A Retrospective Review of Two Years of Admissions to a Tertiary Intensive Care Unit for patients with a primary diagnosis of Burns.

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Who do we Treat?
- Epidemiology of our burns
- Admission demographics which might help predict outcome
- Analgesia
- Microbiology and screening
Admission Demographics

- Ninety-four admissions 2015/2016 (1 excluded on review of notes)
- Sex
  - Male 64 (70%)
    - 16 Deliberate self harm
    - 21 recreational substance use
  - Female 27 (30%)
    - 10 Deliberate self harm,
    - 1 forensic
    - 7 recreational drug use as a confounder
- Age Range 17-85 yrs (Median 43.65 Yrs)
- IHT or Direct – 41 Direct and 52 IHT (1 or 2 centres) – no statistical difference in mortality
- Recreational Drug use reported on admission – Yes 35.8% No 53 (64.2%)
- Primary Cause - Accidental 64 (70%)  Deliberate Self Harm 26 (28.5%)  Forensic 1 (1.5%)
- LOS 1-78 days (median 11 days)
Mechanism of Burn by Age

- Electrocution
- Flash
- Accelerant
- Self Immolation
- Fire
- Blast/flame

Age (years):
- 11-20
- 21-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71-80
- >80

Number of Patients

- 0
- 2
- 4
- 6
- 8

Age (years) vs. Number of Patients
Gender and Age at time of Admission

Age (years)

<table>
<thead>
<tr>
<th>Age Range</th>
<th>% TBSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-30</td>
<td>31-40</td>
</tr>
<tr>
<td>41-50</td>
<td>51-60</td>
</tr>
<tr>
<td>61-70</td>
<td>71-80</td>
</tr>
<tr>
<td>&gt;80</td>
<td></td>
</tr>
</tbody>
</table>

Female

Male
TBSA with Gender for all Mechanisms of Burn

Difference between total body surface area (TBSA) between genders for all mechanisms of burn (p=0.0162)
Associated Inhalation injuries or Facial Burns

- Inhalation Injury - Yes 78 (86%)
- Facial Burns - Yes 77 (85%)
Mortality

- 17 deaths in total
  - Gender (not statistically significant)
    - 7 females 10 males
  - Intention – 7 DSH, 9 accidental, 1 forensic
  - Illicit Drugs 6 (35%)
  - Age – 100% mortality if age > 80yrs
  - TBSA - 84% Mortality if TBSA >80%
- Resuscitation
  - If Parklands Resus 10-20L 25% mortality
  - If >20L 50% mortality
  - No correlation between vasopressors and mortality
- Modified Beaux Score
  - 9 score <140, 8 score >140
  - Not predictive of mortality in this cohort
- Biochemistry
  - pH and Temp strongly associated with mortality but not
  - Lactate
Deaths by % TBSA

- >80%: 5 deaths, 3 patients
- 60-80%: 6 deaths, 7 patients
- 40-60%: 1 death, 15 patients
- 20-40%: 1 death, 21 patients
- <20%: 0 deaths, 30 patients

Legend:
- Green: Death
- Blue: Number of patients
Age on Admission and Mortality

- <20 yrs
- 20-30yr
- 30-40
- 40-50
- 50-60
- 60-70
- 70-80
- >80

Number of Admissions

Deaths
% Parklands resuscitation per Mechanism

Mechanism of Injury

Electrocution
Flash
Accelerant
Self Immolation
Fire
Blast/flame

% Parklands

-400 -300 -200 -100 0 100 200 300 400 500 600 700 800 900 1000
Fluids

- 41 (48%) patients did not have accurately recorded fluid balances prior to ICU admission
- 68 pts (73%) with fluids recorded had more than their calculated parklands in the first 24 hours of resuscitation.
- Lack of good data on actual BW and height. Likely underestimated
- If your Parkland Calculation was
  - >15L -20L – 25% mortality
  - >20L- >50% mortality rate
  - >30L 50% mortality. 1 patient had 46,200mls and survived!
- Multiple fluids used in Resus
  - Crystalloids – Hartmanns/N saline
  - Colloids – 4% albumin, 20% albumin, PRC and other Blood products
  - Significant variation between clinicians in their fluid of preference
- Mortality
  - 10 Pts more than their estimated Parklands
  - 6 Pts less
Vasopressors

• No statistical significance between use or number of vasopressors and mortality
  • 43 patients fluid resuscitation only
  • 40 patients single agent 38 NA – metaraminol 2
  • 2 patients dual agent NA/A or NA/V
  • 1 patient triple NA/A/V
• No association between number of sedatives in regimen and requirement for pressors/tropes
Haematology and Biochemistry on Admission to ICU

• HB range 70-215 (no statistical relationship to mortality)
• pH 6.81 - 7.56
  • 15/17 deaths had acidaemia pH <7.35 (statistical relationship to mortality)
  • No deaths in patients with alkalaemia or pH >7.4
• Temperature
  • <35 degrees Celsius on admission to ICU 7/12 patients died
  • <36 degrees 10/26 patients died
  • Normothermia 36-37.9 3/57 died
  • >38 2/9 died
Figure shows an identified association between body temperature and outcome, indicating with decreasing temperature from normothermic, a proportion of deceased patients increases linearly ($r^2=0.97$)

Analysis of pH on admission shows a linear trend ($r^2=0.9851$) with the proportion of patients with positive outcomes (discharge) decreasing with the rise in serum pH
### Sedation

- 14 different regimens used for sedation in 89 patients

<table>
<thead>
<tr>
<th>Sedation Agent</th>
<th>Number patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>4</td>
</tr>
<tr>
<td>clonidine</td>
<td>2</td>
</tr>
<tr>
<td>morphine</td>
<td>1</td>
</tr>
<tr>
<td>propofol</td>
<td>1</td>
</tr>
<tr>
<td>fentanyl/propofol</td>
<td>12</td>
</tr>
<tr>
<td>morphine/midazolam</td>
<td>29</td>
</tr>
<tr>
<td>fentanyl/midazolam</td>
<td>12</td>
</tr>
<tr>
<td>morphine/midazolam/propofol</td>
<td>6</td>
</tr>
<tr>
<td>fentanyl/midazolam/morphine</td>
<td>6</td>
</tr>
<tr>
<td>fentanyl/morphine/propofol</td>
<td>1</td>
</tr>
<tr>
<td>fentanyl/midazolam/propofol</td>
<td>5</td>
</tr>
<tr>
<td>midazolam/morphine/ketamine</td>
<td>1</td>
</tr>
<tr>
<td>fentanyl/midazolam/ketamine</td>
<td>1</td>
</tr>
<tr>
<td>fentanyl/morphine/midazolam/propofol</td>
<td>2</td>
</tr>
<tr>
<td>fentanyl/midazolam/morphine/ketamine/propofol</td>
<td>3</td>
</tr>
</tbody>
</table>
Analgesic Doses for First v Second Debridement/Grafting Operations per patient

- A1: 240 mins
- A2: 200 mins
- B1: 180 mins
- B2: 380 mins
- C1: 260 mins
- C2: 190 mins
- D1: 370 mins
- D2: 250 mins

Colors:
- Blue: Fentanyl
- Orange: Morphine
- Gray: Ketamine
Comparison Intraoperative analgesia

Total Dose per operation

Dose mg/min per operation

p=0.0326

p=0.0085
Discharge Analgesia by Gender

No statistical significance of TBSA to Discharge Dose
Mean dose Males 24.3mg v Females 21.1mg
Discharge Analgesia – Previous Recreational drug use.

No Statistical Significance between previous drug users and non users in opiate prescribing 23.4mg v 21.4mg
Neuropathic Agents on Discharge

P value 0.024 male more likely to get some than none
P value 0.065 males get a greater dose of Lyrica
MRO screening for Burns Patients

• Currently all patients are screened on admission
• They are then screened routinely every Monday and Thursday.
• Each set of screening test costs $60.75
  • on top of any septic screening
• All burns patients are barrier nursed in single rooms – delivery of care is not affected by screening results
• Our unit has a nurse initiated system.
• 2010 Prevention and control if infection in healthcare (currently under review)
• ACSQHC in collaboration with the Introduction of National Guidelines for Surveillance – on admission and twice weekly
Number of Screening Tests per patient in RBH

- 401 tests performed in 93 patients
  - Number of new positive tests 2.5% (13 tests – 3 already known to be colonized)
- Mean number of tests per patient 4.35
- Frequency of testing 2.7 days
- Cost per test $60.17
- Total cost for the burns patients
  - $24,128 2 years,
  - $12,064/year
- Review of data
  - Some patients had 2 sets of swabs in a day
  - One patient 4 rectal VRE swabs in 3 days
  - V poor compliance with unit protocol
  - Long stay patients fell off the pathway, short stay patients had multiple screens
Microbiology

- 36 organisms

**Gram +ve Cocci**
- Staph Aureus MSSA
- Staph Aureus MRSA
- Staph Cromogenes
- Staph Epidermidis
- Staph Lugdenesis

**Gram –ve Cocci**
- Moraxella Catarrhalis

**Gram +ve Bacilli**
- Strep Pneumoniae
- Strep Salivarius
- Strep sanguinus
- Strep mitis
- Corynebacterium
- Egglethera Lenta
- Propionobacterium acnes
- Enterobacter aerogenes

**Gram -ve Bacilli**
- Klebsiella Oxytoca
- Klebsiella Pneumoniae
- Pseudomonas Aeruginosa
- Pseudomonas chloraraphis
- Pseudomonas putida
- Bacteroides stercolis
- Bacteroides thetaiotaomicron
- Bacteroides fragilis
- Enterobacter Cloaceae
- Aeromonas hydrophilia
- Serratia mascarens
- Hafnia Alvei
- Acinetobacter Baumannii
- E coli
- Citroebacter Freundii
- Coliforms
- Enterobacter Aerogenes
- Curvularia species
- Fusobacterium Necrophorum
### Incidence and location

<table>
<thead>
<tr>
<th>Organism</th>
<th>Sputum</th>
<th>Blood</th>
<th>Urine</th>
<th>Wound</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staph aureus MSSA</td>
<td>31</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>37</td>
</tr>
<tr>
<td>Klebsiella Pneumoniae</td>
<td>12</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Acinetobacter Baumannii</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Pseudomonas Aerogenes</td>
<td>12</td>
<td>4</td>
<td>1</td>
<td></td>
<td>17</td>
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<tr>
<td>H influenza</td>
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<td>15</td>
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<td>Enterobacter Cloacae</td>
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<td>5</td>
<td></td>
<td>2</td>
<td>14</td>
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<tr>
<td>Strep pneumoniae</td>
<td>7</td>
<td></td>
<td>1</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Serratia Mascarens</td>
<td>2</td>
<td>2</td>
<td></td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>E coli</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Proteus Mirabilis</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Moraxella catarrhalis</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

All the rest had 1 positive test
Microbiology

• Respiratory tract infections
  • R/F for Resp infections include
    • Early endotracheal intubation *only controllable variable*
      • Unnecessary intubation may increase morbidity and mortality
      • Predictor of early onset Pneumonia – portal for contamination
      • Most patients had a gram negative on their admission ET aspirate
    • Inhalation injury
      • Associated with higher rates of pneumonia
      • The more severe the inhalation injury the higher the risk
  • lCan prolong intubation/ventilation and ICU LOS
Number of Organisms by Site per patient

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Sputum</th>
<th>Blood</th>
<th>Urine</th>
<th>Wound</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Organism</td>
<td>70</td>
<td>71</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>1 Organism</td>
<td>28</td>
<td>11</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>2 Organisms</td>
<td>14</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3 Organisms</td>
<td>12</td>
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<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4 Organisms</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5 Organisms</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6 Organisms</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ESKAPE organisms

- Acinetobacter Baumannii (new species)
  - “Irakibacter”, homeless
  - “red alert” pathogen
  - 1 identified in PRC
- Targets moist tissues
  - MM
  - Skin
  - Initially “peau d’orange”
  - Later sandpaper
  - Vesicular
  - Hemorrhagic bullae
- Co pathogens
  - Klebsiella
  - Candida
  - Enterococcus faecalis
- Highest colonization
  - Axilla, groin and toe webs
- ICU increased risk
  - Intubation, dialysis, lines, antimicrobials
  - Biofilms on ET tubes and abiotic surfaces- glass

- Klebsiella pneumoniae
- MRSA
- Pseudomonas aeruginosa
- E coli

MRO by Site

- Sputum
- Blood
- Urine
- wound
- MRO
- E coli
<table>
<thead>
<tr>
<th>Discharge Antibiotics</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>53</td>
</tr>
<tr>
<td>Cipro/gent/tobramycin/vanc/piptaz/fluconazole</td>
<td>1</td>
</tr>
<tr>
<td>ceftriaxone</td>
<td>1</td>
</tr>
<tr>
<td>cefepime/vancomycin/gentamycin</td>
<td>1</td>
</tr>
<tr>
<td>Meropenem</td>
<td>1</td>
</tr>
<tr>
<td>cephazolin</td>
<td>1</td>
</tr>
<tr>
<td>ciprofloxacin/tobramycin/meropenem/piptaz</td>
<td>1</td>
</tr>
<tr>
<td>piptaz/vancomycin</td>
<td>2</td>
</tr>
<tr>
<td>ceftriaxone/vancomycin</td>
<td>1</td>
</tr>
<tr>
<td>flucloxacillin/ceftriaxone/piptaz</td>
<td>1</td>
</tr>
<tr>
<td>piperacillin/tazobactrim</td>
<td>1</td>
</tr>
<tr>
<td>fluconazole/piptaz</td>
<td>1</td>
</tr>
<tr>
<td>piptaz/lincomycin/vancomycin</td>
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</tr>
<tr>
<td>fluconazole/piptaz/ceftriaxone</td>
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</tr>
<tr>
<td>flucloxacillin/piptaz</td>
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<tr>
<td>Ciprofloxacin</td>
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</tr>
<tr>
<td>Amikacin</td>
<td>1</td>
</tr>
<tr>
<td>Tigecycline/meropenem</td>
<td>1</td>
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<tr>
<td>lincomycin</td>
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</tr>
<tr>
<td>lincomycin/piptaz</td>
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</tr>
<tr>
<td>piptaz, cipro, moxifloxacin, vanc</td>
<td>1</td>
</tr>
<tr>
<td>colistin, tigecycline, flucloxacillin</td>
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</tr>
</tbody>
</table>
In summary

• What are we doing well?
  • Survival rates – Only 7 patients died having active treatment.
  • LOS – Relatively short LOS
  • Retrieval. IHT have the same mortality as the direct admissions.

• What can we do better?
  • Standardization of analgesia, fluids, blood products, nutrition
  • Documentation of fluid resuscitation on admission

• Plan from here
  • Extend the audit to 5 years – low death rate meant it was hard to demonstrate statistical significance despite trends.
  • Present in our QI group and review our practice as a unit
  • Identify areas of further potential research