, hyperglycaemia is often perceived as a stress response, and physicians typically treat hyperglycaemia only after blood glucose concentrations exceed the renal threshold of resorption of glucose 200-250 mg/dl (11.1-13.8 mmol/L), resulting in osmotic diuresis[2]. This is frequently due to the perception that avoidance of hypoglycaemia and its potential consequences are more important than glycaemic control while patients are hospitalised[3].

Several clinical studies have shown that hyperglycaemia not only reflects the severity of acute illness but indicate that hyperglycaemia is a risk factor for adverse outcomes during acute illness[4]. Kingsley investigated, in a retrospective study of 1826 patients, the relationship between hyperglycaemia and hospital mortality in a heterogeneous group of critically ill patients[5]. Mean and maximum glucose values were significantly higher among nonsurvivors than among survivors for the entire group ($p < 0.001$). The lowest hospital mortality, 9.6%, occurred among patients with mean glucose values between 80 and 99 mg/dL (4.4 and 5.5 mmol/L). Hospital mortality increased progressively as glucose values increased, reaching 42.5% among patients with mean glucose values exceeding 300 mg/dL (16.7 mmol/L). Umpierrez et al showed that hyperglycaemia in hospitalised patients was associated with a higher rate of admission to the intensive care unit, longer hospitalization and was an independent marker of in-hospital mortality[6]. In adults who had experienced ischaemic stroke, glucose values in excess of 108-144 mg/dl (6.0-8.0 mmol/l) were associated with a 3-fold increase in risk of mortality (OR, 3.1; 95% CI, 2.5-3.8) and seem to be related to the degree of permanent disability after the stroke[7]. Likewise, in adults who have just experienced myocardial infarction, glucose values greater than 110-144 mg/dl (6.1-8.0 mmol/l) were associated with at least a 3-fold increase in risk of mortality (OR, 3.9; 95% CI, 2.9-5.4) and a higher risk of heart failure[1]. Hyperglycaemia has also been shown to be an independent predictor of poor outcome in patients with severe head injury[8] and multiple-system trauma[9]. Early hyperglycaemia as defined by glucose > 200 mg/dL (11.1 mmol/L) is associated with significantly higher infection and mortality rates in trauma patients independent of injury characteristics[10]. It has also been shown that the relation of hyperglycaemia and mortality is more pronounced in trauma patients than in surgical intensive care unit patients admitted for other reasons[11]. Hyperglycaemia has also be associated with diminution in pulmonary function, even in nondiabetic adults[12] and also results in delayed gastric emptying and decreased small intestinal motility in adults[13,14]. Other studies have demonstrated the association of hyperglycaemia with infections both in adults and children[15,16,17].

Despite the wealth of literature in adults, fewer studies in children have demonstrated the association of hyperglycaemia and adverse outcome. Srinavasan et al have demonstrated, in a retrospective cohort study, that hyperglycaemia is also associated with poor outcome in critically ill children needing mechanical ventilation or vasoactive infusions, independent of disease category[18]. This study showed a higher than expected prevalence of hyperglycaemia in critically ill children and, in particular, the independent association of peak blood glucose levels and duration of hyperglycaemia of greater than 7.0 mmol/L with mortality. Similar results were obtained by Faustino et al in a retrospective cohort study of hyperglycaemia in critically ill non-diabetic children[19]. Hyperglycaemia occurred frequently among critically ill nondiabetic children and correlated with a greater degree of in-hospital mortality rate and longer length of stay. Hyperglycemia, especially its persistence over time, also seems to be an important negative prognostic factor in those with head injury[20,21].

MECHANISMS INVOLVED IN CELLULAR DAMAGE CAUSED BY HYPERGLYCEMIA

The association of hyperglycaemia with organ/tissue dysfunction and poor outcomes has been well documented in laboratory research settings. Findings in both global models of cerebral ischaemia have revealed that hyperglycaemia exacerbates intracellular acidosis[22,23,24], accumulation of extracellular glutamate[25], brain oedema formation[26], blood-brain barrier disruption[27], and a tendency toward haemorrhagic transformation of ischaemic infarcts[28]. In the setting of ischaemic brain injury, hyperglycaemia may worsen injury via promotion of anaerobic metabolism and intracellular metabolic acidosis. Hyperglycaemia-induced reduction of cerebral adenosine production may also play a role in ischaemic brain injury[29]. Hyperglycemia also has deleterious effects on the rat myocardium, as evidenced by enhanced inducible NO synthase gene expression. Up-regulation of inducible NO synthase and raised NO generation are accompanied by a marked concomitant increase of superoxide production, a condition favouring the production of peroxynitrite. This is a powerful pro-oxidant that can mediate the toxic effects of high glucose on the myocardium by itself or via the formation of nitrotyrosine, as suggested by the detection of cell apoptosis[30]. Myocardial cell apoptosis is also mediated, at least in part, by activation of the cytochrome c-activated caspace-3 pathway, which may be triggered by reactive oxygen species derived from high levels of glucose[31].

Other studies have demonstrated the adverse effects of hyperglycemia on pulmonary and renal tissue through mechanisms involving nonenzymatic glycosylation of collagen, activation of protein kinase C resulting in production of reactive free radical production, and by increased production of sorbitol with concomitant depletion of intracellular glutathione[32,33,34,35]. In vitro studies have shown that exposure of monocytic cell lines to hyperglycemia results in elevation of nuclear factor-κB and activator protein-1 (a transcription factor that regulates the expression of metalloproteinases) with an increase in the expression of tumour necrosis factor-α, a proinflammatory cytokine[36].

CONTROL OF HYPERGLYCAEMIA AND OUTCOME

Control of hyperglycemia during acute illness in adults has been associated with improved outcomes[37,38,39]. A recent randomized trial in mechanically ventilated adults in a surgical ICU compared strict control (goal blood glucose levels of 80-110 mg/dl [4.4-6.1 mmol/l] with conventional therapy to maintain blood glucose levels of 180-200 mg/dl [10-11.1 mmol/l]. Strict glycaemic control significantly reduced ICU mortality by 43% (death OR, 0.52; 95% CI, 0.33-0.81), hospital mortality by 34%, mean ICU stay by 22%, and prevalence of bacteraemia and haemodialysis by 50%[37]. Another randomized trial of intensive insulin therapy (from admission to 3 mos after discharge) in diabetic patients after myocardial infarction (DIGAMI trial) demonstrated that 1-yr mortality rate was 29% lower in patients receiving intensive insulin therapy than in standard treatment group[38]. Similarly, the risk of sternal wound infections after coronary artery bypass graft surgery was reduced by 58% with glycaemic control of 150-200 mg/dl (8.3-11.1 mmol/l)[39].

In a meta-analysis of randomized controlled trials where insulin therapy was used for critically ill hospitalised patients, it was found that insulin therapy decreases short-term mortality by 15% (RR, 0.85; 95% CI, 0.75-0.97)[40]. In subgroup analyses, insulin therapy decreased mortality in the surgical intensive care unit (RR, 0.58; 95%CI, 0.22-0.62), when the aim of therapy was glucose control, and in patients with diabetes mellitus (RR, 0.73;95%CI, 0.58-0.90). A near-significant trend toward decreasing mortality was seen in patients with acute myocardial infarction who did not receive reperfusion therapy (RR. 0.84; 95%CI, 0.71-1.00). At the time of this meta-analysis, no randomized trials of insulin in the medical intensive care unit were identified. The authors concluded that insulin therapy initiated in the hospital in critically ill patients has a beneficial effect on short-term mortality in different clinical settings.

Van den Berghe and colleagues have since published the results of a randomized, controlled study intensive insulin therapy in 1200 adult patients admitted to a Medical Intensive Care Unit[41]. Intensive insulin therapy significantly reduced morbidity but not mortality among all patients in the medical ICU (40.0 percent in the conventional-treatment group vs. 37.3 percent in the intensive-treatment group,

P=0.33). Morbidity was significantly reduced by the prevention of newly acquired kidney injury, accelerated weaning from mechanical ventilation, and accelerated discharge from the ICU and the hospital.

To date, the impact of tight glycaemic control in children has only been assessed in one retrospective review[42]. The records of 64 children who had received conventional insulin therapy and 33 who had received intensive insulin therapy were reviewed. Conventional insulin therapy consisted of intravenous insulin administration for persistently increased glucose more than 200 mg/dL (11 mmol/L) with a goal of maintaining plasma glucose levels to less than 200 mg/dL. Intensive insulin therapy consisted of continuous intravenous insulin infusion for any plasma glucose level more than 140 mg/dL (7.7 mmol/L), with a goal of maintaining a plasma glucose level between 90 and 120 mg/dL (4.95 and 6.6 mmol/L). Intensive insulin therapy was found to be positively associated with survival. There was no data of complications resulting from the use of intensive insulin therapy.

COMPLICATIONS

In the study by Van den Berghe et al, hypoglycaemia was reported as a BGL of less than 2.2 mmol/l[37]. Hypoglycaemia rates were significantly higher in the intensive insulin treatment group compared with the control group. Hypoglycaemia occurred in 39 out of 765 intensive insulin therapy patients (5%) versus six out of 783 control patients (0.7%). The original study paper did not identify how many episodes of hypoglycaemia occurred in each patient; however in a subsequent paper 18% of patients had more than one hypoglycaemic event (median 3)[43]. Solano et al have found that prior to the institution of intensive insulin therapy, hypoglycaemia was measured in 35 out of 1059 patients (3%). After study institution, 51 out of 447 patients (11%) had a BGL of less than 2.2 mmol/l, of whom 39 out of 447 (8%) were on insulin at the time of the hypoglycaemic BGL[44]. There were no long-term consequences of these hypoglycaemic events. These hypoglycaemia rates led to an alteration of the protocol to lessen the likelihood of rapid BGL falls. The most common cause of hypoglycaemia was the continuation of insulin during periods of feed cessation. In addition, as a result of the requirements for very frequent BGL measurement, the protocol variations were most frequently caused by a prolongation of the intervals between BGL measurements.

CONCLUSION

Under the auspices of the Surviving Sepsis Campaign, glycaemic control (maintenance of glucose < 150 mg/dl or 8 mmol/l has been recommended as an adjunctive therapy in adults with sepsis[45].

Despite the data from retrospective studies of the adverse effects of hyperglycaemia in children, a prospective, randomized trial of strict glycaemic control in critically ill children is warranted. In general, infants are at risk for developing hypoglycaemia when they depend on intravenous fluids[46]. This means that glucose intake of 4 – 6 mg/kg/min is advised. To date, there are no prospective studies in paediatric patients analyzing the effects of rigid glycaemic control using insulin. More data needs to be obtained to elucidate the benefits of strict glycaemic control and its risks in children, especially the younger infants, before firm recommendations can be made for children. Many more questions remain to be answered including target glucose levels and safe protocols for intensive insulin therapy in children.

REFERENCES

1. Capes SE, Hunt D, Malmberg K, et al. Stress hyperglycemia and increased risk of death after myocardial infarction in patients with and without diabetes: A systemic overview. Lancet 2000;355:773-8
2. Rose BD. Proximal tubule. In: Clinical Physiology of Acid-Base and Electrolyte Disorders. Rose BD (ED). New York, McGraw-Hill, 1989. p102
3. Montori VM, Bistrian BR, McMahon MM. Hyperglycemia in acutely ill patients. JAMA 2002;288:2167-9
4. McCowen KC, Malhotra A, Bistrian BR. Stress-induced hyperglycemia. Crit Care Clin 2001;17:107-24
5. Kingsley JS. Association between hyperglycaemia and increased hospital mortality in a heterogenous population of critically ill patients. Mayo Clin Proc 2003;78:1471-78
6. Umpierrez GE, Isaacs SD, Bazargan N, et al. Hyperglycemia: an independent marker of in-hospital mortality in patients with undiagnosed diabetes. J Clin Endocrinol Metab 2002;87:978-92
7. Capes SE, Hunt D, Malmberg K, et al. Stress hyperglycemia and prognosis of stroke in nondiabetic and diabetic patients: A systematic overview. Stroke 2001;32:2426-2432
8. Rovlias A, Kotsou S. The influence of hyperglycemia on neurological outcome in patients with severe head injury. Neurosurgery 2000;46:335-42
9. Yendamuri S, Fulda GJ, Tinkoff GH. Admission hyperglycemia as a prognostic indicator in trauma. J Trauma 2003;55:33-8
10. Laird AM, Miller PR, Kilgo PD, et al. Relationship of early hyperglycaemia to mortality in trauma patients. J Trauma 2004;56:1058-62
11. Vogelzang M, Nijboer MM, van der Horst ICC, et al. Hyperglycaemia has a stronger relation with outcome in trauma patients than in other critically ill patients. J Trauma 2006;60:873-9
12. Lange P, Groth S, Kastrup J, et al. Diabetes mellitus, plasma glucose and lung function in a cross-sectional population study. Eur Resp J 1989;2:14-9
13. van Petersen AS, Vu MK, Lam WF, et al. Effects of hyperglycaemia and hyperinsulinaemia on proximal gastric motor and sensory function in humans. Clin Sci (Lond) 2000;99:37-47
14. Russo A, Fraser R, Horowitz M. The effect of acute hyperglycaemia on small intestinal motility in normal subjects. Diabetologia 1996;39:984-9
15. Veterans Affairs Total Parenteral Nutrition Cooperative Study Group: Perioperative total parenteral nutrition in surgical patients. N Engl J Med 1993;325:525-32
16. Kudsk KA, Lauledkind A, Hanna MK. Most infectious complications in parenterally fed trauma patients are not due to elevated blood glucose levels. J Parenter Enteral Nutr 2001;25:174-79
17. Gore DC, Chinkes D, Heggers J, et al. Association of hyperglycemia with increased mortality after severe burn injury. J Trauma 2001;51:540-4
18. Srinavasan V, Spinella PC, Drott HR, et al. Association of timing, duration and intensity of hyperglycemia with intensive care unit mortality in critically ill children. Pediatr Crit Care Med 2004;5:329-336
19. Faustino EV, Apkon M. Persistent hyperglycemia in critically ill children. J Pediatr 2005;146:30-4
20. Chiaretti A, De Benedictis R, Langer A, et al. Prognostic implications of hyperglycaemia in paediatric head injury. Childs Nerv Syst 1998;14:455-459
21. Paret G, Tirosh R, Lotan D, et al. Early prediction of neurological outcome after falls in children: Metabolic and clinical markers. J Accid Emerg Med 1999;16:186-8
22. Hoxworth JM, Xu K, Zhou Y, et al. Cerebral metabolic profile, selective neuron loss, and survival of acute and chronic hyperglycemic rats following cardiac arrest and resuscitation. Brain Res 1999;82:467-79
23. Siesjo BK, Katsura KI, Kristian T, et al. Molecular mechanisms of acidosis-mediated damage. Acta Neurochir Suppl 1996;66:8-14
24. Anderson RE, Tan WK, Martin HS, et al. Effects of glucose and PaO2 modulation on cortical intracellular acidosis, NADH redox state, and infarction in the ischaemic penumbra. Stroke 1999;30:160-70
25. Li PA, Shuaib A, Miyashita H, et al. Hyperglycemia enhances extracellular glutamate accumulation in rats subjected to forebrain ischaemia. Stroke 2000;31:183-92
26. Pulsinelli WA, Waldman S, Rawlinson D, et al. Moderate hyperglycemia augments ischaemic brain damage: A neuropathologic study in the rat. Neurology 1982;32:1239-46
27. Dietrich WD, Alonso O, Busto R. Moderate hyperglycemia worsens acute blood-brain barrier injury after forebrain ischaemia in rats. Stroke 1993;24:111-6
28. Demchuk AM, Morgenstern LB, Krieger DW, et al. Serum glucose level and diabetes predict tissue plasminogen activator-related intracerebral hemorrhage in acute ischaemic stroke. Stroke 1999;30:34-9
29. Steingrub JS, Mundt DJ. Blood glucose and neurologic outcome with global brain ischaemia. Crit Care Med 1996; 24:802-6
30. Ceriello A, Quagliaro L, D'Amico M, et al. Acute hyperglycemia induces nitrotyrosine formation and apoptosis in perfused heart rat. Diabetes 2002;51:1076-82
31. Cai L, Li W, Wang G, et al. Hyperglycemia-induced apoptosis in mouse myocardium: Mitochondrial cytochrome C-mediated caspase-3 activation pathway. Diabetes 2002;51:1938-48.
32. Popov D, Simionescu M. Alterations of lung structure in experimental diabetes, and diabetes associated with hyperlipidemia in hamsters. Eur Resp J 1997;10:1850-8
33. Brownlee M. Biochemistry and molecular cell biology of diabetic complications. Nature 2001;414:813-20
34. Kang BP, Frencher S, Reddy V, et al. High glucose promotes mesangial cell apoptosis by oxidant-dependent mechanism. Am J Physiol Renal Physiol 2003;284:F455-66
35. Lin S, Sahai A, Chugh SS, et al. high glucose stimulates synthesis of fibronectin via a novel protein kinase C, Rap1b, and B-Raf signaling pathway. J Biol Chem 2002;277:41725-35
36. Guha M, Bai W, Nadler JL, et al. Molecular mechanisms of tumour necrosis factor alpha gene expression in monocytic cells via hyperglycemia-induced oxidant stress-dependent and –independent pathways. J Biol Chem 2000;275:17728-39
37. Van den Berghe G, Wouters P, Weekers F, et al. Intensive insulin therapy in the surgical intensive care unit. N Engl J Med 2001;345:1359-67
38. Malmberg K. Prospective randomized study of intensive insulin treatment on long term survival after myocardial infarction in patients with diabetes mellitus: DIGAMI (Diabetes Mellitus, Insulin Glucose Infusion in Acute Myocardial Infarction) Study group. BMJ 1997;314:1512-5
39. Furnary AP, Zerr KJ, Grunkemeier GL, et al. Continuous intravenous insulin infusion reduces the incidence of deep sternal wound infection in diabetic patients after cardiosurgical procedures. Ann Thorac Surg 1999;67:352-62
40. Pittas AG, Siegel RD, Lau J. Insulin therapy for critically ill hospitalised patients: A meta-analysis of randomized controlled trials. Arch Intern Med 2004;164:2005-11
41. Van den Berghe G, Wilmer A, Greet H, et al. Intensive insulin therapy in intensive care. New Engl Med 2006;354:449-61
42. Pham TN, Warren AJ, Molitor F, et al. Impact of tight glycemic control in severely burned children. J Trauma 2005;59:1148-54
43. Bertolini G, Latronico N, Brazzi L, et al. Insulin dose or glycaemic control for the critically ill? Crit Care Med 2003;31:2565-6
44. Solano T, Totaro R. Insulin therapy incritically ill patients. Curr Opin Clin Nutr Metab Care 2004;7:199-205
45. Cariou A, Vinsonneau C, Dhainaut JF. Adjunctive therapies in sepsis: An evidence-based review. Crit Care Med 2004;32[Suppl]:S562-570
46. Parker M, Hazelset JA, Carcillo JA. Pediatric considerations. Crit Care Med 2004;32[Suppl]:S591-4

OUTCOME OF CHRONIC LUNG DISEASE

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INTRODUCTION

Chronic lung disease (CLD) has been used to describe a variety of chronic lung conditions that may occur in both children and adults. In infants however it is also known as bronchopulmonary dysplasia (BPD) and largely involves very low birth weight (VLBW) babies (ie babies with birth weight of < 1500 g). The incidence of BPD among surviving VLBW infants as reported in 2 large databases was 26% in Canada (1996-1997)[1] and 23% in United States (1995-1996).[2] In Malaysia the incidence of CLD among 1957 VLBW survivors as obtained from the Malaysian National Neonatal Registry (MNNR) 2004 database was 12.5%.[3]

Before discussing outcomes of chronic lung disease it will be helpful to study its pathogenesis and management as they are closely related to the outcome.

HISTORY

BPD was first described by Northway and colleagues in 1967 who described some classical radiological changes of fibrosis and cystic changes in a group of premature babies who have been ventilated for a significant period of time.[4] It was thought to be secondary to injury to the immature lung by barotrauma and oxygen toxicity. The infants involved then had gestational ages of 33.2 +/- 3.8 weeks and weighed 1894 +/- 703 g.

Pathological changes on some of the infants who died showed lung inflammation with areas of fibrosis and emphysema. This is the original description of children with the 'old BPD'. In the present day NICU very much more immature babies receive respiratory support and intensive care and chronic lung changes may set in-utero as a result of chorioamnionitis or soon after birth and the picture is quite different from the classical description. Infants affected with this 'new BPD' are generally of extreme low birth weight (ELBW) ie with BW < 1000g and pathogenesis includes inhibition or arrest of alveolar and pulmonary vascular development.

DEFINITIONS

Various definitions for BPD have been used and classically it pertained to preterm babies who:

1) had received positive pressure ventilation during the early days of life
2) still required oxygen at 28 days of age and
3) showed clinical signs of respiratory distress in the presence of
4) characteristic chest radiograph findings.

With changes in treatment and survival patterns of VLBW infants these diagnostic criteria are not practical to identify those infants who will require ongoing treatment for lung disease beyond the neonatal period. It has been suggested that the term may be more appropriate for those infants who continue to have significant pulmonary dysfunction at 36 weeks corrected age (CA).

Presently the definition used is quite inclusive and CLD usually means[5-8]

1) oxygen dependence at 36 weeks' postmenstrual age or 28 days' postnatal age in conjunction with
2) persistent clinical respiratory symptoms and
3) compatible abnormalities on chest radiographs

PATHOGENESIS

Most important factor appears to be the marked structural, biochemical and physiologic immaturity of the premature lung. Injury is initiated or compounded by inadequate antioxidant defenses, surfactant deficiency, inflammatory mediators, infections and pulmonary oedema. Primary lung condition associated with CLD is respiratory distress syndrome but other conditions like chorioamnionitis is also an important primary risk factor.

Even though the aetiology of CLD is not completely understood it is recognized to be an inflammatory condition in response to mechanical ventilation and supplemental oxygen. Cytokine release into amniotic fluid may also cause a foetal inflammatory response predominantly in the foetal lung and brain, increasing the risk of white matter damage.

Recent pathology findings of BPD are characterized by arrest of alveolar development resulting in fewer and larger alveoli.[9] This has implication on long-term pulmonary outcome as these children may have permanent loss of alveoli and surface area for gas exchange.

PREVENTION AND TREATMENT

Many therapies have been tried to prevent BPD but the only effective strategy is the 'prevention of prematurity'.

Surfactant therapy has led to an increased survival of ELBW infants but unfortunately it has not been shown to decrease the incidence of chronic lung disease.[10]

Clinical trials of Vitamin E and superoxide dismutase have not resulted in practical recommendations for their use but Vitamin A has been shown to confer benefit[11] and has been recommended to be used for prophylaxis. Intramuscular Vitamin A however is not readily available and hence its use is not widespread.

The role of steroids in the prevention and treatment of CLD remains controversial. It is recognized that antenatal steroids are beneficial[12], and postnatal dexamethasone given to preterm infants who are mechanically ventilated decreases the incidences of CLD and extubation failure but does not decrease overall mortality.[1] Use of dexamethasone has been associated with both short-term and long-term complications and the major adverse effect limiting its use is the increased risk of growth impairment and neurodevelopmental delay in children who have been treated.

Inhaled steroids are also being studied but evidence so far is not supportive of its use as it is less effective than systemic steroids.[13]

Management of CLD remains largely supportive and includes respiratory support, oxygen therapy, diuretics, bronchodilators, nutritional support, prevention and treatment of infections and growth and developmental monitoring.

OUTCOMES

Incidence

Chronic lung disease usually affects surviving very preterm especially extremely preterm infants in an NICU. The chronic lung disease (using the classical definition of oxygen dependence at 28 days) scenario as obtained from data available from the Malaysian National Neonatal Registry (MNNR) in 2004 is as highlighted below:

Total number of babies < 32 weeks gestation	: 2522	
Number with chronic lung disease	: 281	(11.1%)
Number given post-natal steroids	: 194	(7.7%)
Survival at discharge for babies with CLD	: 233	(82.9%)
Survival at discharge for babies with no CLD	: 1512	(67.5%)

The incidence of CLD among VLBW (BW 501-1500 gm) survivors in this study was 12.5% which was lower than the 23 % in the US National Institute of Child Health and Development Network, 26% in the Canadian Neonatal Network. This is largely due to the lower survival of the extremely low

birthweight babies (BW < 1000gm) who are at most risk of CLD, in the Malaysian cohort. Generally many of these babies have died before developing CLD.

NICU morbidity

Incidences of co-morbidities of confirmed bacterial sepsis (16% vs 6%), Grade 3 or 4 IVH (12% vs 7%), anaemia of prematurity (58% vs 19%), necrotising enterocolitis (13% vs 7%), gastroesophageal reflux (20% vs 3%) and Stage 3 or 4 ROP (12% vs 2%) were significantly higher in babies with CLD compared to those without. $p<0.01$

Other complications while in NICU include gastritis, feeding intolerance, bradycardic, apnoeic and cyanotic episodes, pulmonary aspiration and poor growth which may be related the disease itself or with its treatment. Short term side effects of dexamethasone include impairment of linear growth and weight gain, glucose intolerance, adrenal suppression, myocardial hypetrophy, hypertension and decreased bone mineral content.

Generally babies with CLD requires longer respiratory support and longer duration of hospital stay. For < 32 weeks gestation survivors of CLD the mean duration of ventilatory support was 26.9 +/- 24.5 days compared to 7.3 +/- 9.5 days for non-CLD survivors, while the hospital stay was 80 +/- 42 days for survivors of CLD compared to 38.9 +/- 23.0 days for survivors without CLD. $p<0.001$.

Growth

Infants with CLD have increased energy requirements and are at increased risk of reduced intake. There is often difficulty in optimizing enteral feeding due to problems associated with respiratory distress eg apnoea, bradycardia, coughing and choking, inadequate oxygenation, ventilation support and gastro-oesophageal reflux. Prolonged parenteral nutrition is also complicated by exhausted venous access and catheter-related blood stream infections.

Growth however is of utmost importance in the pulmonary recovery of an infant with BPD. Fortification of expressed breastmilk, low birthweight formula and addition of polycose and or medium chain triglyceride oil are some of the ways to increase calorie intake to up to 30-50% greater than that necessary for a healthy infant.

With proper nutritional management and growth monitoring many of these infants have been shown to attain normal growth rates and often demonstrate some 'catch-up' growth.[14,15]

Pulmonary Function

Severe CLD may lead to hypoxaemia and respiratory failure. Cardiac function may also be compromised and terminal events include pulmonary hypertension and cor-pulmonale. It has been suggested by some authors that keeping oxygen saturation above a certain level eg 92% is essential for reducing the risk of pulmonary hypertension and growth impairment. However there has been no clear consensus on this. Requirement for oxygen often extends NICU stay and in one study 19% of infants were discharged with home oxygen.[16]

Varying degrees of abnormal lung function have been found in surviving children with chronic lung disease on long-term follow-up. A study done by Northway and colleagues on 'Late pulmonary sequelae of severe bronchopulmonary dysplasia' which included some of the children in Northway's original description of BPD in 1967 showed that of 25 patients, 68% had some abnormality of pulmonary function, primarily of small airways obstruction. In most the abnormalities were mild but 24% had moderate to severe small airways obstruction and in 24% the obstruction was fixed.[17]

Studies of more recently affected children with CLD have shown persistence of pulmonary problems throughout infancy and childhood. Up to 50% of infants are rehospitalised in the first 2 years of life for respiratory causes. They have increased pulmonary symptoms including cough and wheeze and pulmonary function tests continue to show an increase in small airway obstruction and an increase in airway responsiveness that persists into adolescence. Some have a decrease in oxygen saturation

and/or an increase in small airway obstruction with exercise though exercise capacity is normal.[18-20]. It is very likely that these pulmonary abnormalities may persist into later adulthood and old age.

Children with chronic lung disease should be advised on the importance of health maintenance eg avoidance of tobacco smoke and immunizations. Besides the routine vaccines given for healthy children pneumococcal and influenza vaccines should also be considered. It is also recommended that infants with BPD should receive prophylaxis against respiratory syncytial (RSV) viral infection as up to 13% of infants with BPD are hospitalised with RSV infection. Palivizumab, a monoclonal antibody is available as monthly injections to be given during the epidemic season and it was shown to be effective in reducing the rate of hospitalization due to RSV from 12.8% to 7.9%.[21]

Neurodevelopment

VLBW infants are inherently at an increased risk of neurodevelopmental delay. However systematic reviews of randomized controlled trials have shown that children who have received postnatal steroids for CLD have a higher risk of motor dysfunction and other neurodevelopmental disability. Mortality otherwise was similar in study and control groups. One review of 5 trials showed that motor dysfunction was significantly greater with postnatal steroid treatment with an event rate difference of 11.9% favouring controls (95% CI: 4.6%-19.2%). Another review demonstrated a relative risk of neurodevelopmental impairment of 1.34 (95% CI:1.51-2.71) and cerebral palsy of 2.89 (95% CI: 1.96-4.27)[1].

The exact mechanism of postnatal steroids in cerebral injury is not known but there is evidence to suggest that it may affect the brain responses to hypoxia – ischaemia in the pathogenesis of periventricualr leucomalacia and interfere with myelination and neuronal maturation.[22]

Even though some individual studies have shown no increase in long-term adverse neurodevelopmental outcome it is now recommended that systemic dexamethasone should not be routinely used for the prevention nor treatment of chronic lung disease.

Future

Further research on dosages, schedule and duration of dexamethasone and other steroid preparations eg hydrocortisone and methylprednisolone are being conducted to see if a better outcomes can be achieved with postnatal corticosteroid therapy.

Various ventilation modes have been studied to prevent CLD and reduce its complications but no clear benefit has been demonstrated with trigger, volume –controlled, high frequency ventilation or otherwise. Nasal CPAP is considered a gentler form of respiratory support and causes less lung injury but may not be adequate for treating more severe forms of prematurity and respiratory distress syndrome. Role of prolonged inhaled nitric oxide is also being investigated and results are anxiously being awaited.

Other therapies being studied include anti-oxidant, vascular endothelial growth factor, anti-proteases and stem cell therapy.

CONCLUSION

With the advent of surfactant therapy and better neonatal ventilation and intensive care, smaller and more premature babies are being saved. However the incidence of chronic lung disease has not reduced. Children who survived with CLD are at higher risks of adverse pulmonary, growth and neurodevelopmental outcomes which may persist into adulthood.

Outcomes of very preterm babies with CLD are a cause of great concern and prevention and treatment of CLD remains a 'Hot Topic in Neonatology'.

REFERENCES

1. Lee SK, McMillan DD, Ohlsson A, et.al. Variations in practice and outcomes in the Canadian NICU Network: 1996-1997 Pediatrics 2000; 106:1070-1079
2. Lemons JA, Bauer CR, Oh W, et al. Very low birth weight outcomes of the National Institutes of Child Health and Human Development Neonatal Research Network, January 1995 through December 1996, Pediatrics 2001; 107 (1)
3. Lim NL and Malaysian National Neonatal Registry . Chronic lung disease scenario in NICUs. Paper presented at the 5th NNR Forum in June 2006.
4. Northway WHJ, Rosan RC, Porter DY. Pulmonary disease following respiratory therapy of hyaline membrane disease: bronchopulmonary dysplasia , N Engl J of Med 1967; 276:357-68
5. O'Brodovich HM, Mellins RB. Bronchopulmonary dysplasia. Unresolved neonatal acute lung injury. Am Rev Respair Dis. 1985; 132:694-709
6. Shennan AT, Dunn MS, Ohlsson A, Lennox K, Hoskins EM. Abnormal pulmonary outcomes in premature infants : prediction from oxygen requirement in the neonatal period. Pediatrics. 1988; 82:527-532
7. Kinali M, Greenough A, Dimitriou G, Yuksel B, Hooper R. Chronic respiratory morbidity following premature delivery-prediction by prolonged respiratory support requirement ? Eur J Pediat. 1999; 158:493-496
8. Jobe AH, Bancalari E. Broncopulmonary dysplasia. Am J Respir Crit Care Med. 2001; 163: 1723-1729
9. Jobe AJ. The New BPD. An arrest of lung development. Pediatr Res 1999; 46:641-643
10. Hudak BB and Egan EA. Impact of lung surfactant therapy on chronic lung diseases in premature infants. Clinics in Perinatology 1992; 19: 591-602
11. Cochrane on Vitamin A
12. Crowley P. Antenatal corticosteroid therapy: a meta-analysis of randomized trials, 1972-1994. Am J Obstet Gynecol 1995; 173:372-335
13. Shah SS, Ohlsson A, Halliday H, Shah VS. inhaled versus systemic corticosteroids for the treatment of chronic lung disease in ventilated very low birth weight preterm infants. (Cochrane Review). In the Cochrane Library, Issue 2, 2002.
14. Eber E and Zach MS. Long term sequelae of bronchopulmonary dysplasia (Chronic lung disease of infancy). Thorax 2001; 36: 317-323
15. Vrlenich LA, Bozynski MEA, Shyr Y, Schork MA et al. The effect of bronchopulmonary dysplasia on growth at school age. Pediatrics 1995; 95: 855-859
16. Armstrong DL, Penrice J, Bloomfield FH, Knight DB, Dezoete JA, Harding JE. Follow up of a randomized trial of two different courses of dexamethasone for preterm babies at risk of chronic lung disease. Arch Dis Child Fetal and Neonatal Ed. 2002: 86:102-107
17. Northway WH, Moss RB, Carlisle KB, Parker BR et al. Late pulmonary sequelae of severe bronchopulmonary dysplasia. N Engl J Med 1990; 323: 1793-1799
18. Jacob SV, Coates AL, Lands LC, MacNeish CF et al. Long-term pulmonary sequelae of severe bronchopulmonary dysplasia. J Pediatr 1998; 133:193-200
19. Gross SJ, Iannuzzi DM, Kveselis DA and Anbar RD. Effect of preterm birth on pulmonary function at school age : a prospective controlled study. J Pediatr 1998;133 : 188-192
20. Giacoia GP, Venkataraman PS, West-Wilson KI and Faulkner MJ. Follow-up of school-age children with bronchopulmonary dysplasia . J Pediatr 1997; 130:400-408
21. American Academy of Pediatrics. Section 3. Respiratory Syncytial Virus. In : Pickering LK, ed. 2000 Red Book: Report of the Committee on Infectious Disease. 25th ed. Elk Grove, Il. American Academy of Pediatrics, 2000 :483-487
22. Baud O. Postnatal steroid treatment and brain development. Arch Dis Child Fetal and Neonatal Ed 2004; 89:F96-F100

CONFLICTS IN THE INTENSIVE CARE UNIT: DEALING WITH FAMILIES

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In an environment in which children are critically ill and can often die, parents and intensive care staff inevitably exhibit strong emotions. For every parent an immense tragedy is unfolding which threatens to change their lives for ever. The parents are in an acute state of vulnerability, an understandable mixture of hope, fear and anxiety. On the other hand, the medical and nursing staff knows that death and disability are a possible consequence of saving the life of a child. They are often torn between their twin roles of curing and counseling. Their ability to work in such an environment is often dependent on their own denial that this could ever happen to them and an ability not to feel the parents' tragedy too acutely.

It is hardly surprising then that in this cocktail of emotion and threat, there should be conflict. In this talk I will argue that conflict often arises because the PICU staff fails to comprehend the complexity and nature of the parent experience and that this is aggravated by the lack of continuity in much of PICU care. Parents often feel marginalized and abandoned. To prevent these feelings, the central defining role of the love of a parent for his or her child needs to be affirmed and given credibility. At the same time it is important for staff to understand the emotions which they themselves bring to their own work, not least of all a need to feel that they are delivering equitable and meaningful treatment. Ways of practically confronting and resolving such conflict will be discussed.

ACUTE RENAL FAILURE: HOW TO AVOID IT

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Acute renal failure (ARF) is a common complication in critically ill intensive care patients which is associated with increased morbidity and mortality. In these patients, the aetiology of the ARF is usually multifactorial, with sepsis predominating. Other common causes include ischaemia and nephrotoxins.

We all regularly use a number of pharmacological approaches to protect the injured kidney. However, a recently published Cochrane review on "Interventions for Protecting Renal Function in the Peri-operative Period" concluded that: "There is no reliable evidence from the available studies that any of the measures used to protect the kidney from damage are beneficial".

The review identified 451 studies, of which 37 (1227 patients) were included. Five were considered to be of "good" quality, 3 "moderately good" and 29 were of "poor quality".

There was no good data to support the use of: dopamine and it's analogues, diuretics, Ca^{2+} channel blockers, ACE-inhibitors, vasodilators, or particular types of resuscitation fluids.

Intensive care patients are also commonly exposed to radio-contrast, aminoglycosides and aprotinin, all toxins to the kidney. 19 randomized trials, 4 prospective non-randomized trials and 11 meta-analyses have dealt with the former, with conflicting results.

New proposed therapies to protect the kidney include: anti-TNF, inhibition of Platelet Activating factor, inhibition of Nitric Oxide Synthetase, antagonism of endothelin, inhibition of arachidonic acid, natriuretic peptides, inhibition of leukocyte adhesion, inhibition of coagulation, growth factors, adenine nucleotides, theophylline, prostaglandins, inhibition of thromboxane synthetase, thyroxine, allopurinol, recombinant superoxide dismutase, ascorbic acid and D.F.O, all of whom have shown promise in experimental and animal studies but have failed to convincingly show benefit in human studies.

Caspase inhibitors are a long way from human trials.

The statins, particularly if used prior to the injury, seem to provide benefit, independent of their cholesterol-lowering properties.

The above may well explain why, despite major advances in the care of the critically ill, the development of renal dysfunction in these patients remains common, and the mortality high.

TRIAGE IN THE INTENSIVE CARE UNIT

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The demand for intensive care unit beds in Malaysia far exceeds the availability. A survey done in 2002 showed that only 1% of our hospital beds consist of ICU beds. This is in contrast to 4 to 8% in more developed countries. As a result of this, 45% of patients referred to ICU in Malaysia were denied admission. This has also led to the undesirable practice of ward ventilation which is widely believed to have a higher mortality. As the demand for intensive care outstrips the availability, the process of prioritizing patients or triaging as it is known has become a priority in ICU circles. The aim of triage is to select the patients who will benefit most from ICU care and not patients who are 'too sick' or 'too well' to benefit from ICU care. Various medical factors like age, severity of illness, diagnosis, quality of life and advance directives have been used.

Age has been used as a triage tool as it is a simple and objective measure of life expectancy. However, by the year 2020 the average life span of Malaysians is expected to rise significantly. This would make it difficult to assign an arbitrary cut off point and ethically questionable to triage based on age alone. Furthermore it has been shown that age is only a minor contributor to mortality with severity of illness and coma being better predictors of mortality. However, there is a trend showing that ICU physicians are more likely to refuse admission in older patients.

The ability to predict outcome in ICU has regrettably been hampered by the lack of accurate predictive instruments. Current severity of illness scores suffer from low sensitivity and are not useful for predicting the outcome of individual patients. Current recommendations suggest that predictive tools should be used in conjunction with physicians' estimates to improve their accuracy. Not surprisingly, patients with severity of illness scores in the middle territory have been shown to benefit most from ICU care i.e. 'not too sick or well'. But how to identify those who will benefit most within this group remains unknown. Certain diagnostic groups have also been shown to have a greater chance of admission compared to others with patients with ultimately fatal diseases having the highest refusal rates. There also appears to be a bias against medical patients whereby surgical and postoperative patients are more likely to be admitted.

Quality of life measures appear to be an attractive triaging tool as it gives information on the prior function of the patient and what can be achieved with intervention. However, it is difficult in practice to obtain this information rapidly and accurately in a critically ill patient. It has been shown that patients who are dependent prior to hospitalization actually have higher hospital mortality rates. This is reflected by the higher refusal rates to ICU in this group of patients. Although functional status is used as a quality of life indicator in ICU, it is important to consider the fact that patients with poor function may still perceive good health and happiness.

In an attempt to standardize the process of triaging, the Society of Critical Care Medicine issued guidelines on triaging in 1999. However, compliance to these guidelines was shown to be poor in one study. There appears to be a need to develop a triage to ICU guidelines that can strike a balance between medical and ethical requirements but regrettably these guidelines are still missing. In Malaysia where there is a shortage of ICU beds, improving the efficiency of ICU is of paramount importance. This may assist the triaging process in several ways; the pooling of ICU beds by having a central bed manager to identify available ICU beds in the region, 'step down' units to free up ICU beds, use of an early warning system to identify critically ill patients early to allow for effective triage and better 'end of life' management to avoid unnecessary ventilation of patients. For the foreseeable future, triage to ICU will continue to be based on imperfect predictive tools combined with subjective assessments.

ACUTE RENAL FAILURE: HOW TO AVOID IT

Carlos Scheinkestel

Alfred Hospital, Melbourne, Australia

Acute renal failure (ARF) is a common complication in critically ill intensive care patients which is associated with increased morbidity and mortality. In these patients, the aetiology of the ARF is usually multifactorial, with sepsis predominating. Other common causes include ischaemia and nephrotoxins.

We all regularly use a number of pharmacological approaches to protect the injured kidney. However, a recently published Cochrane review on "Interventions for Protecting Renal Function in the Peri-operative Period" concluded that: "There is no reliable evidence from the available studies that any of the measures used to protect the kidney from damage are beneficial".

The review identified 451 studies, of which 37 (1227 patients) were included. Five were considered to be of "good" quality, 3 "moderately good" and 29 were of "poor quality".

There was no good data to support the use of: dopamine and it's analogues, diuretics, Ca^{2+} channel blockers, ACE-inhibitors, vasodilators, or particular types of resuscitation fluids.

Intensive care patients are also commonly exposed to radio-contrast, aminoglycosides and aprotinin, all toxins to the kidney. 19 randomized trials, 4 prospective non-randomized trials and 11 meta-analyses have dealt with the former, with conflicting results.

New proposed therapies to protect the kidney include: anti-TNF, inhibition of Platelet Activating factor, inhibition of Nitric Oxide Synthetase, antagonism of endothelin, inhibition of arachidonic acid, natriuretic peptides, inhibition of leukocyte adhesion, inhibition of coagulation, growth factors, adenine nucleotides, theophylline, prostaglandins, inhibition of thromboxane synthetase, thyroxine, allopurinol, recombinant superoxide dismutase, ascorbic acid and D.F.O, all of whom have shown promise in experimental and animal studies but have failed to convincingly show benefit in human studies.

Caspase inhibitors are a long way from human trials.

The statins, particularly if used prior to the injury, seem to provide benefit, independent of their cholesterol-lowering properties.

The above may well explain why, despite major advances in the care of the critically ill, the development of renal dysfunction in these patients remains common, and the mortality high.

HOW TO GET THE BEST OUTCOMES FROM RENAL FAILURE IN CRITICALLY ILL PATIENTS WITH CRRT

Carlos Scheinkestel

Alfred Hospital, Melbourne, Australia

The Alfred Hospital's ICU commenced CRRT in July 1986. 1257 patients have been treated. In 1994, a major review of the technique was performed. This involved an assessment of convective versus diffusive therapy, vascular access, anticoagulation and nutrition. This resulted in major improvements to our technique and subsequent patient outcome.

Year	N	ICU LOS	APACHE II	ROD %	HOS MORT %	SMR
1986-1994	213	18.0	26.6	53.5	69.2	1.29
1994-2006	1053	14.7	24.0	43.6	44.7	1.03
Total	1257	15.0	24.2	44.5	46.8	1.05

A further review in 2006 in light of recent studies and literature, has resulted in further procedural changes being implemented and the following advice:

1. Dialysis is the preferred technique with predilution by 10% of blood flow
2. Tailored anti-coagulation with heparin/LMWH
3. Platelets will fall
4. Blood & platelet transfusions will clot filters
5. Access is one of the most important determinants of filter life
   Recommend wide end-hole or co-axial double-lumen catheters
6. Filter efficacy decreases with time. Recommend change filters at 72-96 hours
5. Based on the clinical evidence at the present time, recommendations about the use or avoidance of specific membranes in CRRT cannot be made.
   However, "...until proven otherwise, there is consensus in favour of synthetic over cellulose-based Membranes".
6. For renal failure, dose should probably be increased to 35 mls/kg/hour but not higher
7. In nearly all cases of critically ill patients with ARF, lactate-buffered solutions may be used as well as bicarbonate solutions
8. HVHF not yet proven to be beneficial and is likely to be associated with:
   - Increased Costs
   - Probable Loss of Significant Thermal Energy
   - Probable depletion of nutrients, albumin, hormones, vitamins, trace elements & antibiotics

   All of which will require careful monitoring & appropriate replacement.

Free Papers (NCIC Award)
15 September 2006, Friday

P 01	1645 – 1655	A Comparison Of Plain Ropivacaine 0.5% With Plain Bupivacaine 0.5% In Spinal Anaesthesia For Orthopaedic Surgery **N Almeeri, G Phutane, W A Wan Aasim, A Saedah, J Kamarudin, N M Nik Abdullah** *Department of Anaesthesiology, School of Medical Sciences, Health Campus, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia*	38
P 02	1655 – 1705	Perioperative Complications Of Limb Salvage Surgeries **D Krisnan, N M Nik Abdullah, H Shamsulkamaruljan, O Mahamarowi, J Kamarudin** *Department of Anaesthesiology, School of Medical Sciences, Health Campus, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia*	39
P 03	1705 – 1715	A Review Of Leptospirosis And Acute Renal Failure At Hospital Pulau Pinang **D Abraham, K K Chan, B H Tan, C H Lim, J Hassan** *Department of Anaesthesia and Intensive Care, Penang Hospital, Pulau Pinang, Malaysia*	40
P 04	1715 – 1725	Central Venous Catheter-Related Blood Stream Infections: An Analysis Of Incidence And Risk Factors **Tan Cheng Cheng, Zanariah Yahaya, Lim Kai Inn, S Balan** *Department of Anesthesiology & Intensive Care, Hospital Sultanah Aminah Johor Bahru, Johor Bahru, Malaysia*	41
P 05	1725 – 1735	Tracheal Aspirate Culture And Sensitivity And Its Significance **Tan Cheng Cheng, Mahazir Kassim, Mohd Faizal Zuhri, Loo Pey Lin, Omar Sulaiman, Abdul Hamid Redzuan, Lim Kai Inn, S Balan** *Department of Anesthesiology and Intensive Care, Hospital Sulatanh Aminah Johor Bahru, Johor Bahru, Malaysia*	42

P 01

A COMPARISON OF PLAIN ROPIVACAINE 0.5% WITH PLAIN BUPIVACAINE 0.5% IN SPINAL ANAESTHESIA FOR ORTHOPAEDIC SURGERY

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OBJECTIVE

To compare the effect of intrathecal injection of 15 mg 0.5% ropivacaine and bupivacaine in term of onset and duration of action of sensory blockade at T10 dermatomal level as well as the median cephalad spread of dermatomal blockade. We also evaluate the onset and duration of motor blockade according to Modified Bromage Scale.

METHODOLOGY

A double blinded randomized clinical trial on 72 ASA grade I- II patients who were scheduled to undergo orthopedic surgery of the lower limb with duration of operation less than 3 hours. These patients were randomly divided into two groups and allocated to receive intrathecal injection of either: 15 mg 0.5% plain ropivacaine (3 ml), or 15 mg 0.5% plain bupivacaine (3 ml) for the above procedure. Sensory block assessment was detected by using a loss of sensation to pinprick test at midclavicular level according to a reference to standard diagram of dermatome level. The assessment was performed initially at 2, 5 minutes post injection and then 5 minutes interval up to maximum upper and lower spread is detected. Patients were kept in recovery room until first request for analgesia is made. Motor blockade assessment was made at the same time interval by using Modified Bromage Scale (MBS). Student t-test was used for analyzing the difference between two group's means with normal distribution. P-value <0.05 was accepted as significant.

RESULTS

the onset time to reach T10 dermatomal blockade were longer in ropivacaine group as compared to bupivacaine (9.3±5.2 min versus 6.4±3.3 min respectively; P=0.015), while there was no significant difference at T12 dermatomal blockade between the two groups. The median cephalad spread of bupivacaine group was higher at T8 (T12-T4) as compared to T10 (L1-T4) for the ropivacaine group; (P=0.000). In bupivacaine group the mean duration of sensory blockade was 5.4 ±1.2 hrs as compared to ropivacaine group which was 6.5 ±2.44 hrs (P=0.02). The mean onset time of motor blockade to reach Modified Bromage Score in bupivacaine versus ropivacaine were MBS1 (1.4±0.8 min versus 2.1±1.5 min; P=0.01), MBS2 (1.6±0.9 min versus 3.0±2.0 min; P=0.000), and in MBS3, (2.1±1.1 min versus 3.6±1.8 min; P=0.000). In the bupivacaine group the mean duration of motor block was 4.7±1.1 hours and in ropivacaine group was 3.5±1.4 hours (P=0.000).

CONCLUSION

Ropivacaine in a dose of 15 mg as 0.5% plain solution can be used with an acceptable onset of sensory and motor blockade with a longer duration of analgesia and early mobilization for the lower limb in patient undergoing orthopedic surgery of duration less than three hours and a level of lower than T12 dermatome.

P 02

PERIOPERATIVE COMPLICATIONS OF LIMB SALVAGE SURGERIES

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OBJECTIVE

To study the incidence of perioperative anaesthetic complications and morbidity following limb salvage surgeries, to determine the extent of contribution of preoperative status and duration of surgery towards incidences of these perioperative complications as well as the extent and quality of postoperative care.

METHODOLOGY

The medical records of 120 patients who underwent limb salvage surgery were traced and studied for incidences of perioperative anaesthetic complications in 4 categories: haematological, temperature, cardiovascular and pulmonary. Necessary informations were tabulated into individual data collection sheets.

RESULTS

Intraoperative hypothermia appeared to be the only significant perioperative anaesthetic complication. We were able to demonstrate a significant relationship between the duration of surgery / anaesthesia and the development of intraoperative hypothermia (p=0.04). The contribution of preoperative status (based on ASA classification) towards incidences of perioperative complications however was not significant (p=0.518). Almost half the patients (67) were ventilated postoperatively for a mean duration of 22.96 hours. Majority of care was instituted in the intensive care unit. Other facilities for post operative care included coronary care unit (CCU), postoperative care unit (PACU) and the general orthopaedic ward. The development of postoperative complications such as prolonged mechanical ventilation, cardiac complications, respiratory infections, renal failure and coagulopathy were also found to be non significant.

CONCLUSIONS

Intraoperative hypothermia is a proven perioperative anaesthetic complication of limb salvage surgery. Incidences of hypothermia in limb salvage surgery are directly proportional to the duration of surgery and anaesthesia.

P 03

A REVIEW OF LEPTOSPIROSIS AND ACUTE RENAL FAILURE AT HOSPITAL PULAU PINANG

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Leptospirosis is a common zoonosis in Malaysia because of its tropical climate. It is caused by infection with pathogenic Leptospira species. It has a wide clinical spectrum – from the inapparent and asymptomatic to the fulminant and fatal. It is associated with multi organ dysfunction but renal failure is the single most serious reversible complication, apart from sepsis itself.

In this retrospective review, we analyzed the characteristics of severe leptospirosis, indications of ICU admission and the outcome of patients treated at the ICU Hospital Pulau Pinang in the year 2005. A total of 24 patients had positive serology tests and 7 were admitted to the ICU. The most frequent clinical manifestation of those requiring ICU management were septic shock, respiratory failure, acute renal failure and liver impairment. All patients had acute renal failure with associated multiorgan involvement (Weil's syndrome). 5 of them required haemodialysis and 2 improved with conservative management. All of them required ventilatory support. 3 patients required prolonged ventilation and ended up with tracheostomy. All of them had cardiovascular complications and required inotropic support. Bradycardia was present in 2 patients while 1 presented with cardiac arrest on arrival. 5 of the ICU patients survived but 2 died due to multiorgan failure and nosocomial infection.

In conclusion, acute renal failure is a common manifestation of leptospirosis. It is crucial to arrest its progress by providing appropriate resuscitation and renal support in the ICU to prevent further deterioration of organ failure and other complications associated with hospital stay. As the length of stay increases, the course of disease is protracted with nosocomial infection and this is associated with a poor outcome. Patients with premorbid chronic illnesses such as diabetes and hypertension are also associated with a poorer prognosis.

P 04

CENTRAL VENOUS CATHETER-RELATED BLOOD STREAM INFECTIONS: AN ANALYSIS OF INCIDENCE AND RISK FACTORS

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OBJECTIVE

To determine the incidence of central venous catheter-related blood stream infection (CR-BSI) and to analyse risk factors.

DESIGN

One year prospective observational study

METHODS

Data were collected from all central venous catheters (CVC) in ICU in the year 2005 in relation to the venue where the insertion was done, site of insertion, number of lumen of CVC and number of attempts. CR-BSI was diagnosed using well defined criteria. Catheters which stay less than 2 days or which were inserted in patients less than 12 years old are excluded in the analysis.

RESULTS

A total of 655 CVCs were assessed in 496 patients, representing 4029 catheter days. CR-BSI were diagnosed in 74 catheters, giving an incidence of 18.4 CR-BSI per 1000 catheter days. The mean duration in situ of infected CVC was 7.9 +/- 4.5 days while the mean duration in situ of non infected CVC was 5.9 days +/- 3.8 days and the difference is significant (p=0.000). The 2 common sites of insertion were the subclavian and internal jugular routes and there was no statistical difference in CR-BSI between them (p=0.68). Regarding the venue of insertion, CVC inserted in ICU had the highest infection rate (17%) compared to OT (4.7%) and ward (6.2%). The highest rate of CR-BSI occurred with 4-lumen catheters with a percentage of 31.5%. Number of attempts more than 1 had higher rate of CR-BSI compared to single attempt with percentage of 16.9% vs 13.1%. The top 3 common organisms were Klebseilla pneumonia, Pseunomonas aeruginosa and MRSA.

CONCLUSIONS

The incidence of CR-BSI in our ICU is 18.4 CR-BSI per 1000 catheter days which is high compared to international figures which range from 2.8 to 12.8 CR-BSI per 1000 catheter days. The risk factors were the duration of CVC in situ, the venue of insertion, the number of lumen of the catheter and the number of attempts. The site of insertion was not a risk factor.

P 05

TRACHEAL ASPIRATE CULTURE AND SENSITIVITY AND ITS SIGNIFICANCE

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OBJECTIVE

To study the tracheal aspirate culture and sensitivity done on admission to ICU and its clinical significance

METHODS

Tracheal aspirate culture and sensitivity results done on admission to ICU were recorded on a culture and sensitivity form. Those results which grew organisms were decided on clinical grounds to see if they were real infections or contaminations/colonisations or neither one. A review of these results in year 2005 was carried out. Culture results of those patients with repeated admission were excluded.

RESULTS

There was a total of 1012 admissions. After exclusion of readmission, missing forms and cultures not done, 678 tracheal aspirate cultures were available for analysis. Of these 678 tracheal aspirate cultures, 344 (50.7%) cultures were negative. Of the 334 cultures with growth, 41 (12.3%) isolates were real infections, 266 (79.6%) were contaminations/colonisations, 13 (3.9%) were difficult to conclude and 14 (4.2%) were not commented. The top 3 organisms for real infections were Klebseilla, Pseudomonas and Acinetobacter, while the top 3 organisms for contaminations/colonisations were Klebseilla, Staph aureus and Candida. Seven out of the 41 isolates which were real infections had more than one organism while 79 (29.7%) out of the 266 contaminated/colonized isolates had more than one organism. The difference is not statistically significant (p=0.09). Two of the fourteen Klebseilla which were real infections were ESBL producers while 7 out of the 72 Klebseilla which were contaminations/colonisations were ESBL producers and the difference is also not statistically significant (p=0.64).

CONCLUSION

About 80% of the tracheal aspirate C&S done on admission to ICU were contaminations/colonisations. Klebseilla was the most common organisms grown from tracheal aspirate and the percentage of ESBL was about 10%. The practice of ordering tracheal aspirate C&S on admission needs to be reviewed.

Programme
16 September 2006, Saturday

0800 – 0830	**PLENARY 2** — Venue: Pyramid 2 Chairperson: Tang Swee Fong Head Injury: What Progress Has Been Made in the Last 40 Years? *Balasubramaniam Venkatesh* [pg 44-45]	
0830 – 0900		
0900 – 0930	**PLENARY 3** — Venue: Pyramid 2 Chairperson: Tang Swee Fong Improving the Quality of End-of-Life Care in the PICU *Jonathan Gillis* [pg 46]	
0930 – 1000		
1000 – 1030	TEA	
1030 – 1100	Venue: Pyramid 2 **SYMPOSIUM 5 • Sepsis** Chairpersons: Jenny Tong / V Sivasakthi • Sepsis Markers: Clinical Utility in Sepsis [pg 47-49] *Tai Li Ling* • Infection Control and Multi-Resistant Microorganisms Acinetobacter Baumannii: Angel or Devil? *Jeffrey Lipman* • The Impact of ICU Environment on Nosocomial Infections *Norliza Ariffin* • Pharmacological Principles and Antibiotic Dosing in the Critically Ill *Jeffrey Lipman* Questions and Answers	Venue: Pyramid 3 **SYMPOSIUM 6 • Fluids and Blood** Chairpersons: Chan Yoo Kuen / Lim Chew Har • Fluids and Coagulation [pg 50] *Nor'Azim b Mohd Yunos* • Novel Resuscitation Fluids *Suresh Rao* • Coagulation Abnormalities – Data Interpretation *Balasubramaniam Venkatesh* • Blood Products: To Give or Not to Give *Loo Shi* Questions and Answers
1100 – 1130		
1130 – 1200		
1200 – 1230		
1230 – 1400	LUNCH	
1400 – 1430	Venue: Pyramid 2 **SYMPOSIUM 7 • Mechanical Ventilation** Chairpersons: Nik Abdullah Mohamad / Sekar Shanmugam • VAP: Everything You Want to Know [pg 51-53] *Shanti Rudra Deva* • Ventilating the Obese Patient: Is It Different? [pg 54] *Chen Fun Gee* • Pressure vs Volume Predetermined *Mohd Basri Mat Nor* • NIV: The Right Way *Loo Shi* Questions and Answers	Venue: Pyramid 3 **WORKSHOP TUTORIAL** Chairperson: Nor'Azim Mohd Yunos • Biochemical Data Interpretation *Balasubramaniam Venkatesh* • Acid Base Balance *Balasubramaniam Venkatesh* Questions and Answers
1430 – 1500		
1500 – 1530		
1530 – 1600		
1600 – 1630		
1630 – 1700	TEA	

HEAD INJURY: WHAT PROGRESS HAS BEEN MADE IN THE LAST 40 YEARS?

B Venkatesh
Australia

Traumatic brain injury (TBI) remains the most common cause of trauma-related death and disability. The majority of victims are male, and it is the leading cause of death in children. Importantly, the cost of survivors in all societies in emotional, social and financial terms is substantial, as the disabling effects of the original injury may persist for many years.

Over the last 40 years, a number of epidemiological studies in developed countries have described the causes and outcomes of TBI. The all-cause mortality from severe brain injury in developed countries has consistently remained at approximately 30% over the last twenty years. Of patients who survive the initial injury to reach the health care system, attributable mortality to TBI of those who subsequently die is approximately 90%. This has occurred despite marked improvements in pre-hospital resuscitation, intensive care, operative technology, intensive research into the pathobiology of primary brain injury and promulgation of evidence-based management guidelines. This begs the question – what progress have we made in the last 40 years?

In this review, I will explore some of the major changes which have evolved over the last 40 years in the management of head injury which have impacted on outcome.

HEAD INJURY MANAGEMENT IN THE 1970S

In the 70s, the only tools most doctors had for assessing head injured patients were their clinical skills and plain skull films. CT scan was not commonplace and even techniques such air encephalography and angiography considered to be important investigation tools in head injury were not routinely available in neurosurgical centres and were only capable of demonstrating the more gross pathological changes. Furthermore, the biological basis of head injury and the subsequent deterioration was poorly understood.

Intensive care units were in evolution and the ability to monitor was limited. Few epidemiological data had ever been collected, and there was no widely accepted way to classify head injury or measure its severity.

In the 1970s, scientific inquiry into neurotrauma proceeded at a rapid pace. Several landmark papers were published. These included the "talk and die" studies by Riley et al which paved the way for the development of concepts such as primary and secondary insults in neurotrauma.

Calls for the development of a data bank to assess the epidemiology of neurotrauma prompted the first major epidemiological survey by Jennett in 1977. A survey of 700 head injured patients from 3 countries revealed an overall mortality of 50% and on a dichotomised GOS – a favourable outcome of 35% and an unfavourable outcome of 65%. This represented the first major step towards large-scale epidemiology studies.

The next 30 years saw several major steps forward in our understanding of the physiology, pathophysiology and management of neurotrauma.

These are summarised below and will be reviewed in my talk in more detail:

a) Improved imaging

1. Advent and routine availability of CT scan
2. Introduction of MRI and more recently PET scans

b) Improved understanding of pathophysiology

1. Concepts of primary and secondary insults
2. Intracranial hemodynamics – Intracranial and cerebral perfusion pressure
3. Ability to measure global, regional and tissue oxygenation in the brain
4. Understanding of mechanisms of cell death – apoptosis, necrosis

c) Improved monitoring

1. Ability to measure ICP and CPP continuously
2. Bedside techniques to measure CBF

d) Standardised clinical assessment

1. Development of the GCS scoring system

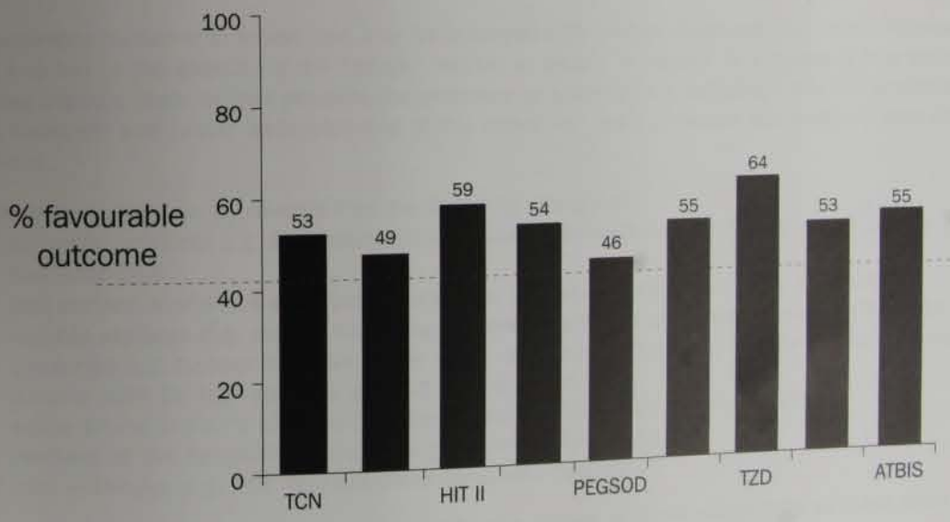
e) Development of standardised guidelines for management of TBI

1. BTF guidelines – version 1 (1995)
2. BTF guidelines – version 2 (2000)
3. EBIC guidelines

f) Development of neuroprotective agents

g) Improved rehabilitation techniques

Of note however is the disturbing observation that despite several advances on many aspects of TBI diagnosis and management, the proportion of improved outcome has not changed significantly. Figure 1 below illustrates the proportion of successful outcome in various epidemiological and neuroprotection studies of TBI. The possible reasons for this observation will be discussed in more detail in the presentation.



IMPROVING THE QUALITY OF END-OF-LIFE CARE IN THE PICU

Jonathan Gillis

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In this talk I will firstly outline the issues involved in end-of-life care in the PICU, secondly a broad philosophical approach which I believe would enhance the quality of that care, and lastly the practical ways of implementing that approach. For parents and indeed society any child death is an unacceptable tragedy devoid of any obvious meaning. Many children now die in the PICU after a decision to limit a treatment which is failing to deliver recovery. Most studies show considerable family dissatisfaction with the care that dying children receive. This includes observations that dying children are suffering with considerable symptoms and that communication between the health team and family is very poor. I believe that the quality of end-of-life care in the PICU suffers from too much reliance on an ICU approach equating cure and care. This can be addressed by introducing the principles of palliative care into intensive care practice. When such principles are applied treatment may be changed, but care is never withdrawn, never limited, never withheld and never futile. This talk will delineate both the strategic and practical aspects of such an approach.

SEPSIS MARKERS: CLINICAL UTILITY IN SEPSIS

Tai Li Ling

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Sepsis is defined as the systemic host response to infection. The pathophysiology of sepsis is highly complex. Today, sepsis remains mainly a clinical diagnosis and continues to be defined using the ACCP/SCCM consensus conference definition that was described in 1992 (1) but this definition is too broad and does not allow for precise characterization and staging of patients. The 2001 SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions Conference has added the presence of biochemical marker; plasma C-reactive protein (CRP) or procalcitonin (PCT) > 2 SD above the normal value to the list of criteria in the diagnosis of sepsis (2). A staging system for sepsis was also proposed to determine optimum treatment for individual patients by stratifying their individual symptoms and risks. The staging system proposed was the Predisposition, insult Infection, Response, and Organ dysfunction (PIRO) staging system (3) but to date this system is not ready for the day-to-day use in the clinical setting.

The pathophysiology in sepsis is highly complex and heterogenous which involves several factors that interact in a long chain of events from pathogen recognition to overwhelming of host responses. The host response to the invading micro-organism includes activation of soluble or humoral elements (complement, acute phase proteins, cytokines) and cellular elements (monocytes, macrophages, neutrophils, dendritic cells, natural killer cells) leading to release or activation of pro-inflammatory and anti-inflammatory mediators. Excessive production of pro-inflammatory mediators (e.g. (tumour necrosis factor, interleukin-1, interleukin-6, interleukin-8) lead to organ dysfunction while excessive production of anti-inflammatory mediators (e.g. (interleukin-4, interleukin-1ra, interleukin-10) may induce a state of imunosuppression.

A favourable outcome in sepsis can only be achieved with prompt diagnosis and timely management. This has led to the search for the "magic" marker in sepsis. A marker is a measure that identifies a normal biologic state or that predicts the presence or severity of a pathologic process or disease (3). New research and better understanding of the molecular basis of sepsis has revealed abundance of markers.

Markers in sepsis can be divided into the following categories:

(i) microbial products e.g. endotoxin activity assay, enterobacterial common antigen, *Candida* antigen, bacterial DNA
(ii) cell surface markers e.g. polymorphonuclear leucocyte, monocyte CD64, E-selectin
(iii) soluble markers e.g. soluble triggering receptor expressed on myeloid cells-1 (sTREM-1)
(iv) cytokines e.g. tumour necrosis factor (TNF), interleukins (IL), macrophage inhibitory protein-1alpha (MIP-1), high mobility group-1 protein (HMG-1)
(v) acute phase proteins such as CRP, lipopolysaccharide-binding protein (LBP)
(vi) markers of the coagulation system e.g. anti-thrombin III (AT-III)
(vii) miscellaneous e.g. PCT, mid pro-atrial natriuretic peptide

In the clinical management of septic patients, the marker is expected to fulfil at least three major functions:

(i) establish or confirm the diagnosis of sepsis in patients with systemic inflammatory response syndrome (SIRS)
(ii) quantify the severity of the disease and predict the prognosis
(iii) monitor the course of disease or response to treatment and guide therapeutic decision

Additional requirements would include reproducibility, time-saving and cost-effectiveness.

Further discussion will focus on the common sepsis-related markers used in clinical practice today i.e. C-reactive protein (CRP) and procalcitonin (PCT), and a new potential marker: soluble triggering receptor expressed on myeloid cells-1 (sTREM-1).

C-reactive protein (CRP)

CRP is an acute phase protein released by the liver as a consequence of inflammation; in response to the elaboration of acute phase response cytokines, such as IL-1, IL-6, and TNF-_. Upon binding to polysaccharides present in bacteria, fungus or parasites, CRP is able to activate the classical complement pathway and promote phagocytosis.

CRP is also induced by a variety of non-bacterial stimuli e.g. post-surgery, autoimmune disorders, myocardial infarction, burns and malignancy. Viral infections usually do not raise plasma CRP levels significantly.

The induction of CRP requires a minimum period of 12 - 18 hours after an infectious stimulus and reaches a peak after 36 – 50 h. Normal plasma levels of CRP are below 6 mg/l.

Procalcitonin (PCT)

PCT, the precursor of calcitonin is normally produced in the C-cells of the thyroid gland. The exact origin of PCT during severe systemic infections is unknown but believed to be from the hepatocytes and macrophages and its release is stimulated by lipopolysaccharide (LPS), TNF-_ and IL-6. The exact role of PCT during sepsis is unknown. PCT does not initiate the septic response but augments the process. It also acts as a modulator of the activated immune system and increases inducible nitric oxide synthase (iNOS) and nitric oxide (NO) production.

PCT serum levels increase during severe bacterial, parasitic or fungal infections with systemic manifestation. PCT is not usually elevated during viral infections or inflammatory reactions of non-infectious origin. Patients with localised infections or infections without systemic manifestation also do not demonstrate high levels of PCT.

PCT is rapidly secreted and can be measured in the plasma as early as 2 - 4 hours after stimulation and peaks at 8 hours. The half-life is 25 - 35 hours and not altered significantly by renal failure. Normal values are below 0.5 ng/ml.

Soluble triggering receptor expressed on myeloid cells (sTREM-1)

The TREM-1 is a cell-surface receptor identified on neutrophils and in a subset of monocytes and is a member of the immunoglobulin family. This receptor is specifically involved only in cases of infectious origin. Experimental studies have suggested that its expression is upregulated in the presence of bacterial LPS or fungi. TREM-1 associates with a transmembrane adaptor molecule and this engagement of TREM-1 triggers secretion of IL-8, monocyte chemotactic protein-1, and TNF-_ and induces neutrophil degranulation. TREM-1 is also shed by the membrane of activated phagocytes and can be found in a soluble form in body fluids called soluble triggering receptor expressed on myeloid cells (sTREM-1).

Concentrations of sTREM-1 in plasma of > 60 mg/L can indicate infection in patients with SIRS (4) while concentrations of > 5 ng/L in bronchoalveolar lavage can indicates ventilator-associated pneumonia (5).

Biomarker to confirm the diagnosis of sepsis and guide treatment

A recent meta-analysis evaluating 12 studies that simultaneously compared CRP and PCT levels for the diagnosis of bacterial infection in hospitalised patients, showed that PCT levels were more sensitive (85% vs. 78%) and also more specific (83% vs. 60%) than CRP levels to distinguish bacterial from non-bacterial inflammation (6). The sensitivity for differentiating bacterial from viral infections was also higher for PCT markers (82% vs. 73%), so was the specificity (88% vs. 81%).

Clec'h in his recent study found that the diagnostic cut-off value of PCT was higher in surgical than in medical patients (7). The best diagnostic cutoff value was 9.7 ng/mL in surgical patients and 1.0 ng/mL in medical patients. He concluded that PCT was a reliable early prognostic marker in medical but not in surgical patients with septic shock.

In a study comparing the diagnostic performance of CRP, PCT and sTREM-1 in patients with suspected sepsis, plasma sTREM-1 more than 60 mg/ml was more accurate than PCT or CRP for indicating infection with a sensitivity of 96%, specificity of 89%, positive likelihood ratio of 8.6, and a negative likelihood ratio of 0.04 (4). For PCT, the sensitivity was 84% and specificity 70% and for CRP, sensitivity was 76% and specificity 67%.

Christ-Crain demonstrated that the use of antibiotics in lower respiratory tract infections in patients admitted to the ICU can be guided by procalcitonin (8). 73% of patients with acute exacerbation of COPD, bronchitis or asthma in the control group received antibiotics while only 23% of patients in the PCT-guided group received antibiotics with identical outcome. However, there was no difference in the antibiotic prescribed in patients with community-acquired pneumonia in the standard or PCT-guided groups.

Biomarker for prediction of prognosis

Plasma concentration of IL-6 correlates with the severity of the inflammatory response and have the best performance in predicting outcome in sepsis but is not used widely clinically.

Plasma levels of PCT among ICU patients with sepsis are significantly higher in non-survivors than in survivors (9, 10). Clec'h demonstrated that PCT cutoff value of 6 ng/ml on day 1 separated patients who died from those who survived with 87.5% sensitivity and 45% specificity (10). Gibot found that baseline plasma levels of CRP did not differ between survivors and non-survivors, whereas PCT concentrations were higher among non-survivors (11). However, sTREM-1 concentrations were lower in non-survivors but these levels increased and became significantly higher than survivors after day 5.

In patients with ventilator-associated pneumonia, serum PCT concentrations were higher in patients with unfavourable outcomes (death, persistent infection, relapse) than in patients with favourable outcomes (12). A serum PCT level of > 0.5 ng/ml on day 7 was the strongest independent marker for unfavourable outcome.

Biomarker for monitoring the course of disease or response to treatment

Christ-Crain demonstrated that PCT guidance in hospitalised patients with community-acquired pneumonia led to more judicious antibiotic use by reduced antibiotic use on admission and earlier discontinuation of antibiotic therapy (median 5 days in PCT-guided vs. 12 days in control) and outcomes are similar in both groups (13).

CONCLUSION

Although there is data to demonstrate that some markers of sepsis can improve the diagnosis, predict outcome and guide therapy in sepsis, only a few have impact on therapy while none fulfill all the clinical requirements. Perhaps a panel of sepsis-related markers should be used instead of individual marker to improve diagnostic and prognostic efficiency. Currently, biochemical marker cannot be recommended as a substitute for a careful clinical examination of a patient and should always be evaluated in the clinical setting of sepsis.

REFERENCES

1. American College of Chest Physicians/Society of Critical Care Medicine Consensus Conference: definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. *Crit Care Med* 1992; 20:864-874
2. Levy MM, Fink MP, Marshall JC, et al. 2001 SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions Conference. *Crit Care Med* 2003; 31:1250-1256
3. Marshall JC, Vincent JL, Fink MP, et al. Measures, markers, and mediators: Toward a staging system for clinical sepsis. A Report of the Fifth Toronto Sepsis Roundtable, Toronto, Ontario, Canada, October 25–26, 2000. *Crit Care Med* 2003; 31: 1560-1567
4. Gibot S, Kolopp-Sarda MN, Bene MC, et al. Plasma level of a triggering receptor expressed on myeloid cells-1: Its diagnostic accuracy in patients with suspected sepsis. *Ann Intern Med* 2004; 141:9-15.
5. Gibot S, Cravoisy A, Levy B, et al. Soluble triggering receptor expressed on myeloid cells and the diagnosis of pneumonia. *N Engl J Med* 2004;350:451-8.
6. Simon L, Gauvin F, Amre DK, et al. Serum procalcitonin and C-reactive protein levels as markers of bacterial infection: a systematic review and metaanalysis. *Clin Infect Dis* 2004; 39:206—217.
7. Clech C, Fosse JP, Karoubi P, et al.Differential diagnostic value of procalcitonin in surgical and medical patients with septic shock. *Crit Care Med* 2006; 34(1):102-107
8. Christ-Crain M, Jaccard-Stolz D, Bingisser R, et al. Effect of procalcitonin guided treatment on antibiotic use and outcome in lower respiratory tract infections: cluster randomised,single-blinded intervention trial. *Lancet* 2004;363(9409) : 600- 607
9. Harbarth S, Holeckova K, Froidevaux C, et al. Diagnostic value of procalcitonin, interleukin-6 and interleukin-8 in critically ill patients admitted with suspected sepsis. *Am J Respir Crit Care Med* 2001; 164:396-402.
10. Clech C, Ferriere F, Karoubi P, et al. Diagnostic and prognostic value of procalcitonin in patients with septic shock. *Crit Care Med* 2004; 32(5): 1166-1169.
11. Gibot S, Cravoisy A, Kolopp-Sarda MN, et al. Time-course of sTREM-1, procalcitonin and C-reactive protein plasma concentrations during sepsis. *Crit Care Med* 2005; 33(4): 792-796
12. Luyt CE, Guérin V, Combes A, et al. Procalcitonin kinetics as a prognostic marker of ventilator-associated pneumonia. *Am J Respir Crit Care Med* 2005;171:48–53.
13. Christ-Crain M, Jaccard-Stolz D, Bingisser R, et al. Procalcitonin guidance of antibiotic therapy guided treatment in community-acquired pneumonia: a randomised controlled trial. *Am J Respir Crit Care Med* 2006;174:84-93

FLUIDS AND COAGULATION

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Fluid management is central to intensive care medicine. The questions of what, when and how much to give, continue to dominate intensive care research area. One specific issue that has attracted a lot of interest is the effects of various types of intravenous fluids on coagulation. That these fluids are commonly given, often in large volumes, in bleeding cases or to patients at risk of coagulopathy; is one reason for such interest.

Studies on fluids and coagulation have explored both in vitro and in vivo techniques in deriving results. Thromboelastograph (TEG), a global test of haemostasis, is often used in addition to standard tests of hemostasis and single factor measurements.

Although crystalloids are generally believed to have no effects on coagulation, hypercoagulability with use of crystalloids has been demonstrated in several studies. A disproportionate reduction of antithrombin III levels following haemodilution appears to be the explanation. There is no difference in the degree of this hypercoagulability between the two common crystalloids, lactated Ringer's and 0.9% saline.

Decreased levels of Von Willebrand factor (vWF) and factor VIII following colloids administration have been identified as main contributing factors leading to coagulation abnormalities. The effects vary between dextrans, albumin, gelatins and the different preparations of hydroxyethyl starches (HES). The mean molecular weight (Mw) and the degree of substitution (DS) are the determinants of the effects of HES on coagulation.

Despite the wealth of literature on the effects of fluids on coagulation, the clinical significance of these findings remains unclear. Other factors, including haemostatic changes during stress and the need for massive volume of replacement in bleeding and septic cases, may considerably influence the choice of fluids.

VAP: EVERYTHING YOU WANT TO KNOW

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Ventilator-associated pneumonia or VAP is one of the most dreaded yet common nosocomial infections occurring in the critically ill.

VAP is defined as pneumonia occurring in patients more than 48 hours after endotracheal intubation and mechanical ventilation. It is commonly classified as early onset if it develops during the first 4 days of ventilation and late onset if it develops 5 or more days of ventilation. Early onset VAP is usually associated with antibiotic sensitive organisms while late onset is associated with antibiotic resistant ones.

EPIDEMIOLOGY

The incidence of VAP in the majority of reports varies between 8 and 28% and this is probably due to the different diagnostic criteria defining VAP. The oft-quoted overall prevalence of nosocomial pneumonia by the European Prevalence of Infection in Intensive Care or the EPIC study is 10%. Cook et al in their prospective cohort study showed that although the cumulative risk of VAP increased over time, the daily hazard rate decreased after day 5 ie 3.3% at day 5, 2.3% at day 10 and 1.3% at day 15.

The development of VAP is associated with prolonged ventilation, ICU as well as hospital stay. A study by Heyland showed that patients with VAP stayed an average of 4.3 days longer in the ICU. With the prolongation of ICU as well as hospital stay health care cost would invariably increase.

The mortality attributable to VAP is difficult to quantify as there are many compounding factors affecting the mortality of critically ill. Reported crude mortality rates of VAP vary between 24 to 50% and can reach up to 76% in specific settings or when lung infection is caused by high risk pathogens.

RISK FACTORS

Multiple risk factors have been identified to the development of VAP. Intubation is perhaps the most significant risk factor and has shown to increase the risk of nosocomial pneumonia by 6- to 21- fold. Other risk factors include reintubation and unplanned extubation, severity of illness on admission (APACHE II score > 16), acute and chronic lung disease, excessive sedation, patients admitted with trauma or burns, witnessed arrest and aspiration and the use of paralytic agents.

DIAGNOSIS

Diagnosing patients with VAP early is crucial as early and appropriate antibiotics have been shown to decrease morbidity and mortality. However diagnosing VAP accurately is neither easy nor straightforward.

The latest American Thoracic Society guidelines divide diagnostic strategy into a clinical or bacteriological one. When the clinical approach is used, VAP may be suspected if there is a new or progressive infiltrate on the chest X-Ray with two of three clinical signs of infection (fever, leucocytosis or leucopenia purulent secretions). Empiric antibiotic may be started based on the above. The initial empiric antibiotic should be based on the risk factors for specific pathogens as well local patterns of antibiotic resistance and organism prevalence. Sampling of the lower respiratory tract secretions for culture and blood culture should be done prior to starting antibiotics.

There is now renewed interest in the modified Clinical Pulmonary Infection Score or CPIS in the diagnosis of VAP. The original CPIS score introduced by Pugin et al had some limitations as it included microbiological cultures to diagnose VAP. The modified CPIS is however calculated based on radiological and physiological parameters only with a score of more than 6 diagnosing VAP.

The bacteriological approach to diagnose VAP uses quantitative cultures of the lower respiratory tract secretions ie endotracheal aspirates, BAL or PSB specimens). Growth above specific threshold is required to diagnose and determine the causative microorganism. Quantitative cultures are useful to diagnose VAP in patients with low or equivocal clinical suspicion of infection.

PATHOGENESIS

The pathogenesis of VAP requires bacterial colonization of the aerodigestive tract and the subsequent aspiration of these contaminated secretions into the lower airways around the endotracheal tube cuff. Some investigators have postulated that colonization of the endotracheal tube with the bacteria encased in biofilm may result in the embolization into the alveoli during suctioning or bronchoscopy.

Inhalation of pathogens from contaminated aerosols and direct inoculation could result in VAP though this is less common.

PREVENTION

Prevention is the cornerstone to decreasing the incidence of VAP. General as well as specific infection control measures should be put in place at all times in the intensive care unit.

Perhaps the most important and effective general infection control measure taken to prevent all nosocomial infections is hand washing. Adequate hand washing facilities and alcohol hand rubs help decrease cross contamination of multidrug resistant organisms between patients. Formal education program directed at intensive care nurses has been shown to decrease the incidence of VAP by Zack et al.

Specific preventive strategies are targeted at preventing aspiration. These include placing the patient in the semi recumbent position, optimizing endotracheal cuff pressure and preventing unplanned extubation as well as reintubation.

As intubation has been shown to increase the incidence of VAP by manyfold early liberation from ventilation is warranted. Daily sedation vacation and weaning protocols can decrease time spent on the ventilator. Non invasive ventilation should be used whenever possible in selected patients with respiratory failure.

Use of special endotracheal tubes which allow continuous aspiration of subglottic secretions has been shown to decrease early onset pneumonia and is recommended if available in patients who are going to be ventilated for more than 4 days.

Routine change of ventilator circuits is not advocated as the tubings become colonized as soon as they are changed. What is more important is to prevent the condensates that accumulate within the circuit tubings from entering the endotracheal tube. Scheduled drainage of these condensates is thus necessary to prevent this.

TREATMENT

Appropriate antibiotic selection with adequate dosing ensures a favorable outcome in patients with VAP. Choice of antibiotics should be aided by local sensitivity patterns as well as culture results. Assessment of patients who are at high risk for multidrug resistant pathogens is important to ensure that the initial antibiotics target these organisms.

Reducing the duration of treatment in patients with VAP has led to good outcomes with more antibiotic free days and less super infection. A large multi-center trial showed that there was no difference in terms of mortality, relapse or length of ICU stay in patients treated with 8 or 15 days of antibiotics. Singh and co-workers used the modified CPIS to guide them on the duration of antibiotics with low risk patients (CPIS 6 or less) having only 3 days of antibiotics compared to the conventional 10 -14 days. These patients had a better outcome when compared to the conventional group.

Shortening the course of treatment to VAP appears to limit cost and the potential for resistance while preserving a clinically acceptable response. Another aspect when treating VAP is de-escalation of antibiotics. This is currently recommended to ensure the culprit pathogen is treated while preventing superinfections and the emergence of resistance strains.

CONCLUSION

Preventing, diagnosing and treating VAP continues to be challenging to the intensivist. Great efforts should be made to decrease the incidence of VAP as it represents a major health care burden as well as morbidity and mortality. Preventing VAP should be made an important focus for quality improvement and infection control in the ICU.

REFERENCES

1. American Thoracic Society. Guidelines for the management of adults with with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Am J. Respir Crit Care Med* 2005; 171: 388 – 416
2. Cook DJ, Walter SD, Cook RJ, Griffith LE et al. Incidence and risk factors for Ventilator-associated pneumonia in critically ill patients. *Ann Intern Med* 1998: 129: 440
3. Chastre J, Fagon JY. Ventilated – associated pneumonia. *Am J. Respir Crit Care Med* 2002; 165:867-903
4. Singh N, Rogers P et al. Short course empiric antibiotic therapy for patients with pulmonary infiltrates in the intensive care unit: prospective evaluation of the CPIS score as an early predictor of outcome. *Am J. Respir Crit Care Med* 2000;162:505 -511

VENTILATING THE OBESE PATIENT: IS IT DIFFERENT?

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Morbid obesity has long been associated with increased mortality. Recently it was reported that the incidence of obesity in the surgical intensive care was 26.7% with 6.8% with BMIs of > 40. After controlling for age, gender and severity of illness, extreme obesity was an independent risk factor for risk of death and prolonged stay in the intensive care (1).

The ARDS network study on low tidal volume ventilation in ARDS found improved outcomes if patients were ventilated with 6 mls / kg of predicted tidal volume. This was based on the height of the patient and does not take into account of the actual weight of the patient. There was no specific recommendations as a result of the study for ventilating obese patients.

The morbidly obese patients suffer from several disadvantages during mechanical ventilation. There are decreases in FRC, chest compliance, expiratory flow limitations. There is VQ mismatch, impairment of A-aDO2 gradient made worse by anaesthesia, site of surgery and the supine position (2).

Though there is no ventilation outcome study specific to the obese patient, a rational approach is to use predicted weight rather than actual weight to adjust the tidal volumes. Due to expiratory flow limitations, the presence of iPEEP will need to be monitored and managed with appropriate PEEP settings.

Consideration should be made of obstructive sleep apnea syndrome, obesity hypoventilation syndrome during weaning of mechanical ventilation. The use of tracheostomy or NPPV may be necessary to help in weaning.

REFERENCE

1. Nasraway S et al. Morbid obesity is an independent determinant of death amongst surgical critically ill patients. CCM 2006; 34: 964-70
2. Ugern-Sternberg et al. Effect of obesity and site of surgery on perioperative lung volumes. BJA 2004; 92: 202-7

Programme
17 September 2006, Sunday

0815 – 0900	**PLENARY 4** Venue: Pyramid 2 Chairperson: Shanti Rudra Deva Quality of Life After Critical Illness – An Assessment of Long-Term Outcome in Those Admitted and Refused ICU Admission *Gavin M Joynt*	
0900 – 0930		
0930 – 1000	**PLENARY 5** Venue: Pyramid 2 Chairperson: Shanti Rudra Deva Nutritional Requirements of the Critically Ill *Carlos Scheinkestel* [pg 56]	
1000 – 1030		
1030 – 1100	TEA	
1100 – 1130	**SYMPOSIUM 8 • Sedation** Venue: Pyramid 2 Chairpersons: Subrahmanyam Balan / Toh Khay Wee • ICU Delirium *Lim Chew Har* • Current Practice of Sedation – Continuous versus Intermittent *Tan Cheng Cheng* [pg 57-60] • Monitoring Sedation Level in ICU *Nik Abdullah Mohamad* [pg 61-62] Questions and Answers	**SYMPOSIUM 9 • Paediatrics (2)** Venue: Pyramid 3 Chairpersons: Sushila Sivasubramaniam • Critical Care Illness Polyneuropathy (CCIPN) *Loh Tsee Foong* [pg 63] • Management of Renal Replacement Therapy in ICU: Dosing of Antibiotics and Adaptation of Nutritional Support *Lim Yam Ngo* [pg 64-65] • Long-Term Follow Up of Children Discharged from PICU: What We Can Learn *Jonathan Gillis* [pg 66] Questions and Answers
1130 – 1200		
1200 – 1230		
1230 – 1300		
1300 – 1330	LUNCH	
1330 – 1400		

NUTRITIONAL REQUIREMENTS OF THE CRITICALLY ILL

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Major potential complications arise from both under and overfeeding critically ill patients and as a result, the nutrition pendulum has swung from no feeding to overfeeding to "hypocaloric feeding" and continues to swing.

We performed 3 studies in 61 critically ill anuric patients with MSOF on CRRT receiving continuous infusions of isocaloric combinations of dextrose and intralipid with incremental protein to determine caloric and protein requirements.

RESULTS

1. Blood levels of measured amino acids (AA) did not rise significantly until protein intake reached 2.5gm/kg/day
2. AA balance increased by 230% and became more positive as protein input increased ($p=0.0001$)
3. At protein intakes <2.5gm/kg/day, blood levels of up to 60% of AA were below the normal range.
4. Positive nitrogen balances were attained with protein intakes>2gm/kg/day ($p=0.0001$)
5. Positive nitrogen balance was independent of time with nitrogen balance becoming positive in trial patients over time but negative in control patients over time ($p=0.0001$)
6. There was no correlation between nitrogen balance and days of ventilation or length of stay (ICU or Hospital)
7. Attaining a positive nitrogen balance was however directly linked to a successful ICU ($p=0.02$) and hospital ($p=0.03$) outcome.
8. Patient survival was much better than predicted by Apache II
9. Nitrogen balance was inversely related to energy expenditure ($p=0.05$)
10. Mean measured daily energy expenditure (EE) using a metabolic cart was 2400 calories
11. Predictive formulae underestimated expenditure by 19% if predicted EE <2700 calories/day and overestimated expenditure by 6% if predicted EE >2700 ($p=0.0008$)
12. Energy received was 99% of predicted and 90% of measured EE
13. Glucose losses in dialysate were directly proportional to blood glucose level

CONCLUSIONS

1. Ensure calories received = calories required
2. Use metabolic cart to measure EE, especially if predicted EE<2700
3. Control blood glucose to minimize glucose losses in dialysate
4. Protein intake >2gm/kg/day to obtain positive AA and nitrogen balance, avoid deficiencies of essential AA and improve survival

CURRENT PRACTICE OF SEDATION – CONTINUOUS VERSUS INTERMITTENT

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INTRODUCTION

Achieving and maintaining adequate levels of analgesia and sedation in the critically ill is a fundamental and essential part of ICU care. As many as 90% of patients in the ICU showed evidence of an anxiety disorder[1] and agitation occurred at least once in 71% of patients in a medical-surgical ICU[2]. Anywhere from 30 to 70% of patients are bothered by pain during their ICU stay[3-5].

Sedation of agitated critically ill patients should be started only after providing adequate analgesia and treating reversible physiological causes. In other words achieving adequate analgesia is the first priority when administering sedation in the ICU[6]. Once a pain freestate is assured, then look for reversible causes of agitation (eg anxiety, delirium, dyspnea, physical discomfort, full bladder and paralysis) before considering sedative therapy.

SEDATION IN ICU

Sedation is the process of establishing a state of relaxation or well-being. It does not, as often assumed, necessarily involve a depressed level of consciousness[7]. In fact, the desired level of sedation for the critically ill patient has undergone an important change. In 67% of ICUs in 1981, the goal of sedation was to completely detach patients from their environment. However, a survey published 6 years later observed that the goal of sedation had changed; the majority of ICUs now seed to maintain a patient who is sleepy but easily awakened[8].

The drugs most commonly used are benzodiazepines (mostly midazolam) and opioid analgesics (morphine and fentanyl mainly)[9,10]. A recent survey in Danish ICUs found a significant reduction in the use of benzodiazepines and opioids but an increase in the use of propofol[11]. Whatever the sedation drugs used, they can be administered by either intermittent bolus dosing or continuous infusion.

CONTINUOUS VERSUS INTERMITTENT SEDATION

Administering sedatives by continuous intravenous infusion have become common practice[12]. Advantages provided by continuous infusion include circumvention of both high-plasma drug concentrations, resulting from administration of the large bolus doses required of an intermittent technique, and also of the low-plasma drug concentrations that can occur before the administration of the next bolus. When appropriately titrated, continuous infusion of a sedative drug minimizes periods of both the over- and under-sedation associated with intermittent bolus administration[13].

Unfortunately, continuous intravenous infusion of sedative drugs is not without problems. Pharmacokinetic and pharmacodynamic profiles of sedatives in critically ill patients remain unpredictable and uncertain[14-16]. Similar plasma concentrations of a sedative agent can produce different effects in different individuals. In addition, as pathophysiologic changes occur within an individual patient, the pharmacokinetic disposition of the drug and pharmacodynamic effect may also change. Furthermore, individual sedative needs constantly change depending on the nature and course of the disease[17]. Further unpredictability arises from the multicompartmental pharmacokinetics exhibited by many of the sedative drugs used in the ICU.

Midazolam is water-soluble, highly lipid soluble at physiologic pH and has a six-fold to ten-fold greater clearance than lorazepam and 30-fold greater clearance than diazepam[17]. Its elimination half-life is only 1.7-2.6 hours in normal volunteers[17]. In a study of 4 ICU patients, Shafer et al[18] found an elimination half-life for midazolam of 14-26 hours. Malacrida et al[19] also reported that the half-life of midazolam ranges from 3.8 to 7.7 hours in ICU patients. Studies of propofol in the critically ill have likewise shown prolonged half-life after long-term infusion[17].

In traditional pharmacokinetic modeling, the elimination half-life was thought to better predict clinical effects of a drug given as a continuous infusion. However, recent work has shown that the relationship between duration of clinical effect of sedatives and traditionally measured elimination half-lives does not hold. When an infusion is delivered over several hours, days, or even weeks (as can be the case in the ICU), after infusion stops, the context-sensitive half-time predicts the rapidity with which the drug concentration declines better than elimination half-life[17]. The context-sensitive half-time represents the time for the drug plasma concentration to decrease by 50% after cessation of a continuous infusion. The figure below showed the context-sensitive half-times of the three intravenous benzodiazepines and propofol. Propofol, midazolam , and diazepam have significantly shorter context-sensitive half-lives than lorazepam when administered by continuous infusion. Thus use of these agents should result in the ability to alter blood concentrations more rapidly and result in greater control over depth of sedation.

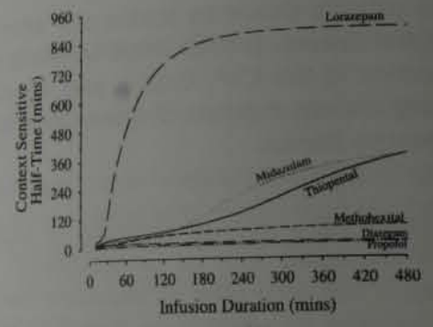

Figure showing context-sensitive half-times for lorazepam, diazepam, and midazolam. The context-sensitive half-times increase with the duration of drug infusion. (Data from Greenblatt et al, Persson et al, and Klotz and Reimann)[17].

Though the knowledge of context-sensitive half-times may be helpful, complications with the use of continuous intravenous sedative drugs especially with long term administration are real.

Prolongation of sedation after discontinuation of a midazolam infusion is frequent. There can be many causes. The tendency to accumulate is caused partly by the high lipid solubility of the drug and partly by prolonged elimination half-life attributed to increased volume of distribution[19]. Reduction in liver perfusion reduces the rate of midazolam metabolism[20]. Drug interaction play a role too. The interaction between erythromycin and midazolam is significant, and erythromycin should be avoided when possible during midazolam sedation, or dosage of midazolam should be reduced by 55 to75% during erythromycin therapy[21]. Theophylline and cimetidine are other examples. Prolonged sedation can also occur due to accumulation of an active hydroxylated metabolite of midazolam[22].

Continuous infusions of propofol longer than 24 to 48 hours are associated with unusual and potentially serious complications, including progressive hyper-triglyceridemia, pancreatitis, increased carbon dioxide production and an excessive caloric load (the emulsion contains approximately 1.1 kcal/ml, most of which is derived from lipids)[23]. In addition, propofol infusion syndrome, rare and often fatal, has been reported both in children and adults[24].

In a prospective observational cohort study by Kollef MH et al in 1998, multiple linear regression analysis of 242 consecutive mechanically ventilated patients demonstrated that patients receiving continuous IV sedation had nearly twice the duration of mechanical ventilation (185 versus 66 hours) compared with patients not receiving continuous IV sedation. This association persisted despite adjustment for age, gender, severity of illness, mortality, indication for mechanical ventilation, use of neuromuscular blocking agents, presence of tracheostomy and the number of acquired organ system derangements. Similarly, the adjusted ICU and hospital lengths of stay were statistically greater among patients receiving continuous IV sedation[25]. However these data must be interpreted cautiously because of the nonrandomized nature of the study.

Dr Carson and colleagues recently published a paper[26] in Critical Care Medicine where they sought to compare a strategy of sedation with continuous infusions of short acting agent to a strategy of intermittent bolus dosing of longer acting agents. In an open- label trial, 132 mechanically ventilated patients were randomly assigned to receive lorazepam by intermittent intravenous bolus or propofol by continuous infusion. Median ventilator-free days were lower in the propofol group (6 versus 8 days). Among hospital survivors, the difference was greater (4 versus 9 days). There was no mortality difference. The trial has been criticized for its design because it is unclear whether the results are due to the different medications or different routes of administration[23].

DAILY INTERRUPTION OF SEDATION

Regardless of the method of sedative delivery, frequent assessment of the patient is required after adequate sedation has been achieved, and the sedative dose should be titrated downward as tolerated[23]. One method for minimizing sedative use is to interrupt continuous sedative infusions on a daily basis in order to assess underlying neurologic status and the continuing need for sedation.

In a randomized controlled trial[27] involving 128 adult patients, those randomized to a daily interruption of sedative infusions had a significantly shorter duration of mechanical ventilation (4.9 versus 7.3 days with p=0.004), a significantly shorter intensive care unit length of stay (6.4 versus 9.9 days with p=0.02), and underwent fewer diagnostic tests to assess changes in mental status (9% versus 27% with p=0.02) than those receiving routine care. There were no difference in the incidence of self-extubation between the 2 groups (4% versus 7% with p=0.88).

One concern with daily interruption of sedation is the possibility of increasing ling-term psychological sequelae, including post-traumatic stress disorder among survivors of critical illness. This questions was assessed in a follow-up study comparing patients enrolled in the trial described above with contemporaneous survivors of critical illness treated with out daily sedative interruption[27,28]. Patients who received daily sedative interruption did not experience adverse psychological outcomes, and were less likely than control patients to have symptoms of post-traumatic stress disorder. These patients also appear to have a lower incidence of complications related to mechanical ventilation and critical illness (2.8% versus 6.2% with p=0.04)[29].

REFERENCES

1. Bone RC, Hayden WR, Levine RL, et al. Recognition, assessment, and treatment of anxiety in the critical care patient. Dis on 1995; 31:296-359
2. Fraser GL, Prato S, Berthiaume D, et al: Evaluation of agitation in ICU patients: Incidence, severity, and treatment in the young versus the elderly. Pharmacotherapy 2000; 20:75-82
3. Donovon M, Dillon P, McGuire L. Incidence and characteristics of pain in a sample of medical-surgical inpatients. Pain 1987; 30:69-78
4. Stevens DS, Edwards WT. Management of pain in the critically ill. J Intensive Care Med 1990; 5:258-291
5. Puntillo KA. Pain experiences in ICU patients. Heart Lung 1990; 19:526-533
6. Society of Critical Care Medicine: Clinical practice guidelines for the sustained use of sedatives and analgesics in the critically ill adult. Crit Care Med 2002; 30:119-141
7. Marino PL. Analgesia and Sedation. In The ICU Book, second edition: 1998 Williams & Wilkins
8. Shafer A. Complications of sedation with midaxolam in the intensive care unit and a comparison with other sedative regimens. Crit Care Med 1998; 26(5):947-956
9. Dasta JF, Fuhrman TM, McCandles C. Patterns of prescribing and administering drugs for agitation and pain in patients in a surgical intensive care unit. Crit Care Med 1994; 22:974-980
10. Soliman HM, Melot C, Vincent JL. Sedative and analgesic practice in the intensive care unit: the results of a European survey. Br J Anaesth 2001; 87(2):186-92
11. Ingrid E, Birgitte VC, Lena J. Trends in sedation practices in Danish intensive care units in 2003: a national survey. Intensive Care Med 2006; 32:60-66
12. Barr J, Donner A. Optimal dosing strategies for sedatives and analgesics in the intensive care unit. Crit Care Clin 1995; 11:827-847
13. Jacobs JR, Reves JG, Glass PSA. Rationale and technique for continuous infusion of midazolam or bolus of diazepam for postoperative sedation in cardiac surgical patients. Int Anesthesiol Clin 1991; 29:23-38
14. Bodenham A Shelly MP, Park GR. The altered pharmacokinetics and pharmacodynamics of drugs commonly used in critically ill patients. Clin Pharmacokinet 1988; 33:347-373
15. Wagner BKJ, O'Hara DA. Pharmacokinetics and pharmacodynamics of sedatives and analgesics in the treatment of agitated critically ill patients. Clin Pharmacokinet 1997; 33:426-453
16. Bertz RJ, Granneman GR. Use of in vitro and in vivo data to estimate the likelihood of metabolic pharmacokinetic interactions. Clin Pharmacokinet 1997; 32:210-258

17. Young C, Knudsen N, Hilton A, Reves J. Sedation in the intensive care unit. Crit Care Med 2000; 28(3):854-866
18. Shafer A, Doze V, White P. Pharmacokinetic variability of midazolam infusions in critically ill patients. Crit Care med 1990; 18:1039-1041
19. Malacrida R, Fritz M, Suter P, et al. Pharmacokinetics of midazolam administered by continuous intravenous infusion to intensive care patients. Crit Care Med 1992; 20:1123-1126
20. Byatt CM, Lewis LD, Dawling S et al. Accumulation of midazolam after repeated dosage in patients receiving mechanical ventilation in an intensive care unit, BMJ 1984; 289:799-800
21. Olkkola KT, Aranko K, Luurila H et al. A potentially hazardous interaction between erythromycin and midazolam. Clin Pharmacol Ther 1993; 53:298-305
22. Bauer TM, Ritsz R, haberthur C et al. Prolonged sedation due to accumulation of conjugated metabolites of midazolam. Lancet 1995; 346:145-147
23. Karen JT, Eric TW. Use of sedative medications in critically ill patients. Up To Date 2006
24. Fudickar A, Bein B, Tonner PH. Propofol infusion syndrome in anaesthesia and intensive care medicine. Curr Opin Anaesthesiol 2006; 19(4):404-410
25. Kollef MH, Levy NT, Ahrens TS et al. The use of continuous IV sedation is associated with prolongation of mechanical ventilation. Chest 1998; 114(2):541-548
26. Carson SS, Kress JP, Rodgers JE et al. A randomized trial of intermittent lorazepam versus propofol with daily interruption in mechanically ventilated patients. Crit Care Med 2006; 34:1326
27. Kress JP, Pohlman AS, O'Connor MF, Hall JB. Daily interruption of sedative infusions in critically ill patients undergoing mechanical ventilation. N Engl J Med 2000; 342:1471-1477
28. Kress JP, Gehlbach B, Lacy M et al. The long-term psychological effects of daily sedative interruption on critically ill patients. Am J Respir Crit Care Med 2003; 168:1457
29. Schweickert WD, Gehlbach BK, Pohlman AS et al. Daily interruption of sedative infusions and complications of critical illmess in mechnically ventilated patients. Crit Care med 2004; 32:1272-1276

MONITORING SEDATION LEVEL IN ICU

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About 74% of the critically ill adult patients become agitated and recall unpleasant memories of their ICU experience during their ICU stay [1]. These include unrelieved pain, sleep deprivation, anxiety, nightmares, hallucinations and these experiences can lead to posttraumatic stress disorders. Inadequate sedation is also associated with patient self extubation, accidental removal of vascular catheters and nasogastric tubes and it may be associated with increased morbidity and mortality.

Excessive sedation is also equally undesirable because it may lead to prolonged mechanical ventilatory support, increased diagnostic testing and increased length of ICU stay.

Finding a balance between providing patient comfort and oversedation has been difficult. Fortunately, the availability of protocols using validated and reliable scoring systems helps to enhance the practice of sedation and analgesia, improve patient outcomes, and reduce resource consumption.

SUBJECTIVE TOOLS TO ASSESS SEDATION

As mechanical ventilation requires deep sedation and often neuromuscular blockade, sedation requirements have changed similarly. In an effort to achieve a balance between too little and too much medication for sedation and analgesia, many clinicians now define specific target behaviors for their ICU patients as part of comprehensive comfort protocols. Incorporating sedation scoring systems in these algorithms provides a means to communicate treatment goals consistently and to assess the response to therapeutic interventions.

No subjective scale is reliable or valid in all ICU patients or situations. For any measurement technique to be considered dependable, it must be reliable and valid. Many scales that are tested for reliability or validity have been developed and applied to patients in the ICU to monitor sedation. These include:

- The Ramsay Scale
- The Riker Sedation-Agitation Scale
- The Motor Activity Assessment Scale
- The Harris Scale
- The Sheffield Scale
- The Vancouver Interaction and Calmness Scale
- The Visual Analog Scale
- The Observer's Assessment of Alertness/Sedation
- The COMFORT Scale
- The Richmond Agitation Sedation Scale

OBJECTIVE TOOLS TO ASSESS SEDATION

Subjective techniques to monitor sedation require the patient to have intact neuromuscular function and a degree of cooperation that often may be lacking among sicker ICU patients. Objective testing of the level of sedation may be helpful during very deep sedation or when therapeutic neuromuscular blockade precludes the use of scales based on observable behavior. Objective tools that may be use to monitor sedation in ICU include:

- Heart Rate Variability
- Electroencephalography Power Spectral Parameters
- The Bispectral Index
- Evoked Responses

EFFECT OF MONITORING SEDATION

The effect of using objective and subjective scoring systems to guide ICU sedation has improved many outcomes including medication costs, duration of ventilator dependence, length of ICU and hospital stays, quality of sedation, avoidance of oversedation, need for tracheostomy, diagnostic testing and duration of neuromuscular blockade.

THE IMPACT OF MONITORING SEDATION ON ICU PATIENT OUTCOMES

AUTHOR	TOOL	STUDY DESIGN	NUMBER OF PATIENTS	PATIENT TYPE	ASSESSMENT TOOL BENEFITS
Brook [2]	Ramsay scale/ protocol	Random controlled trial	321	MICU	Reduce ventilator time by 28%, ICU LOS by 30% tracheostomies by 53%
Kress [3]	Ramsay scale/ protocol	Random controlled trial	128	MICU	Reduce ventilator time by 33%, ICU LOS by 35% diagnostic testing by 67%
Costa [4]	Ramsay scale/ Cook	Random crossover	40	Mixed	Reduce drug costs by 37%, 240% more time in target sedation level
Detriche [5]	Brussels	Before-after	55	Not specified	Reduce unarousability in the morning by 250% and at night 450%
Kaplan [6]	Bispectral index	Before-after	57	MICU	Reduce drug costs by 18% and unpleasant recall by 78%
Anid [7]	Bispectral index	Prospective cohort	12	MICU	Reduce the use of prolonged NMBA by 86%
Maclaren [8]	Ramsay/ Visual Analog Scale (pain)/ protocol	Before-after	158	Mixed	172% more time at target sedation level, 39% fewer observations of pain

Abbreviations: NMBA = neuromuscular-blocking agent: SICU = surgical intensive care unit; MICU = medical intensive care unit; LOS = length of stay.

SUMMARY

The availability of valid and reliable assessment tools to monitor sedation in the ICU represents an important step in providing patient comfort and the development of ideal treatment strategies. To make the ICU a more humane healing environment, these assessment tools must be used as part of a comprehensive evaluation of interventional and preventive treatments.

REFERENCES

1. Gilles LF, Richard RR: Monitoring sedation, agitation, analgesia, and delirium in critically ill adult patients. *Crit Care Clin* 17(4): 967-87, 2001.
2. Brook AD, Ahrens TS, Schaiff R, et al: Effect of a nursing-implemented sedation protocol on the duration of mechanical ventilation. *Crit Care Med* 27:2609-2615, 1999.
3. Kress JP, Pohlman AS, O'Connor MF, et al: Daily interruption of sedative infusions in critically ill patients undergoing mechanical ventilation. *N Engl J Med* 342:1471-1477, 2000.
4. Costa J, Cabre L, Molina R, et al: Cost of ICU sedation: Comparison of empirical and controlled sedation methods. *Clin Intensive Care* 5 (suppl):17-21, 1994.
5. Detriche O, Berre J, Massaut J, et al: The Brussels sedation scale: Use of a simple clinical sedation scale can avoid excessive sedation in patients undergoing mechanical ventilation in the intensive care unit. *Br J Anaesth* 83:698-701, 1999.
6. Kaplan L, Bailey H: Bispectral index (BIS) monitoring of ICU patients on continuous infusions of sedatives and paralytics reduces sedative drug utilization and cost. *Critical Care* 4:S110, 2000.
7. Anid YS, Southwood RL, Williams DB, et al: Facilitation of early withdrawal from neuromuscular paralysis by bispectral electroencephalographic monitoring of level of sedation. *Chest* 112:32S, 1997.
8. Maclaren R, Plamondon JM, Ramsay KB, et al: A prospective evaluation of empiric versus protocol-based sedation and analgesia. *Pharmacotherapy* 20:662-672, 2000.

CRITICAL CARE ILLNESS POLYNEUROPATHY (CCIPN)

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Neuromuscular dysfunction is a peripheral nervous system disease that can develop secondarily in critically ill patients.

Myopathy and neuropathy are more common in selected groups of patients and the disease presentation is varied and maybe mixed. There is a suggestion that, together with central nervous system disorders (e.g. psychiatric, behavioral and somatic conditions developed after critical illness) that critical illness brain syndrome (CIBS) be studied and evaluated collectively.

Although CCIPN is an under appreciated problem, there is emerging literature in adults that it is an important contributor to morbidity and mortality in the long and short term. A lot of work on its multifactorial etiology and pathogenesis is published but is not yet fully elucidated due to the nature of the disease. Recognition is hampered by the circumstances in which the patient may present and requires a thorough neurological assessment. While most adult literature suggests survivors assume significant recovery, there are those whose quality of life remained poor.

It is essential to identify high risk patients and prevent or manage the problem early by minimizing exposure to critically ill patients to the associated risk factors. Treatment is essentially supportive and rehabilitative. Knowledge and reference in paediatric is limited and more work needs to be done in this area.

MANAGEMENT OF RENAL REPLACEMENT THERAPY IN ICU: DOSING OF ANTIBIOTICS AND ADAPTATION OF NUTRITIONAL SUPPORT

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A: ADAPTATION OF NUTRITIONAL SUPPORT IN PATIENTS ON RENAL REPLACEMENT THERAPY

Most Renal Replacement Therapies (RRT) in the ICU is for patients with acute renal failure (ARF), which often times is part of sepsis or multiorgan dysfunction syndrome. Metabolic derangements in these patients will be determined not only by the acute renal failure but also the underlying disease process and multiple organ dysfunctions, and the type and intensity of RRT. The most profound metabolic derangements of ARF include not only water, electrolyte and acid-base balance but also protein catabolism, hyperglycaemia, and hypertriglyceridaemia. Continuous RRT especially CVVHDF causes a significant loss of water-soluble small molecular weight substances including amino acids and water-soluble vitamins. Peritoneal dialysis leads to increased losses of albumin and other proteins as well as amino acids.

Severe malnutrition is an independent predictor of in-hospital stay and mortality in patients with ARF.

Energy expenditure is usually due to the underlying disease and co-morbities and amounts to only 130% of predicted energy expenditure. The optimal amount of protein supplementation is unknown and hypercatabolism cannot simply be overcome by increasing protein intake. The optimal energy to nitrogen ratio has also not been clearly determined. Micronutrient requirements vary. Vitamin A may be retained causing toxicity. Excess vitamin C may result in secondary oxalosis. Vitamin K is affected by the antibiotics used especially in patients with sepsis and hence supplementation may be necessary. Increased intake of thiamine and selenium may also be needed. Other trace elements are mainly protein bound and poorly affected by ultrafiltration.

Standard formula feeds are adequate for the majority of patients and the preferred route of feeding is the enteral route usually via nasogastric tube. If nutrient requirements cannot be met by enteral feeding, parenteral supplementation may become necessary. Complications of parenteral feeding – whether technical, infectious or metabolic are similar to non-uraemic patients.

B: ANTIBIOTIC DOSING

Many drugs are eliminated from the body by the kidneys. When prescribing drugs to patients with acute renal failure on RRT, several principles need to be considered. These include whether the kidney or the liver normally clears the drug and if it is the kidneys whether HD or CRRT normally removes the drug. Several factors influence drug removal by dialysis therapy. The physicochemical characteristics of the drug determine how and whether it will be cleared during hemofiltration or by dialysis. Only the free non-protein bound fraction of a drug can pass through the dialyser membrane. The characteristics that affect its removal include molecular weight, protein binding, volume of distribution, and water solubility. The ideal drug to be removed by CRRT that requires dose adjustment has a low protein binding, small volume of distribution and low non-renal clearance.

Besides the properties of the drug, the properties of dialysis system also affect drug removal. These include the membrane characteristics, the type of RRT whether convective or diffusive or both, the blood and dialysate flow rates and the duration of RRT. Solute removal, in this case drug removal is especially relevant to antibiotic dosing because many critically ill patients with acute renal failure have serious infections which require effective therapy with more than one antibiotic.

There is usually no adjustment needed to the loading dose of the antibiotic. For maintenance dose adaptation, it is suggested that literature guidelines although scant, be consulted. Frequent drug concentration monitoring if available is important to prevent toxicity and ensure effectiveness.

REFERENCES

1. Druml W. Metabolic aspects continuous renal replacement therapies. Kidney Int 1999, 56(Suppl 72): S-56-61
2. Casno N, Fiaccadori E, Tesinky P, Toigo G, Druml W, et al. ESPEN guidelines on enteral nutrition: Adult renal failure. Clinical Nutrition 2006; 25:295-310.
3. Strejc JM. Considerations in the nutritional management of patients with acute renal failure. Hemodial Int. 2005 Apr;9(2):135-42
4. Veltri MA, Neu AM,. Fivush BA, Rulan S. Parekh RS,. Furth SL. Drug Dosing During Intermittent Hemodialysis and Continuous Renal Replacement Therapy: Special Considerations in Pediatric Patients. Pediatr Drugs 2004; 6 (1): 45-65
5. Golper TA, Marx MA. Drug dosing adjustments during continuous renal replacement therapies. Kidney Int 1998; 53 (suppl 66): S165-168.
6. Bohler J, Donauer J, Keller F. Pharmacokinetic principles during continuous renal replacement therapy: Drugs and dosage. Kidney Int 1999; 56(suppl 72): S24-28.

LONG-TERM FOLLOW UP OF CHILDREN DISCHARGED FROM PICU: WHAT WE CAN LEARN

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While it seems obvious that the ultimate way to evaluate the quality of care for children admitted to the PICU is to followup those children, this is a very complex issue which challenges many of the assumptions, structures and functions of paediatric intensive care. I will first discuss these inherent difficulties and their implications. These include:

(1) PICU is not one disease or therapy and the use and function of PICU depends on local resources and needs (2) There is a high level of discontinuity both within the PICU and between the PICU and other health services (3) It is not clear what outcomes should be measured and evaluated at follow-up (4) It is also not clear how poor outcome should affect future PICU practice. The methodological issues involved in meaningful followup will be further explored. I will then illustrate the implications of long-term followup with reference to general psychological outcome studies and to two specific examples, children with malignancy and children with chronic neuromuscular diseases.

Conclusions can be drawn both about what happens to children discharged from PICU, and also how the lessons of followup can affect the approach, practice and organization of paediatric intensive care.

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PP 01

AN UNUSUAL PRESENTATION OF EMPHYSEMATOUS PYELONEPHRITIS

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Emphysematous pyelonephritis is a life-threatening infection with high mortality rates. It is an uncommon necrotizing infection of the renal parenchyma, characterized by gas production in intrarenal and perirenal tissue. The infection is most commonly seen in diabetic patients and may be associated with a urinary tract infection or ureteral obstruction.

We report a rare presentation of emphysematous pyelonephritis in a 48 year old lady with non-insulin dependent diabetes mellitus. She presented initially with acute abdomen, shock and acute renal failure. She was treated with Imipenem on admission to the ICU. An exploratory laparotomy was performed for hollow viscus perforation following radiological evidence of gas under the diaphragm but yielded negative findings. Both her urine and blood cultures grew E.coli. Subsequently, further radiological investigations to search for the cause of pneumoperitoneum and gram negative sepsis confirmed the diagnosis of left emphysematous pyelonephritis. Percutaneous nephrostomy and perinephric drainage were performed. Her recovery was stormy but she responded to the treatment.

In conclusion, pneumoperitoneum is a rare presentation of emphysematous pyelonephritis. Clinicians should have high index of suspicion in diabetic patients with urinary tract infection or ureteral obstruction and initiate appropriate investigations to confirm the diagnosis. For successful treatment of patients with emphysematous pyelonephritis, appropriate medical therapy should be initiated, and immediate drainage or nephrectomy should not be delayed. Although nephrectomy is the treatment of choice for most patients, percutaneous drainage and antibiotics can be life saving.

PP 02

UNDIAGNOSED CASE OF MYOTONIA FOR LSCS

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Puan S, a 24 year old primigravida at 40 weeks gestation was booked for emergency lower segment Caesarean section (LSCS) due to cephalopelvic disproportion secondary to short stature. She did not have any significant illness previously. Airway examination was unremarkable. General anaesthesia was chosen. After preoxygenation, rapid sequence induction was performed with intravenous sodium thiopentone and suxamethonium. The patient developed generalized stiffness and masseter spasm (trismus) for about 2-3 mins during which she desaturated to 45% while still on 100% oxygen. Her mouth was forcefully opened and oropharyngeal airway inserted. Manual ventilation was commenced and oxygen saturation improved to more than 90%, with cricoid pressure in place. She was subsequently intubated with a size 7 mm endotracheal tube (ETT) with the aid of a gum elastic bougie. Anaesthesia was maintained with 50% oxygen, 50% nitrous oxide with isoflurane and paralysed with IV atracurium. End-tidal carbon dioxide (ETCO2) was maintained at 35-40 mm Hg. Surgery was uneventful and a healthy baby boy was born with good APGAR score. After the surgery, isoflurane and nitrous oxide were stopped and neuromuscular blockade was reversed. Although fully awake and able to obey command, respiratory effort remained poor. ETCO2 progressively increased to 80 mm Hg while she was breathing spontaneously with 100% O2 via the ETT. A full examination of the patient then revealed hypertrophied deltoid and calf muscles and decision was taken to support her ventilation in ICU in view of possibility of myopathy. Post-operative chest X-ray revealed abnormal rib cage. Further investigations revealed elevated creatine kinase (933 i.u./L) and electromyography revealed "dive-bombers" pattern suggestive of myotonia. Exact type of myotonia is yet to be established. She was extubated 22 hours post-operatively and her entire family are undergoing further work-up by the neurologist.

PP 03

AN UNUSUAL CAUSE OF PULMONARY HYPERTENSION

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Mr R, a 34 year old Indian gentleman was referred to Penang Hospital for the management of acute bilateral lower limb weakness. He had history of heavy alcohol consumption for the last 9 years with multiple admissions to the hospital. Ultrasound abdomen then showed fatty liver changes. This admission, he complained of fever for 1 week, breathlessness, abdominal distension, bilateral lower limb weakness and swelling. Physical examination revealed a drowsy patient with blood pressure of 90/50 mm Hg and pulse rate 96/min. Cardiorespiratory examination was unremarkable. His abdomen was distended and there was firm hepatomegaly of 4 cm. There was gross pitting pedal as well as sacral edema. Right internal jugular vein was cannulated and the central venous pressure (CVP) was 38 mm Hg. Attempts at cannulating the radial and femoral arteries for invasive blood pressure monitoring kept showing a reading of 50/30 mmHg and a mean of 40 mm Hg which was thought to be venous. However, the waveforms looked typical of the arterial waveform. The left external jugular vein was cannulated for comparison and the initial reading was also high (mean = 35 mmHg). Finally the left brachial artery was cannulated for invasive blood pressure monitoring (BP 90/60 mm Hg). Echocardiography revealed normal left ventricular (LV) function (Ejection Fraction 59%), moderate tricuspid regurgitation, mean pulmonary arterial pressure (PAP) of 44 mm Hg, dilated right atrium (RA) and right ventricle (RV). Urgent CT scan of Pulmonary artery was inconclusive. Transoesophageal echocardiogram showed dilated RA, RV and PA. A 5 mm X 2 mm thrombus was seen in the right main pulmonary artery, which appeared to be localized, chronic and adherent to the wall. He had a left SVC with a dilated coronary sinus into which the triple lumen catheter tip could be visualized. He had good left ventricular contractility but the heart appeared to be underfilled. He was decided against surgical thrombolysis as the small thrombus could not have attributed to the haemodynamic instability. He passed away the following day. Family refused postmortem despite counseling. All the differential diagnosis will be discussed.

PP 04

BEDSORES AND THE INFLUENCE OF PAMPERS

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OBJECTIVE

To study the occurrence of bedsores in ICU and to see if use of pampers contributes to their development.

DESIGN

Prospective observational study.

METHODS

Since 1st of January 2006, patients occupying odd numbered beds were nursed without pampers while patients occupying even numbered beds were nursed with pampers. All patients were examined for the development of bedsores by the nurse-in-charge every shift and data were collected with regard to the day of occurrence and their severity. A review was made after 6 months. Bedsores which were already present on ICU admission were excluded from the review.

RESULTS

Out of 533 admissions over the 6 month period, there were a total of 77 bedsores. After exclusion of 31 bedsores which were already present on ICU admission, 46 bedsores were analysed. Most (39.1%) bedsores occurred on the 3rd day of ICU admission. None of the 46 bedsores progressed to stage III or IV. Of the 46 patients with bedsores, 21 patients used pampers while 25 patients did not use pampers.

CONCLUSION

Use of pampers had not been found to have any influence on the occurrence of bedsores. The occurrence of bedsores was common (8.6%) but the bedsores were not severe.

PP 05

INCIDENCE OF VENTILATOR ASSOCIATED PNEUMONIA (VAP) IN PATIENTS USING OPEN TRACHEAL SUCTION SYSTEM (OTSS) AND CLOSED TRACHEAL SUCTION SYSTEM (CTSS): A PROSPECTIVE STUDY IN HOSPITAL MELAKA

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Airway suctioning for patients in Hospital Melaka has traditionally been performed by open suction method which includes disconnection of the patient from the ventilator and the introduction of the suction catheter into the endotracheal tube. Alternatively, it can also be accomplished with a closed suctioning system included in the ventilatory circuit, allowing introduction of suction catheter into the airways without disconnecting patient from the ventilator.

The aim of our study was to determine the incidence of ventilator associated pneumonia (VAP) in patients prescribed with closed tracheal suction system (CTSS) and open tracheal (OTSS) suction system. We also studied the cost incurred in these two groups of patients. This prospective randomized trial was performed on 52 patients, of whom 22 received suctioning by an open tracheal suction system (OTSS) method and 30 by a closed tracheal suction system (CTSS) method over a period of 2 months in Intensive Care Unit, Hospital Melaka.

There were no significant difference between groups of patients in age, sex, number of tracheal suctioning per day, volume of daily gastric aspiration and the Acute Physiology and Chronic Health Evaluation II Score (APACHE). Differences in incidence of VAP was not significant (p= 0.725), between closed and open suctioning. The incidence of VAP in the open suction system was 22.7% compared to 16.7% in closed suction system. Differences in the cost incurred were also studied. The cost of the closed system (Pashco®) per day was RM39.50 whereas the approximate cost for the open system was RM4.75. We concluded that in our study there was no difference in the incidence of ventilator associated pneumonia in patients using OTSS and CTSS systems.