Innovations in Trauma Care

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The Alfred
Circa 1930
Circa 2003
Overview

- Technology
- Nursing
- Trauma System
Technology....

And you thought your job sucked
Clinical Microdialysis

Blood capillary

Extracellular fluid
Clinical Microdialysis

- First described in 1974

- The 1987 Rx Parkinson's
What is microdialysis?

- Continuous tissue chemistry monitoring
- Alerts tissue chemistry changes before clinical changes become evident
- Titrate interventions
  - don’t have to wait for lab results
Clinical Applications

- Where continuous monitoring is required
  - neurotrauma
  - shock
  - sepsis
  - invasive monitoring
    - Operative procedures

- Early chemical markers of ischemia can be detected by using microdialysis
  - monitoring of myocutaneous grafts
The Principle of Microdialysis
The Principle of Microdialysis

Blood capillary

Extracellular fluid

Microdialysis catheter
Types

- Brain
- Adipose tissue
Subcutaneous microdialysis

Position of the catheter in the adipose tissue
Analytes:
Glucose
Lactate
Pyruvate
Glycerol
Glutamate
Urea
Catheter locations

- Intracerebral
- Sc arm
- Intracutaneous
- Sc thigh
- M. Pectoralis
- M. brachioradialis
- Sc. abdomen
- Sc. hip
- M. quadriceps femoris
- M. tibiasanterior
- Sc lower limb
Lou Lou rating

- Ease of insertion
  - OK

- Intellectual work
  - High

- Number crunching quotient
  - High
Brain Tissue Oxygen - LICOX
Traumatic Brain Injury
To optimize cerebral blood flow, that is in & out of the head:

Prevent Hypotension
Prevent Hypoxia
Prevent Hypoventilation
LICOX

 Tells you how the injured cells are travelling

Balance between $\text{O}_2$ offered ($\text{O}_2$ content & CBF) & demand (cerebral metabolism)
Catheter

- Pre-calibrated, stable
- Single, double, or triple lumen bolt
- Tunneled
Values

The 30 - 20 - 15 - 10 - 5 Rule

- Normal > 30 mmHg (25 - 50 mmHg)
- Ischemia reported at ranges of less than 8 - 12 mmHg (10)
- Critical $P_{bTo_2} = 5 - 8$ mmHg
Influences on Oxygen....

- Systemic factors of major influence on pbtO2
  - ABP, ICP, paO2, paCO2, pH, temperature
  - Blood Hgb content, viscosity and Hct
  - Medications
ICP / CPP management

- ICP may be normal but pbtO$_2$ ↓

- CPP may be at OK but pbtO$_2$ ↓
ICP / CPP management

CPP at times will need to be much higher than imagined.
Hyperventilation management

- ↓ PaCO₂ lowers ICP but also ↓ pbtO₂

- PaCO₂ results in vasoconstriction & ↓ CBF therefore ↓ O₂
Hyperoxia

- Normal tissue – $\uparrow \text{FiO}_2$ has little effect on $P_b \text{tO}_2$

- Injured brain - $\uparrow \text{FiO}_2$ results in an $\uparrow P_b \text{tO}_2$ (if blood flow present)

C. Robertson et al., 1999
Lou Lou rating

- Ease of insertion
  - same as ICP
- Intellectual work
  - high
- Number crunching quotient
  - high
- Benefit
  - HIGH

Nursing driven intervention
Best Practice Grant for TBI

- Decompressive Craniectomy

- Intensive Neuromonitoring
  - Latrobe University nursing research
Retrievable IVC Filters
Trauma - high-risk

- Virchow’s triad
  - hypercoagulability
  - endothelial damage
  - venous status
- Contraindications to prophylaxis
  - TBI
  - haemorrhage
Premorbid Risk...

- Age
  - 40-60 years relative risk x 2
  - 61-75y x 3
  - >75y x 4
- Obesity x 2
- malignancy x 3
- abnormal coagulation x 2
- history of thrombosis / thromboembolism x 3
Iatrogenic Risk...

- femoral vein lines x 2
- transfusion > 4 units x 2
- operation > 2 hrs x 2
- major venous repair x 3
Injury-related risk

- Twice the risk
  - severe chest injury AIS > 2
  - severe abdomen AIS > 2
  - severe head AIS > 2 / GCS 8 or less

- Three times
  - spinal #

- Four times
  - cord injuries
  - severe lower limb #
  - pelvic #

- multiple system injuries 2x - 4x

Sixth ACCP Consensus Conference Antithrombotic Therapy, Greenfield et al J.Trauma 1997:42,
Agreement 8/4/02 Neurosurgery Intensive Care, The Alfred 8/4/02
Incidence & "high-risk times"

- Velmaunos et al 2000, J Trauma 49:132-8
  - DVT 11.8%
  - PE 1.5%

- O’Malley et al, 1990, J Trauma 30:748-50
  - 2 - 3 % & most < 1 week
DVT prophylaxis...
Prevention of Thromboembolic Complications in Injured Patients

American College of Surgeons
Committee on Trauma
June 1998

Paralysis, Hemorrhage, Shock
Venous Trauma, Fractures
Endothelial Damage
Hypercoagulability
Multiple Transfusions, Severe Injuries
Prevention:

Trauma Patient (*a)

Medical/trauma risk factor(s)?

NO

Contraindication to heparin? (*b)

NO

Compression and/or anticoagulation (*c)

Apply bilateral leg compression devices

NO

Apply bilateral foot pumps

YES

Lower extremity fractures?

NO

Multiple risk factors?

NO

Apply bilateral leg compression devices

YES

Consider serial CFD (*d) scans or vena cava filter if risk period is prolonged

*a. General indications for trauma patients over the age of 18 years. Although children are generally considered at low risk for thromboembolic complications, older teens with paraplegia should also be considered candidates for prophylaxis.

*b. The current contraindications to anticoagulation after trauma include head injury with intracranial hematomata; unstable spinal cord injuries; uncontrolled coagulopathy; ongoing hemorrhage; known heparin allergy; or the use of an epidural catheter for analgesia or anesthetics.
The Alfred experience with retrievable IVC filters

- July 1 2002 - March 30 2003

- 21 pts
  - M 14 : F 7
  - Av age 45.5 yrs (16-82)
  - Av ISS 27.3 (9-59)
Risk factors (Mean 2.5 per pt)

- Long bone # 17
- Prolonged sedation 15
- Spine # +/- cord injury 10
- Pelvic # 10
- Hx of DVT 1
Deployment of IVC filter

- Venous approach
  - 16 R femoral
  - 3 L femoral
  - 2 R internal jugular

- Av time to insertion
  - 77.8 hours (22-288)
Retrieval

- 20 / 21
  - 1 failed at another hospital (day 20)

- Retrieved
  - day 1 - 191 days (av 36.4 days)

- No complications
  - No PE
In summary

- Nurses role
  - remind
  - administer
  - monitor
Nursing
Nurses....

- The greatest pt interface
- Monitoring
- Interventions
The Trauma Nurse Leader

- Innovation in Trauma Centre
- 89 E.F.T staff – 10% TNL
Why?

- High volume
- High acuity
- High staff turn over
- High number of junior staff
What

- Command & control
- Operational
  - Including patient disposition
- Orientation
- Continuing professional development
  - research
  - education
  - QA
  - clinical service delivery
Operational controller

- Dedicated 4 trauma bay, Trauma Centre
- Helipad
- >1000 trauma callouts annually
  - frequently > 1 trauma call
Operational controller

- Coordinating movement of pts through trauma centre
- Appropriate resource utilisation / allocation
- Liaison with OR, Blood Bank, Radiology
Role delineation

Trauma Leader - medico

- Trauma Nurse Leader
- Medical staff
  - Airway Nurse
  - Circulation Nurse
  - Documentation Nurse
Specific responsibilities

- Acts as Team Leader for helipad Response Team
  - conducts safety checks
  - identifies hazards
  - compliance

- Crash
  - scene controller until MFB arrives
Selection Criteria

- Critical Care qualified
- Extensive ED experience
- Leaders
- Communication skills
- Make the team work
Ongoing requirements

- Annual certification
  - helipad
    - hot unloads
- ACLS
- Continuing professional development
Lou Lou rating

- Appropriate role recognition
- Career path
- Develops trauma nursing
- Exciting
- Travelling scholarships
- Research & best practice
- Victorian Clinical Nursing Consortium
  - ED
  - Ward
  - OR
Trauma Systems
Trauma Systems Save Lives

- Matching health resources with patient needs
Victoria - leader in road safety

- 1970 - World first
  - mandatory 3 point restraint front & rear seat passengers in cars
- 1974 - Australian first
  - random breath testing
- 1980’s - Australian first
  - speed cameras & red-light cameras
- 1990 - Australian first
  - compulsory bicycle helmets
Preventable major trauma deaths

- Trauma centre 20%
  - (The Alfred 11-15%)
- Metropolitan 41%
- Large regional 53%
- Small regional 62%

J Trauma 1998
Victorian Response to a 30% Avoidable Mortality

If you have an accident you should be treated in the best setting
Goals of the VSTS

- To deliver the right patient to the right hospital in the shortest amount of time
- To best match state resources with patient needs’ ensuring the delivery of optimal care
The goal of the Victorian Trauma System

The central message of the ROTES report is:

“The right patient to the right hospital in the shortest time”

International research has demonstrated that the outcome of major trauma patients is improved when they receive definitive treatment at a Major Trauma Service
Victoria, geographically ideal for a Trauma System

98% live < 150 km from CBD
## Transfer Appropriateness Payment

<table>
<thead>
<tr>
<th>Category</th>
<th>Transfers</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan</td>
<td>66</td>
<td>$132,000.00</td>
</tr>
<tr>
<td>Regional</td>
<td>50</td>
<td>$150,000.00</td>
</tr>
<tr>
<td>Total</td>
<td>256</td>
<td>$512,000.00</td>
</tr>
</tbody>
</table>

82% of major trauma cases are treated in a MTS (VSTR, 01-02 annual report) from 49% 2001 (Aug 2001 DHS, Vic)
Major Trauma Advice & Referral Line ~ 1800 700 001

- Regardless of the transfer or destination
- For time critical cases
Trauma Line

An immediate Vital Link with the MTS
1800 700 001

Trauma Advice & Referral Line

Caller dials number

Put through to “Victorian Major Trauma Advice & Referral Line”

Press 1 for The Alfred
Press 2 for RMH
Press 3 for RCH

Call immediately transferred to Alfred ED

Call answered by Duty Trauma Centre Physician

Simultaneous calls will be routed to 1800ALFRED system
The future
SICKBAY

Source: ST:M

The Doctor's main office is a control room that has windows on each side to overlook the main sickbay areas.

The primary biobed can generate a shield field around itself. A force field can also be applied to this area to quarantine the patient.

The sickbay has biphase beds that provide a wide variety of sensor readings. Each has a clamshell device which makes the operating area a sterile theatre, and overhead display.

Holographic Room

Scanners are placed in strategic positions around sickbay, allowing the EMH to function.
Emergency Medical Hologram

“Please state the nature of the medical emergency....”
What would I like to see...

- Best matching of needs with resources
- Non-invasive monitoring
- Drug to treat TBI
- Levitation device !!!
Additional Slides....
Thank you...
Temperature regulation

- $1^\circ C = 6.7\%$ change in metabolism
- Brain temperature
  - $0.5 - 1^\circ C >$ core & jugular,
  - $0.3 - 1.9^\circ C >$ bladder,
  - $0.1 - 2^\circ C >$ rectal
- Deep white matter $0.5 - 1^\circ C >$ cortical
- Injured brain temperature $1 - 4^\circ C >$ core
- Greater difference with temperatures $>38^\circ C$

Kurth, Anesth, 2000
Brain temperature is dependent on

- Rate of local CBF
- Level of arterial temperature
- Age? Skull & scalp density
Effect of alterations in CBF

- CBF 50 - 20 ml/100Gm - brain temperature > rectal & core
- CBF < 20 ml/100Gm
  - brain temperature decreases 0.5-0.9°C/hr

Rumana et al 1998
Values

Local brain oxygen levels, may not reflect what is happening in surrounding tissues