Floods in Queensland Infections

Claire Heney
Department of Microbiology
Pathology Queensland

- Floods are the most common disaster in developed and developing countries
- During summer of 2010 - 2011, ¾ of QLD was declared a disaster zone due to significant flooding
- 70 towns flooded
- Peak flooding in Brisbane occurred 13 January 2011

Could we have predicted what infections would occur?

- Infections following flooding usually arise from an agent present in environment prior to the disaster
- Immediate infections in resource-rich countries show a relatively small increase in life-threatening infections
- Wound infections are the most common, secondary to exposure to contaminated flood waters and traumatic injuries acquired during the clean-up
Disruption of public health services and infrastructure
Displaced populations (>200,000 people affected), damaged homes
Damage to water and sanitation networks
Animal carcasses
Food safety, disposal of meat, evacuation centres
Increased environmental exposure to pathogens
Flooded landfill sites

2004 Indian Ocean Tsunami
Polymicrobial wound infections 45% (contamination with seawater and sewage)
Skin: Staphylococcus spp, Streptococcus spp.
Freshwater: Pseudomonas, Aeromonas, Plesiomonas spp., M. marinum
Sea water: Vibrio vulnificus
Sewage: GNB - E. coli, Proteus, Klebsiella spp.
Soil and environment: Clostridium spp, B. pseudomallei, zygomycetes
Mycobacteria: Late-onset skin and soft-tissue infections (60 days) M. marinum, M. abscessus

Data
Retrospective Auslab data for wound isolates (tissue/pus/liquid)
Organisms: Aeromonas, Shewanella and Vibrio spp., B. pseudomallei and Salmonella spp.
  6 week period 25/12/2010 - 31/01/2011 and for same period over previous 2 years.
Sites
  • RBWH and Royal Children's Hospitals
  • Caboolture and Redcliffe Hospitals
  • Logan, QEII and Redlands Hospitals
  • 5 years for all of Queensland: December to March
Leptospirosis
  • Data included all samples submitted to the FSS laboratory from QLD over previous 5 years
Aeromonas

2004 Thailand tsunami - 22.6% of all skin and soft tissue infections
2005 Hurricane Katrina - water in Superdome and hospital

Environmental source
- Aquatic habitats – rivers, estuaries (low salinity), waste water and sewage
- Fish, Red leg disease in frogs, pets, birds, ticks, soil
- Free living bacteria or in association with crustaceans
- Oysters and mussels concentrate organisms through filter feeding
- Increased isolation in warmer months

Major pathogens >85% human infections
Mesophiles 35°C to 37°C (seasonality, freshwater and domestic water)
- A. hydrophila
- A. caviae
- A. veronii bv sobria

Minor pathogens
- A. veronii bv veronii , A. jandaei, A. schuberti

Environmental species
Cryophiles 22°C to 28°C
- A. salmonicida , A. sobria

GIT
- Carriage rate <1% / Mild self-limiting watery enteritis

Wound and soft tissue infections
- >75% direct consequence of traumatic or occupational injuries
- Recreational activity, boating, fishing with major or unapparent trauma
- Simple abrasions (gum boots) or lacerations
- Cellulitis, necrotising fasciitis, myonecrosis
- Natural disasters
- Associated with medicinal leech use

Septicaemia
Aeromonas Central lab

27 wound isolates
- All *A. hydrophila* except one *A. veronii* bv sobria in a calf wound

5 stool isolates
- 2 together with *Campylobacter* and *Salmonella Typhimurium*

1 sputum isolate

Treatment of Aeromonas spp
- 5 year data / 1277 isolates
- Cotrimoxazole and Ciprofloxacin R < 1%

All of QLD - Tissue, fluid, pus - 5 year data
- *A. hydrophila* 90%
- *A. caviae* 5%
- *A. veronii* bv sobria 5%

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Vibrio spp.

- Warm coastal water
- Halophile
- Liver disease, diabetes
- Severe necrotising cellulitis, septicaemia, case fatality rate of 25%
- V. vulnificus isolated from shellfish and crabs
- 2005: Hurricane Katrina wound infections - 5 patients died

Monthly incidence of Aeromonas isolates from tissue and pus specimens

Monthly rainfall for Brisbane 2006 - 2011
Case

- 50 year old male
- Presented to ED 13/01
- Swimming in local creek 10/01
- Obese ++, Type II Diabetes, gout, acute on chronic renal failure
- Sepsis with right leg cellulitis
- Calf wound – Aeromonas veronii bv sobria and Streptococcus Group C
- Blood culture – Vibrio vulnificus
- Deceased 14/01

Vibrio: All of QLD - Tissue, fluid, pus - 5 year data

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**Shewanella**
- Implicated in cellulitis, chronic ulcers, burns
- S. algae will grow at 42°C
- No increase - One isolate of Shewanella spp from wound

**Shewanella: All of QLD / Tissue, fluid, pus / 5 year data**

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<td>Mar</td>
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<td>12</td>
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**Salmonella spp.**
- 26 isolates of Salmonella spp. from stool, urine and blood.
- Despite breakdowns in power supply and concern regarding food-handling, there was no increase in the number of Salmonella isolates.
Case: Salmonella Typhimurium

- 29 year old male
- Involved in clean up at work place
- Diarrhoea and vomiting
- 24/01 Blood culture and stool

Salmonella: All of QLD / All isolates / 5 year data

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<td>315</td>
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Burkholderia pseudomallei

- Endemic in Northern Territory and North Queensland
- Saprophytic in soil and water
- Correlation between rainfall and the incidence of melioidosis
- Most cases occur within 1 day to 2-3 weeks after exposure

Risk:
- Immunosuppressed, diabetics, alcoholics
- Non-intact skin in contact with contaminated soil or surface water
- Aspiration of water
Diagnosis

- Serology (Townsville)
  - 2011: IHA total antibody, IgM and IgG if ≥20
  - Now: IHA total antibody, EIA IgG, no IgM available
- Culture: screened with addition of Ashdowns medium

The only isolate was in a patient in a Brisbane hospital who had been transferred from Cairns with known melioidosis

B. pseudomallei: All of QLD - All isolates - 5 year data

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Leptospirosis

- Most common bacterial zoonosis worldwide
- Many reported outbreaks associated with flooding
- Both developing and industrialised nations, urban and rural areas
- Natural hosts - wild and domestic animals especially rodents
- Leptospires contaminate the soil and water and survive for 6 weeks
Environmental drivers

- Heavy rainfall and flooding wash leptospires into the environment
- Leptospires survive for longer periods in higher temperatures and humid environment
- Exposure to animals – rodents, pets, livestock
- Increase in population of rats from increased debris, rubbish, disruption of sewage and waste disposal

Leptospirosis risk

- Occupational hazard for people who work outdoors or with animals – rice field workers, cane cutters, sewer workers, vets, dairy farmers.
- Recreational activities: camping, fresh water swimming, canoeing.
- Cultural factors: bathing in rivers, animal rearing, pets.
- Disruption to human environment – damage to homes, increased exposure to environment, disruption of sewage and waste disposal.

- Highest number of cases in February / March
- Average age 35.9 years
- Male : Female ratio in QLD    9:1

Leptospirosis - Clinical

- Contact with skin especially if abraded, or mucous membranes with moist soil, mud or vegetation contaminated with urine of infected animals
- Incubation: 1-2 weeks
- Non-specific mild, self-limiting flu-like illness to severe disease with myocardial, pulmonary, renal, or hepatic involvement. Case fatality 5-30%
- Biphasic: acute leptospiroaemic phase followed by development of antibodies.
- Treatment: Oral doxycycline, IV penicillin G, ceftriaxone
Diagnosis of leptospirosis

Appropriate diagnostic testing is dependant on accurate timing of infection

**Acute phase**
- Spiroaemic phase: PCR (7 days) Forensic and Scientific Services
- Culture (may take up to 13 weeks)

**Immune phase**
- Anti-leptospira IgM (5-10 days) ++ false positives. Follow up serology 2-3 weeks later to exclude paradoxical reactions and cross-reactions
- Anti-leptospira IgG / MAT (microscopic agglutination test)
  Reaction of live Leptospira organisms with antibodies found in the patient sera. Serovar specific.
  14-21 days after initial presentation

Serovars determined using the MAT

**L. borgpetersenii serovar Arborea**
- Found world-wide in rats and mice
- Widespread throughout QLD and N. NSW
- Affects mainly those involved in agricultural industry and areas where there is close contact with Mus domesticus and Rattus rattus

**L. interrogans serovar Zanoni**
- Cane-cutter’s Disease / Mackay to Cape York
- Rats and marsupials and dairy cattle on Atherton Tablelands

**L. interrogans serovar Australis**
- Cane-cutter’s Disease / Sarina to Cape York
- Rats and small marsupials
18 cases
- 7 Arborea
- 1 Australis
- 1 Hardjo

Theodore flooded 27, 28 December 2010

- 100 cases of leptospirosis by end March with a second peak after the cyclone
  - all Arborea with high fevers (76 cases)
  - Similar figures to 1999 with a double cyclone and 219 cases

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<tr>
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<td>2011</td>
<td>188</td>
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Summary

No apparent increase:
- Diarrheal pathogens
- Mosquito borne diseases - Dengue, Ross River Fever
- Melioidosis

Increase:
- Wound infections: Aeromonas spp
- PUO: Leptospirosis

Challenges

- Careful history
- Requirement for rapid identification and selective media
- Correct choice of diagnostic test
- Education of clinicians regarding appropriate antibiotic therapy
- Co-infections and late infections
- Understanding the environmental drivers of the pathogens

Flooding, high temperatures, urbanisation!
Keep your feet dry!

Thanks

- To Central Microbiology laboratory staff and Louise Davis (CHRISP) for assistance with data collection and graphs.
- To Craig Scott (FSS) for the Leptospirosis data.
References


M. ulcerans / Buruli Ulcer

- Australia: Melbourne (temperate climate), Daintree (Riverine areas with humid hot climate)
- Aquatic insects (water bugs of order of Hemiptera - detection of bacilli in saliva), molluscs and fish
- Koalas, possums
- Direct transmission from penetrating skin injuries, wading in water, swamps
- Living near water rather than direct contact with water poses a risk - Role of water, mud or insects?
- Incidence highest in ages <15 yrs (West Africa)
- Incubation: 2 weeks to 3 years (3 months)
M:F = 25:26
4 family units

Age distribution for Malaria incidence in 2011