

Management of Carbapenem Resistant Organisms in a Major Burn Centre

F Lin¹, R Jayakar¹, R Wong She¹

1 National Burns Centre, Middlemore Hospital, Counties Manukau District Health Board, New Zealand

Email: bobby.fangbo.lin@gmail.com

Introduction

Multi-resistant organisms (MRO) pose a major challenge to burn care around the world. The recent rise of carbapenem resistant organisms (CRO) represents the latest challenge. At the National Burn Centre (NBC) of New Zealand there have been no episodes of cross-contamination of MRO in the 11 years prior to 2017 with strict infection control measures and physical environmental design. Nevertheless in 2017 there was an episode of cross-contamination of a CRO across three patients forcing closure of the National Service and an urgent review of how these patients needed to be managed differently. These changes along with their effectiveness are reviewed along with any potential risk factors (and this is becoming increasingly relevant given the increased presence of CRO in the community).

Aim

- To document the prevalence of patients with CRO treated in the NBC, to identify any possible risk factors.
- To measure the effectiveness of management changes in containing CRO infections (i.e. minimising cross contamination).

Method

Design

Retrospective review over a 13 year period (June 2006 to June 2019) in Middlemore Hospital, New Zealand.

Patient Selection

CRO positive microbiology samples isolated from any source in patients under the care of the National Burns Service in the NBC or the Intensive Care Unit (ICU).

Results

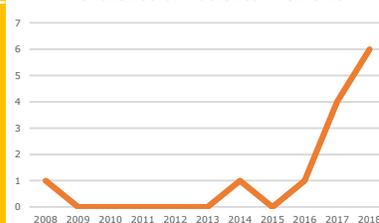
13 patients were isolated with CRO, listed chronologically in table below.

Age 33 years (median)
7-67 years (range)

Gender Male 46%
Female 54%

Locality Local 38.5%
National 23%
Overseas 38.5%

Prevalence of Patients with CRO



Cross-Contamination Events

- First event occurred in the an outbreak in late 2017. Involved patients are highlighted below. There have been no events prior.
- Index patient no. 6 was colonised with three CRO organisms on admission. All were carbapenem resistant Enterobacteriaceae (CPE) with New Delhi metallo-beta-lactamase 1 (NDM-1). Patients 7 and 8 were isolated with NDM-1 expressing CPEs 6 and 17 days after their admissions respectively while both testing negative on admission CRO screening.
- To date, there have been no further events of cross-contamination.

Minimising Cross-Contamination

- NBC closed to new critical burns admissions, with contingency plans set up for regional burns centres
- All overseas patients precautionarily treated as CRO positive until screening negative
- Staff education regarding CRO and CPE
- Multi-resistant organism (MRO) protocol reinforced: appropriate use of personal protective equipment (PPE), hand hygiene (HH), cleaning of multi-use equipment and personal devices
- Bioquell (Andover, UK) hydrogen peroxide vapour decontamination of operating room (OR) and rooms in ICU/NBC
- Widespread environmental screening in OR, ICU, & NBC before and after Bioquell decontamination
- Negative pressure room use for burn patients in ICU and the NBC

- "Open wound events" restricted to one OR only cessation of dressing changes in ICU
- CRO positive or suspected CRO patients were placed at the end of operating lists to allow for decontamination after
- All unnecessary equipment removed and limited consumables allowed in the OR
- Disposal of equipment that cannot be appropriately decontaminated, e.g. pillows
- PPE optimised in theatre to include N95 masks and footwear covers along with sterile gowns
- Advised to change scrubs ± shower after operating on CRO cases
- Minimised CPE patient transfers and precautions set up to improve theatre flow processes
- Two anaesthetic teams for CRO cases with a using a clean and contaminated team

Patient		Locality	Treatment Locations			Burn		1 st CRO Isolate			Notes		
No.	Age Sex		Overseas	Other NZ Hospital	ICU	NBC	Burn Size	MOI	Days from Admission	Ward Location	Organisms	Isolate Location	
1	21F	French Polynesia	Y (3 days)	-	Y	Y	45%	Flame	7	ICU	Acinetobacter baumannii	Tracheal aspirate 1 st , then multiple wound tissues	-
2	8F	Fiji	Y (10 days)	-	Y	Y	55%	Flame	1	ICU	Acinetobacter baumannii	Multiple wound tissue isolates	-
3	47M	Local	-	-	Y	-	35%	Flame	15	ICU	Enterobacter aerogenes	Tracheal aspirate only	Death secondary to respiratory causes. Day 29.
4	32F	Nelson	-	Y (21 days) Nelson Hutt	-	Y	27%	Flame	34	NBC	Pseudomonas aeruginosa	Single wound tissue isolate	-
5	48M	Gisborne	-	Y (<1 day) Gisborne	Y	Y	70%	Flame	73	NBC	Pseudomonas aeruginosa	Multiple wound tissue isolates	-
6	67M	French Polynesia	Y (5 days)	-	Y	Y	85%	Flash	0 (admission screening)	ICU	Escherichia coli Klebsiella pneumoniae Providencia stuartii	1 st on rectal screening, then profusely over wounds, blood cultures and tracheal aspirates	Index patient in CPE outbreak.
7	58F	Whakatane	-	Y (4 days) Whakatane Waikato	Y	Y	45%	Flame	6	ICU	Escherichia coli Klebsiella pneumoniae Providencia stuartii Enterobacter cloacae	Blood cultures and wounds. Despite negative on admission screening.	1 st patient contaminated in CPE outbreak.
8	7F	Local	-	-	Y	Y	40%	Flame	17	ICU	Escherichia coli Klebsiella pneumoniae Providencia stuartii Proteus penneri	Blood cultures and wounds. Despite negative on admission screening.	2 nd patient contaminated in CPE outbreak.
9	30F	French Polynesia	Y (5 days)	-	-	Y	25%	Flash	12	NBC	Pseudomonas aeruginosa	Single wound tissue isolate	-
10	33M	Local	-	-	Y	Y	56%	Flame	14	ICU	Klebsiella pneumoniae	Single rectal screening swab, with multiple other swabs negative for CRO	-
11	45M	Local	-	-	Y	Y	65%	Flame	37	ICU	Pseudomonas aeruginosa	Single wound tissue isolate	-
12	46F	French Polynesia	Y (4 days)	-	Y	Y	45%	Flame	80	NBC	Pseudomonas aeruginosa	2 samples from ankle wound resurfaced by temporising dermal matrix	-
13	16M	Local	-	-	Y	Y	70%	Flash	45	ICU	Pseudomonas aeruginosa	Tracheal aspirate 1 st , then multiple wound tissues	Death from septic shock. Day 96.

Discussion

CRO are not endemic in the New Zealand population but have shown increased prevalence in recent years. 2017 marks the first CRO outbreak in the National Burns Service. Previously thought to be robust MRO protocols were ineffective in preventing cross-contamination of CPE. This could be a testament to the transmissibility of CP organisms with mobile genetic elements of resistance. Our revised multi-modal approach in the management of this challenge have prevented further cross-contamination during the outbreak and, so far, future outbreaks.

Regarding the other CRO patients:

Patient 1 had CRO positive tracheal aspirate a week after admission in ICU. Tracheostomy was inserted overseas. Patient 2 was CRO positive on day 1 and was likely colonised prior as they were on carbapenems overseas. Patient 3 likely had an acquired CRO after prolonged treatment with broad-spectrum antibiotics for severe hospital acquired pneumonia precipitated by inhalation burn injury. They ultimately died from respiratory distress. Patients 4, 9 and 11 all had a single wound isolate growing a strain of carbapenem resistant (CR) Pseudomonas, but not carbapenemase producing (CP). All isolates were after 10 days of inpatient care and all patients were initially CRO negative, suggesting acquisition during their stay. Patients 5 and 13 also were isolated with CR Pseudomonas but were heavily colonised on multiple samples despite being initially CRO negative. In common, both were severe

burns (70% TBSA) with prolonged hospital stays (>30 days) and multiple trips to theatre. We believe multiple courses of empiric broad spectrum antibiotics, particularly carbapenems, have selected for CR strains. Patient 5 regrouped well to treatment and was discharge to their referring centre but patient 13 died of septic shock as well as complications post laparotomy for bowel ischaemia. Patient 12 had also acquired a CR Pseudomonas during her stay, but only seen isolates off an unhealed ankle wound resurfaced by a temporising dermal matrix. All other tissue were of sensitive Pseudomonas. Lastly, patient 10 was isolated with CPE months after the outbreak on a rectal swab. Strict infection control was enforced although they did not again test positive of CPE in subsequent samples.

Conclusion

Prevalence of CRO in the general and burns population are on the rise. Existing MRO protocols were unable to prevent nor contain an outbreak of CPE. Erosion of infection prevention and control practices were a contributing factor. A multi-modal care plan involving theatre, ICU, the NBC and all staff involved served to contain the outbreak. Since implementation, no further cross-contamination has occurred. Sensitive organisms acquiring carbapenem resistance however has been the majority of CRO cases identified. Antibiotic stewardship is imperative in its prevention.