Sustained Low Efficient Dialysis

A New Look at Renal Replacement Therapy

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ICU The Ottawa Hospital
Background

- The Ottawa Hospital has recently transitioned to SLED as the renal replacement therapy of choice for critically ill patients.
- The move was endorsed by nephrologists, intensivists and senior leaders.
- Protocols were developed, roles established and responsibilities outlined.
- The goal of this presentation is to illustrate that process.
Consider

• 75 yr old post op patient who has had pre op contrast, intraop hypovolemia and supra renal aortic cross clamp...third POD acidotic, edematous, anuric with creatinine 345.

• 55yr to ER by EMS, not seen for two days and found in pool of diarrhea, ph 6.8, pCO2 13, HCO3 3, NA 130, k 6.6 and Creatinine 1929

• 33yr old sepsis from pylonephritis who presents with Creat 300, urea 30, HCO3 9 and ph 7.12
Acute Kidney Injury

• AKI is a common complication of critical illness with as many as 50% of the critically ill developing some stage of injury.
• Defined as the reduction in or loss of the ability of the kidneys to excrete waste, balance acid base and fluids and to stabilize electrolytes
• Much debate about the best definition
Impact

• Results in:
  increased morbidity and mortality
  use of considerable health care resources
  overall increased health care burden
Causes

- Multifactoral
  - 45-70% related to sepsis
  - post surgical hypovolemia
  - drug induced toxicity
Treatment

• Renal Replacement Therapy
  - should not be delayed
  - required in 5% of our patients
  - to correct metabolic derangements
  - reduce fluid overload
  - allow for the administration of necessary fluids and nutrition
Choices???

- Number of renal replacement therapies include continuous and intermittent
- Choice depends on availability, expertise, hemodynamic stability and reason for therapy
Choices

• Continuous renal replacement therapies have advantages over conventional intermittent dialysis with:
  - improved cardiovascular stability
  - improved tolerance to ultrafiltration allowing removal of obligatory fluid loads
  - ability to maintain solute control especially in the catabolic patient
Choices

CRRT

- CAVH originally developed as an AV technique depended on BP and dual access
- 1980’s evolved to CVVH then CVVHD using blood pump with single access using volumetric pumps to control affluent and effluent fluids
- refinement of pump systems for CVVHDF 1986 to present
Advantages:
- slow volume control with CV stability and good solute control

Disadvantages:
- costly and complex
- frequent interruptions
- continuous anticoagulation
- nursing workload
IHD

Advantages:
- greater volume removal in shorter period

Disadvantages:
- high UF not tolerated
- periodic solute and fluid control problematic
SLED

Advantages:
- slow fluid removal with solute control
- cost efficient with decreased workload

Disadvantages:
- plumbing
- maintenance
What is SLED?
Sustained Low-Efficiency Dialysis
Hybrid between CRRT and IHD

- low UF rates for HD stability
- low efficient solute removal for less imbalance
- longer and intermittent treatment times
- uses conventional HD machine and dialyzers
- 8-12 hrs per day, 5–7 days a week
What does the Research say?

- Bellmo et al, 1993 looked at greater than 20 retrospective studies comparing the impact of CRRT and IHD on patient outcomes. Neither showed superiority in renal recovery or outcomes.

- Marshall et al, 2004 concluded that SLED was a viable alternative to CRRT.
Research

- Feighen et al 2010 found that SLED had comparable hemodynamic control to CRRT in the critically ill.
- Kumar et al in 2000 compared 42 patients, 25 with SLED and 17 with CVVH found that SLED was well tolerated, offer the same benefits as CRRT and was technically easier.
Why SLED?

- cost – city water
- complexity and nursing workload
- safety- additives, anticoagulation
- flexibility
- patient rehab
What about the cost?

**CRRT**
- Filter & circuit $235.00
- Solutions bags $28.00 (10 bags per day)
- More expensive for Citrate anticoagulation
- Cost over $1000.00 per day
- Includes RN labour

**SLED**
- Filter $13.00-$20.00
- Tubing $10.00
- Drugs & Solutions $45.00
- Cost about $300.00 per day
- Includes RN labour
<table>
<thead>
<tr>
<th></th>
<th>CRRT</th>
<th>SLED</th>
<th>IHD</th>
</tr>
</thead>
<tbody>
<tr>
<td># Treatment week</td>
<td>7 days</td>
<td>5-6 days</td>
<td>3-5 sessions</td>
</tr>
<tr>
<td># Hours/day</td>
<td>24hrs</td>
<td>8-12 hrs</td>
<td>4 hrs</td>
</tr>
<tr>
<td>Blood Flow (ml/min)</td>
<td>100-200</td>
<td>200-300</td>
<td>350 to 400</td>
</tr>
<tr>
<td>Dialysate Flow (ml/min)</td>
<td>20-30</td>
<td>300-350</td>
<td>500 to 800</td>
</tr>
<tr>
<td>Anticoagulation</td>
<td>Heparin or Citrate</td>
<td>Heparin or Nothing</td>
<td>Heparin or Nothing</td>
</tr>
<tr>
<td>Hemodynamic Stability</td>
<td>++</td>
<td>+/-</td>
<td>--</td>
</tr>
<tr>
<td>MD ordering</td>
<td>Nephrologists Intensivist Consult</td>
<td>Nephrologist Intensivist Consult</td>
<td>Nephrologist</td>
</tr>
</tbody>
</table>
SLED at TOH

- Fall 2010 the ICU group approached by Nephrology team interested in pursuing SLED as an option to CRRT in the ICU
- Meetings in Spring 2011 to plan a pilot project for the Civic Campus
- Site visit at UHN
Demographics
Civic campus

- 33 bed ICU with 28 beds operational
- Trauma, Neurology, Neurosurgery, Vascular Gen Surg and Medicine
- Approximately 180 nurses, full and part time
- Fiscal year April 2010 to March 2011
  CRRT days 566, average 40 days month
Average occupancy > 90%
Demographics

General campus

• 32 beds with 27 operational
• Oncology, thoracics and med surg
• Approximately 160 nurses full and part-time
• Same time frame 367 CRRT days
SLED Pilot/Trial

- plan for 3 to 6 month trial with nocturnal treatments Monday to Friday as per HD availability
- pre printed physician orders developed
- equipment: 2 HD machines + RO units on loan to ICU for duration of trial
- shared project between HD and ICU nurses
- Patient criteria included those on only one pressor or less.
- CRRT still available
## Model of Delivery

<table>
<thead>
<tr>
<th>Hemo Nurse</th>
<th>ICU Nurse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine set-up</td>
<td>Review orders &amp; calculate goal with hemo</td>
</tr>
<tr>
<td>Review orders &amp; calculate goal with ICU</td>
<td>Intradialytic treatment management</td>
</tr>
<tr>
<td>Mix dialysate additives</td>
<td>-documentation/monitoring</td>
</tr>
<tr>
<td>Program the machine</td>
<td>-NS Fluid boluses PRN</td>
</tr>
<tr>
<td>Initiate treatment</td>
<td>Basic alarm management</td>
</tr>
<tr>
<td>Document start treatment notes</td>
<td>End of treatment</td>
</tr>
<tr>
<td></td>
<td>-document end of treatment notes on HD flow sheet</td>
</tr>
<tr>
<td></td>
<td>Call hemo unit for advanced troubleshooting (e.g. clotted circuit, blood leak)</td>
</tr>
</tbody>
</table>
SLED - SUSTAINED LOW EFFICIENCY DIALYSIS - DIALYSE SOUTENUE À FAIBLE EFFICACITÉ

NB: Please write a new order sheet after making any change in orders.

| Schedule: Daily | Dialyzer (Filter): F40S OR None |
| Duration: 8 hours OR ___ hours (shorter time) | Blood Flow (QB): 200 mL/min OR ___ mL/min (higher flow) |
| Dialysate Flow (QD): 300 mL/min OR ___ mL/min (higher flow) | Temperature: 35.5°C OR ___ °C (higher temperature) |
| Fluid Removal Goal: ___ L per session | **HYPOTENSION MANAGEMENT** |

- Use inotropes, pressors and IV fluids as per ICU orders.
- Stop ultrafiltrate (UF) rate for 10 minutes and reassess.

**DIALYSATE COMPOSITION**

| Na: ___ mmol/L OR ___ mmol/L | K: 4 mmol/L OR 3 mmol/L OR ___ mmol/L |
| Ca: 1.25 mmol/L ON OR 1 mmol/L ON OR 1.5 mmol/L ON OR 1.75 mmol/L | Bicarbonate: 30 mmol/L OR ___ mmol/L |
| P04: None OR ___ mL of Fleet enema (usually 150 mL of monobasic and dibasic sodium phosphate) |

NB: for every 30 mL of Fleet enema added, the dialysate phosphate concentration increases by 0.2 mmol/L.
HEPARIN ANTICOAGULATION VIA ARTIS SYRINGE PUMP

☐ Heparin regular: 1000 units bolus followed by 1000 units/hr infusion

OR  ☐ Heparin low dose: 500 units bolus followed by 500 units/hr infusion

OR  ☐ Heparin other regimen: _______ units bolus followed by _______ units/hr infusion

OR  ☐ No Heparin; use normal saline flushes as per ICU

Note: To prepare heparin syringe, withdraw 10,000 units (10 mL) of Heparin (1000 units/mL) in a 10 mL BD syringe. This will give a final concentration of 1000 units/mL.

BLOOD TESTS

- Twice daily: before initiating SLED and Post-SLED (NB: collect blood a minimum of 2 hours after last SLED session to minimize rebound)

☐ Urea, creatinine, glucose, Na, K, Cl, tCO2, Ca, PO4, Mg

☐ Other: ____________________________

<table>
<thead>
<tr>
<th>Date (yyyy/mm/dd)</th>
<th>Time-Heure</th>
<th>Physician/Médecin (prénom et lettres initalisées)</th>
<th>Signature</th>
</tr>
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<tbody>
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<td>Note (noted-notice)</td>
<td>Time-Heure</td>
<td>Processé par</td>
<td>Signature (Infirmière)</td>
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SPO 500 (10/2012) 1-CHART-DOSSIER 2-PHARMACY-PHARMACIE
Training of staff (ICU)

- Core Group of ICU nurse (40 nurses)
- 8 hr training sessions (8 to 10 nurses/session)
- training done by company Educator
- trained: troubleshooting, discontinuing, disinfection, NS flushes
- support from HD nurses at the bedside
Evaluation
ICU Nurse

- Nurse comfort with treatments
- Less interventions than CRRT
- Support from HD
- Patient comforts ie activities and sleep
- 50% had increased comfort
- 74% less interventions if Heparin
- 95% were wells supported
- 6/8 patients had interrupted sleep
Evaluation Process HD

- time spent in ICU (on procedure troubleshooting bedside support)
- time spent on the phone for support

- 47% felt comfortable leaving the ICU nurse
- 66% felt they offered good support
- 69.5 hrs / 344 hrs treatment spent assisting
Evaluation process-Nephrologist

- whether patients could last the weekend (66hrs) without dialysis
- the relationship between pressor use and ultrafiltration goals
- transitioning patterns between CRRT, SLED and HD

- 2 patients transitioned to CRRT for the weekend
- pressors added or increased in 16/43 treatments
- 62% patients CRRT to SLED to HD
Results

• Pilot October 2011 to March 2012
• Eight patients eligible, 7 AKI and 1 CRD
• Total of 43 sessions Monday to Friday
• RN felt more exposure and training needed
• Any increase in workload was usual line issues or frequent flushes when no Heparin
Challenges

- Machine conversion
- Scheduling issues
- CVC line issues
- ICU physician staff buy-in
- Use of SLED pre-printed order sheet
- UF calculation
- Night to day treatment
- Storage of equipment & disinfection
After the Pilot

• Team meeting to review evaluation results
• Budget review by senior members
• Plan to move forward with full implementation corporately
• Three machines and three RO machines purchased per campus
• CRRT machines aging at this time
Moving Forward from Pilot

• September 2012- training at Civic site
• October- training at General site
• Go live date: Civic October, General November
• Full transition January 2013 at Civic May 2013 at General
New Model

- SLED Treatments 24/7
- timing patient specific
- Nephrology consult service
- ICU nurse start to finish
- partnership with HD for ongoing maintenance of machines and tech support
- Sharing of information with the educators
Challenges

• CVAD as with CRRT, new line trial
• heparin free patients
• earthquake in Italy
• Staff education on RO as well as Dialysis machine
• Ongoing maintenance and storage of idle equipment
References


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• Sharon Slivar RN Educator ICU General Campus
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