

Bugs, Blood and Barrier Breaches

Professor Adriano Duse, Johannesburg, South Africa

A Webber Training Teleclass

Bugs, Blood, and Barrier Breaches

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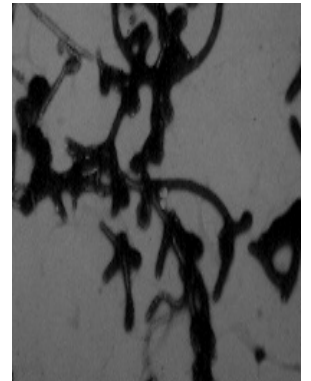
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“Ex Africa semper aliquid nova”

Pliny the Elder (23-79 AD)

“Ex Africa Semper Aliquid Nova”

- Index case:
 - 46y old anaesthetic assistant, private clinic in Johannesburg
 - 2/11/96: ill with fever
 - 5/11/96: severe headache
 - 6/11 to 13/11: admitted, leukopaenia, thrombocytopenia, deranged LFTs, deteriorating renal function - dialysis (13/11)
 - 14/11: presumptive laboratory diagnosis of Ebola virus; definitively confirmed 15/11
 - 16/11 to 22/11: T/F to JH ICU, critical condition, haemorrhaging, secondary nosocomial bacterial and fungal infections, large intracranial haemorrhage (22/11)
 - 24/11/96: demised



“Ex Africa Semper Aliquid Nova”

- Primary case/source:
 - Very ill 40 y old doctor transported by air from Libreville, Gabon; admitted to private clinic on 27/10/1996
 - 29/10/1996: Index case (anaesthetic assistant) exposed to large amount of his blood during CVC insertion and subsequent cleaning-up process
 - Unusual presentation - misdiagnosed as suffering from a polymyositis-overlap syndrome - given hydrocortisone - prompt improvement - discharged 11/11/1996
 - 16/11/1996 traced to a convalescence home. Ebola titres >1/512 confirmed he was primary case
- Nosocomial implications: critical retrospective review of South African VHF infection control practices



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Objectives Of Presentation Are To:

- Review some blood-borne pathogens endemic to the African continent that are transmissible by contaminated medical paraphernalia
- Illustrate the manufacture, import and export dynamics of these microbes: "Out of Africa"
- Describe, using case scenarios typical, unconventional, bizarre, and sinister modes of transmission of these organisms
- Discuss possible preventive strategies to control the transmission of blood-borne pathogens

OUT OF AFRICA: ENDEMIC BLOODBORNE MICROBES

VIRUSES:

- VHF Agents
- HIV
- Hepatitis B,C
- And Others...

Out Of Africa: Viruses

Agent LASSA VIRUS	Properties And Nosocomial Transmission	Prevention / Treatment
(Arenavirus) 1950s: W Africa 1969: Jos, N Nigeria (virus isolated) (Nigeria -> Guinea; ~ 5000 deaths/yr ...) 2000: 5 cases exported from Sierra Leone (outbreak) to Europe	Easily inactivated for safe lab tests (heat 56 C/30 mins; B-proprionilactone; formalin; UV radiation) Disinfection 0.5% phenolic; 10% hypochlorite; peracetic acid Sharps injuries; ill advised surgery; blood exposure; contaminated equipment	Infection control (isolation; PPE: gloves, gowns, masks; dispose single-use items (esp. needles, syringes, gloves) and sharps safely; sterilize equipment adequately; Ribavirin (Vaccine)

Lassa Fever: The High Price Of Poor Medical Practice

- 1989: 2 hospital outbreaks in Imo State (southern central Nigeria) *BMJ 1995;311:857-859*
 - Among 34 cases: 20 patients, 6 nurses, 2 surgeons, 1 physician, son of a patient (65% mortality)
 - Most cases exposed in hospitals (attack rate in one hospital 55%)
 - Both hospitals inadequately equipped & staffed, with poor medical practice: parenteral drug rounds with sharing of syringes fuelled the epidemic; Staff infected during emergency surgery and during health care delivery

Out Of Africa: Viruses

Agent MARBURG VIRUS	Properties And Nosocomial Transmission	Prevention / Treatment
(Filovirus) Germany & Yugoslavia – 37 cases: lab workers, medical personnel, caregivers (1967); exposure to imported African Green Monkeys from Uganda); South Africa 1975 – 1 nurse; Zimbabwe (1975, 1982); Kenya (1980 – 1 doctor, 1987); DRC (1998)	Shown to survive in semen of a convalescent patient for up to 83 d after disease onset; also isolated from anterior of eye of a convalescent patient with uveitis 80 days after disease onset Nosocomial transmission as for Ebola virus	Infection control isolation; PPE: gloves, gowns, masks; avoid re-use of inadequately sterilized equipment; sharps & waste disposal

Out of Africa: Viruses

Agent EBOLA VIRUS	Properties And Nosocomial Transmission	Prevention / Treatment
(Filovirus) - EBO DRC (Zaire) Yambuku, DRC (1976) – 318 cases Kikwit, DRC (1995) – 316 cases; 25% of these were HCWs Gabon (1994-5, 1996) Gabon and DRC (2001-2) EBO Sudan (1976, 1979, Uganda 2000-1) EBO Reston (Virginia) (Philippines – 1989, 1990, 1992, Italy 1996) EBO Cote d'Ivoire (1994)	EBO v isolated from semen of convalescent 61 days after disease onset Finding of abundant viral antigens & particles in the skin of EHF: ? possible aetiologic role for contact transmission Contact with blood and high risk body fluids predominant mode of spread; ? touch, droplet, airborne particle, fomite Percutaneous exposure through unsterilised needles; laboratory accidents; person-to-person by direct physical contact or contact with blood, stool, vomitus Viral survival in used syringes in excess of 7 d at tropical ambient temperatures (35 C) !	Infection control (isolation; PPE: gloves, gowns, masks; avoid re-use of inadequately sterilized equipment; sharps & waste disposal; handling of the dead)

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Out of Africa: Viruses

Agent	Properties And Nosocomial Transmission	Prevention / Treatment
CCHF VIRUS		
(Bunyavirus) 1930s: Soviet Union 1968: Stanleyville Belgian Congo - (virus isolated)	Virus labile: does not survive in dried blood, at high temperatures (cooking meat), pH<6, matured meat Although survival <3d, 1 PM CCHF v survival of 9d.	Infection control isolation; PPE: gloves, gowns, masks; avoid re-use of inadequately sterilized equipment; sharps & waste disposal
Widespread: E Europe, Asia, Middle east, China, all of Africa	Transmission primarily zoonotic (tick bites) or animal blood exposures. Nosoc. transmission: surgeons, nursing staff, other HCWs: direct contact with blood, sharps injury, failure to observe barrier techniques. Airborne in hospital setting not a risk – during autopsy, yes !	PEP: Ribavirin
South Africa: First case diagnosed in 1981. Endemic. Cases seen annually! Tygerburg, South Africa (1996) – 16 ostrich abattoir workers		

VHF Isolation Precautions

- Isolation of patient
- PPE
- Reinforcement of standard and contact precautions
- Safe disinfection of spills, equipment & supplies (enhanced with use of hypochlorite solutions)
- Disposal of sharps and contaminated waste by incineration/burial
- **Safe handling and burial of corpses**
- Education to families & communities re: prevention of VHF and care of patients

Out of Africa: Viruses

Agent	Properties And Transmission	Prevention / Treatment
HIV 1 & 2		
(Retrovirus)	Viability in syringes for up to 4 weeks! <i>J Acq Immune Def Syndromes & Human Retrovirology 1999;20: 73-80</i>	
Origin most probably African: HIV1- most likely SIV (Pan troglodytes troglodytes) HIV 2-almost certainly arose from SIV (sooty mangabey monkey)	Viability HIV-1 rarely seen >21.25 h after death Viability of HIV in post mortem samples up to 11 days <i>Lancet 1991;338:63 (6-14 in other studies)</i>	? Delay autopsy for 24h to markedly decrease infectivity
	Neck needle foreign bodies <i>Archives of Pathology and Laboratory Medicine 2004;125(6):790-792</i>	[?Pre-autopsy X-rays ... brr]
	Sharps & splash injuries Developing countries: re-use of single-use items; transfusions; plasmapheresis equipment; etc.	Adequate sharps & waste disposal esp. single-use items PPE (gloves, visors, etc.) PEP

HIV: The South African Scenario

- Occupational exposure of interns to blood in an area of high HIV seroprevalence *SAMJ 2001;91:57-61*
 - 98 interns in their one-year internship surveyed (anonymous questionnaire)
 - 69%: one/more percutaneous injuries/yr; 33% aware of HIV+ blood exposure
 - 45%: mucocutaneous exposures to HIV+ blood
 - Only 64% (28/44) percutaneous injuries from HIV reported
 - Commonest mechanisms of injury: (1) unexpected patient movement (23%), (2) needle-recapping! (17%), & (3) withdrawal of needle (17%). Approx. 50% of injuries occurred in first 4 months of internship. [N.B.: ELECTIVE STUDENTS !]
 - Overall, only 22% of interns' percutaneous exposures could have been avoided if standard precautions had been followed!

HIV: The South African Scenario

- HIV seroprevalence high!
 - HSRC 2002: 11.4% of country's population of 2 years/older (~ 5.2 million) are living with HIV/AIDS. 12.8% females, 9.5% males. Highest prevalence in 25-29y age group (28%), followed by the 30-34y age group (24%). 15.6% of people are HIV positive among the 15-49y age group
 - 40-70% of admitted hospital patients are HIV-infected
- Available guidelines for management of occupational exposures to blood-borne pathogens may not be applicable
- Strategies to minimize sharps injuries must go beyond universal (standard) precautions

PEP Is Not Necessarily A Solution

- 21 documented failures
- 16 used ZDV monotherapy
- 2 used DDI and ZDV
- 3 used at least 3 drugs
- Compliance is a challenge
- Drug resistance is emerging

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The Challenge Of Compliance

- 4 weeks is optimal
- Counselling regarding side effects
- Using regimens which are least toxic
- Avoid unnecessary PEP
- Make drugs accessible to HCWs
- Education regarding seroconversion

What's New – AIDS 2002

- Profile of occupational HIV exposures in urban hospital in Mumbai, India (*Singh et al.*)
 - 31 cases
 - Injuries mainly in residents and surgeons
 - 100% efficacy with PEP
- Absenteeism adds significant cost to HIV needlestick prophylaxis (*Akagi et al.*)
 - PEP associated with significant morbidity
 - Time loss costs are significant

What's New- AIDS 2002

- 6-year longitudinal follow-up of 50 HCW exposed to needle stick injury of symptomatic HIV infected patients in India (*Thakur et al.*)
 - No seroconversions
 - Only 9 used PEP
- Occupational exposure to HIV in paediatricians - a previously undescribed high risk group (*Marais et al.*)
 - Incidence of injury = 69% amongst all doctors
 - Post-call or after-hours (74%)
 - HIV exposure in 26%
 - All received PEP – no seroconversions

What's new – AIDS 2002

- Proposed PEP guidelines for Europe
 - Need for consensus
 - Some countries recommend 3 drugs regardless of risk assessment
- Surveillance of PEP in France (*Lot et al.*)
 - 1995-2001, 2898 HCWs sought advice
 - 31% needed PEP
 - No seroconversions
 - Only 41% follow up

Hepatitis B

- Well- recognised occupational risk
- Related to nature of contact and HBeAg status of source
 - HBeAg +
 - Clinical hepatitis 22-31%
 - Serological evidence of infection 37-62%
 - HBeAg -
 - Clinical hepatitis 1-6%
 - Serological evidence of infection 23-37%

Hepatitis B - A “Long Term Survivor”

- Percutaneous transmission is highly
- There is still a large pool of hepatitis B in South Africa
- Survival of virus in dried blood on environmental surfaces for at least one week!
- HBV transmission from surfaces documented in haemodialysis units

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Organisms Other Than Viruses.....

- Many other infections can potentially be acquired by contact with blood or blood stained fluids
- In Africa:
 - Mycobacterial infections are very important !
 - Cutaneous tuberculosis well-described !

HIV and mycobacterial infections:

- 3rd of world population infected; 3 million deaths/y; 95% in developing countries; (*M tb* in RSA: 495/100 000 pop; 200 000 new cases/year); HIV-: 5-10% TB risk per; lifetime, but if HIV+ 5-10% risk per year; in some parts of SA up to 60% of TB cases co-infected with HIV
- 100 hospitalised HIV+ black South Africans with CD4 counts < 100/cu mm
 - BACTEC (Becton Dickinson) blood culture technique
 - Point prevalence of MAC = 10% (cf. other African studies that report that infection is uncommon)
 - Point prevalence of Mtb = 54%

Clin Infect Dis 2001;33(12):2068-71

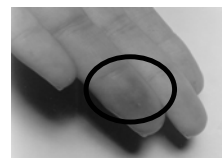
=>NB implications for occupational exposures to NSIs from mycobacteraemic patients

Sharps Injuries And Primary Cutaneous TB

- Primary cutaneous TB after a needlestick injury from a patient with AIDS and undiagnosed TB *Ann Intern Med* 1993;119:594-595
- Tuberculosis of the thumb following a needlestick injury *CID* 1998;26:210-211
- In South Africa high HIV and TB co-infection rates
- Mycobacteraemia (caused by MTB and MOTTs) is very common

Drug-sensitive Cutaneous TB

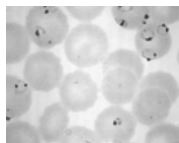
International Journal of Tuberculosis and Lung Disease 1998;2(11)
Suppl 2: Abstract 242-PD



OUT OF AFRICA: ENDEMIC BLOODBORNE MICROBES

PARASITES:

– Nosocomial Malaria



– And Others...(trypanosomes, leishmania, toxoplasma, etc.)

Nosocomial Malaria

- Nosocomial infection in South Africa:
 - NSI-related *Plasmodium falciparum* malaria resulting in death of a phlebotomy nurse in late 1990s. Source patient: confirmed *P falciparum* malaria. Nurse: diagnosis initially missed; mismanaged when diagnosis eventually made; died ~3 weeks post NSI *Sunday Times, January 25 1998:12*
- Nosocomial malaria described in other countries

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Nosocomial Malaria

- UK:
 - Malaria by accidental inoculation *Lancet* 1970;Oct 31:936
 - Needlestick malaria *Lancet* 1995;346, Nov 18:1361
 - And many more...
- West Germany:
 - Malaria transmission from patient to nurse *Lancet* 1982, Nov 27:1212
- Poland:
 - Falciparum malaria probably acquired from infected skin-cut *Lancet* 1987;July 25:220
 - Libya: Hospital-acquired malaria transmitted by contaminated gloves *JHI* 2001;47:156-158
- Saudi Arabia:
 - *Plasmodium falciparum* malaria transmitted in hospital through heparin locks *Lancet* 1997;349:23-25

OUT OF AFRICA – ISSUES

- Contamination Of Injections And Equipment / Infusions / Transfusions / Medications
- Waste Disposal:
 - Recycling of single-use items
 - Vehicle for theft
- Creative Exposures: Body Art
- Ritual Circumcision

Unsafe Injections And Equipment

- Unsafe injections in the developing world & transmission of bloodborne pathogens *Bull World Health Organ* 1999;77:789-800
 - Each person receives on average 1.5 injections/year
 - Majority of these judged unnecessary
 - 50% of injections unsafe in 14/19 countries representing developing world
 - Link between unsafe injections and transmission of hepatitis B and C, HIV, VHF, malaria
 - Unsafe injections account for a significant proportion of all new hepatitis B and C infections
- Nosocomial outbreak of multiple bloodborne viral infections *JID* 2001;184:369-372

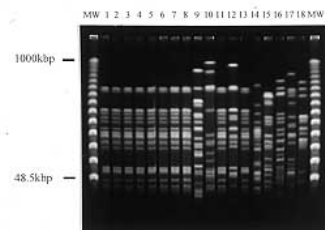
Contamination Of Injectables

- Aspiration of blood (retrograde contamination) into syringe when needle removed – 2×10^{-5} mL blood *NEJM* 1894;310:1335-1337 \Rightarrow ~ 200-2000X greater than amount to transmit hep B to chimpanzees *JID* 1975;132:451-458
- Anaesthetic (propofol and multidose vials), transfusion-, medication (multidose vials)- & many other injectable/infusion-associated infections have been described

Contamination Of Injectables



XbaI restriction digest of *E. cloacae* isolates from an outbreak in a Gauteng hospital run on PFGE



Lanes MW: molecular weight marker VI; 1-18: isolates /strains 1-18

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Blood, Sharps And The Storage And Disposal Of Waste:



CH Baragwanath Hospital: View Over Maternity East



CHB Hospital ICU



Waste Disposal: Means of Transport



Waste Disposal :Wrong Procedures



Searching For Biohazardous Waste



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Circumcision-related Sepsis:

- Outbreak of *S pyogenes* infections following ritual circumcisions
- Same razor blade used for multiple procedures
- Solution: agreement with Trad. Healer that sterile, single-use blades would be provided
- Outcome: no further cases



Body Art



Prevention of infective complications lies in the ambit of infection control philosophy

“Body Art” Or “Self Mutilation”?

- Body piercing
- Tattooing
- Tongue splitting, genital wedge cuts
- Scarification (branding and cutting)
- Other ?

Infectious Complications Of Body Art

- Pyogenic infections: e.g. *S aureus*, *S pyogenes*, *P aeruginosa*
- Non-pyogenic infections: e.g. syphilis, leprosy, TB*, tetanus, rubella, viral hepatitis B/C/D, ? HIV *see Cutaneous inoculation tuberculosis secondary to "Jailhouse Tattooing" *Arch Dermatol* 1985;121:648-650
- Cutaneous diseases that localise in tattoos: e.g. herpes simplex and zoster

OUT OF AFRICA – SINISTER

- Blood Theft
 - Hijacker's Weapon For "Stick-Ups"
 - The Traditional Healer's Market ("MUTI")



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OUT OF AFRICA

CONCLUSIONS...

- Ease of international travel has resulted in high levels of migrancy: blood-borne pathogens (B-BPs), no matter how exotic, can appear in any HCF at any time
- An understanding of the physical properties and survival of B-BPs is essential to avoid making assumptions of their hazard potential

- The profile of occupationally transmitted B-BPs is broader and the risks may be different than those described in the developed world
- The high HIV-seroprevalence in South Africa mandates urgent review and validation of NSI and splash-injury protocols
- Intern and medical student exposure to blood is extremely common but markedly under-reported

- Following Universal (Standard) Precautions may only result in prevention of one-fifth of injuries
- Additionally, contaminated blood, re-use of (single-use) disposable medical devices, ritual practices, illicit use of blood-contaminated items and, possibly, body art all contribute to the transmission of blood-borne viruses

- Intervention priorities include: education, introduction of safer techniques, products and equipment; skills training; methods of reporting blood exposures and a national database
- Finally, appropriate disposal of waste, investigating socio-cultural practices and offering acceptable alternatives, and investigating ways to minimize the potential for criminal events are of crucial importance

Shakespeare: A Sharp Sage

“To be or not to be: that is the question:
Whether 'tis nobler in the mind to suffer
the slings and arrows of outrageous
fortune,
Or to take arms against a sea of troubles,
And by opposing end them?”

Hamlet, Act III, Scene I

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