Blood cultures in the ED

Rachelle Lee, Betty Chan, Elia Vecellio, Angela Chiew

Introduction

- Bacteraemia has significant morbidity and mortality
  - Mortality rates of 15-38%
  - Sepsis annual incidence of 0.77 per 1000 adults (ICU)
- Blood cultures the routine investigation for bacteraemia
  - Guidelines proposed – often not followed

Introduction

Blood cultures indicated for adults with any of the ensuing:

- **Criteria for commencement on the adult sepsis pathway**
- **Severe pneumonia (as scored by CORB/SMARTCOP)**
- **Fever/history of fever and suspected/proven neutropenia**
- **Fever and immunocompromised**
- **Fever or signs of infection and a vascular access device/recent surgery**
- **Fever and recent travel**
- **Altered cognition/delirium**

Blood Cultures – the issues

1. Low rates of positive blood cultures
2. Most positive results are contaminants
3. Limited clinical impact of positive culture results

Introduction – Clinical prediction rules (CPRs)

- Shapiro's rule
- SIRS criteria

Modified Shapiro's rule

Major criteria	Minor criteria (1 point each)
Suspicion of endocarditis (3 points)	Temperature 38.3-39.3°C
Temperature ≥ 39.4°C (3 points)	Age > 65 years
Presence of indwelling vascular catheter (2 points	Chills
	Vomiting
	Hypotension (SBP <90mmHg)
	Platelets < $150x10^9$/L
	Creatinine >176 umol/L
	Neutrophil level >80% on blood film
	White blood cell count >$18x10^9$/L

SIRS criteria

Clinical parameter
Heart rate > 90 beats per minute
Respiratory rate >20 breaths per minute
Temperature <36°C or >38°C
White blood cell count $<4x10^9/L$ or $>12x10^9/L$

Objectives

Primary:

- Compare the sensitivity and specificity of modified Shapiro's and SIRS criteria

Secondary

- Common organisms associated with true positive and contaminated cultures
- Rates of contamination
- Clinical usefulness of true positive blood cultures

Methods

- Retrospective study at Prince of Wales Hospital's ED
- 12 month study period

Assumptions

- If an aspect of the criteria was not recorded, it was assumed to be absent
- Bandemia excluded

Methods

Immunosuppression was defined as the following conditions:

- *HIV/AIDS*
- *Leukemia*
- *Non-Hodgkin's Lymphoma*
- *Any history of chemotherapy*
- *Neutropenic fever*
- *Transplanted organ*
- *Chronic steroid-use (>1 month)*

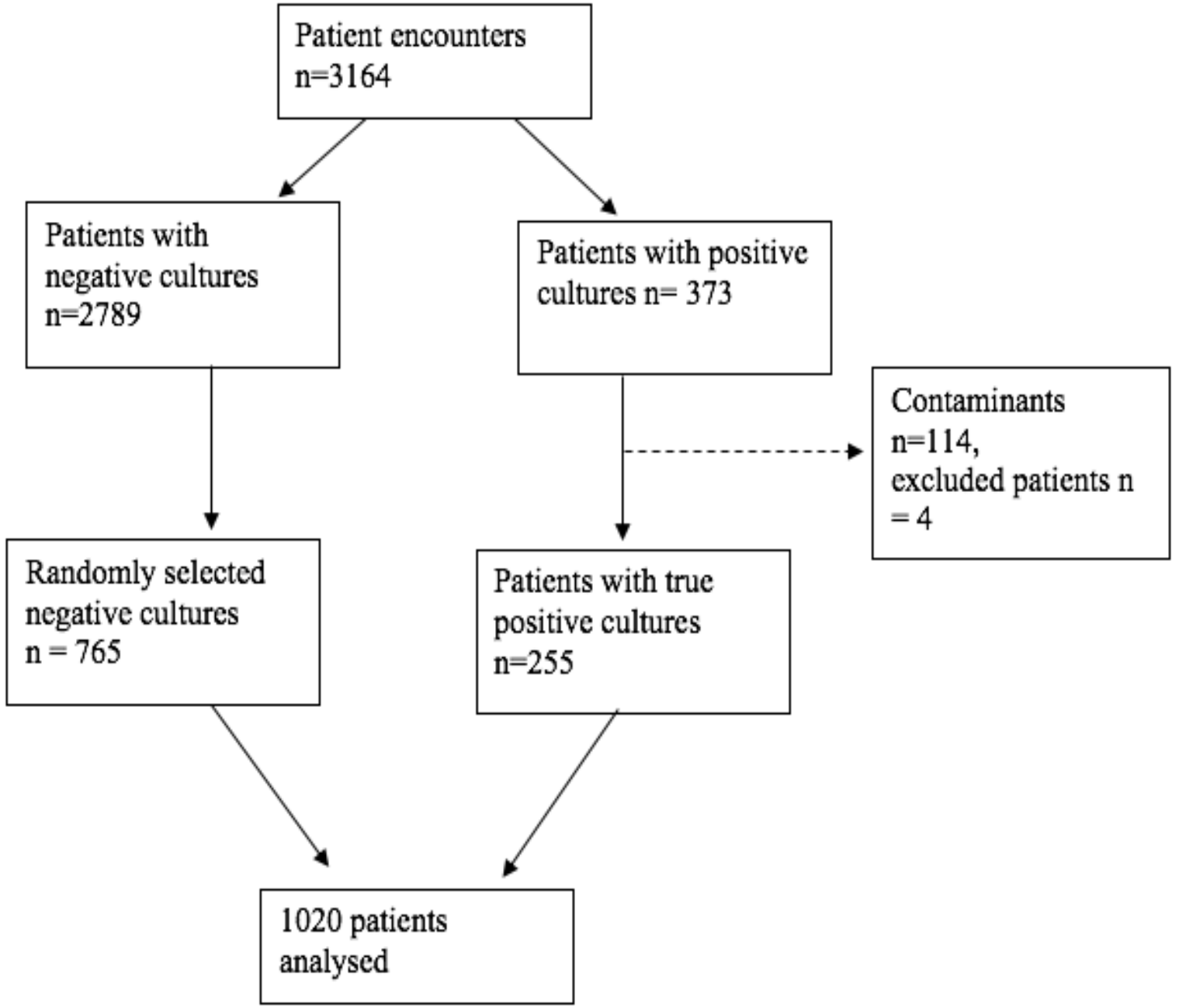
Methods

The following were defined as contaminants:

- *Coagulase negative staphylococci*
- *An/aerobic diphtheroids*
- *Micrococcus sp.*
- *Bacillus sp.*
- *Viridan group streptococci*
- Documented in clinical notes

Positive cultures to negative cultures in ratio 3:1

Results


Patient encounters
n=3164
Patients with
negative cultures
n=2789
Patients with positive
cultures n= 373
Contaminants
n=114,
excluded patients n
= 4
Randomly selected
negative cultures
n = 765
Patients with true
positive cultures
n=255
1020 patients
analysed

Results – demographics

		Positive cultures (n=255)	Negative cultures (n=765)	P value
Age (years)		71 (58-83)	60 (36-78)	<0.0001
Gender (%)	Males	151 (59.2%)	390 (51.3%)	
	Females	104 (40.3%)	370 (48.7%)	
Immunosuppressed		32 (12.5%)	102 (13.4%)	
Temperature (°C)		38.5 (37.8-39.1)	38 (37-39.6)	<0.0001
Systolic blood pressure (mmHg)		129 (110-147)	130 (115-147)	0.1276 (NS)
Deaths		14 (6%)	14 (2.8%)	

Results – primary outcome

Predictive rules		Positive (n=255)	Negative (n=765)	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	PPV (%) (95% CI)	NPV (%) (95% CI)
mShapiro's rule	Yes	240 (94.1%)	495 (64.7%)	94.1 (90.5-96.4)	35.3 (32.0-38.7)	32.8 (29.5-36.3)	94.7 (91.4-96.8)
	No	15 (5.9%)	270 (35.3%)				
SIRS criteria	Yes	199 (78.4%)	465 (60.8%)	78.1 (72.6-82.7)	39.2 (35.8-42.7)	30.1 (26.7-33.7)	84.2 (80.0-87.6)
	No	56 (22.0%)	300 (39.2%)				

Results – source of infection

		True positive blood cultures (n=255)	Negative blood cultures (n=765)
Source of infection	Chest	29 (11.4%)	162 (21.3%)
	Urine	106 (41.8%)	81 (10.7%)
	Skin	24 (9.4%)	50 (6.6%)
	Abdominal	33 (13.3%)	64. (8.4%)
	Others	45 (17.7%)	66 (8.7%)
	Viral	0	131. (17.2%)
	Undefined/no infectious source	21 (8.3%)	209 (27.5%)
	Common isolates isolated	*Escherichia coli* (35.8%) *Staphylococcus aureus* (12.2%) *Klebsiella pneumoniae* (7.1%)	-

Results – secondary outcomes

- Altered management in 188 (73.4%) of individuals
  - Conferring changes in abx therapy – 46.3%
  - Narrowed prescribing – 18.8%
  - Initiation of treatment – 7.8%
- 56 (22.0%) individuals had no change in abx use
- 9 (3.5%) patients were recalled

Results – contaminants

- 114 (3.7%) of patients had contaminated blood cultures
- *Staphylococcus epidermidis, Staphylococcus hominis, Propionibacterium acnes*

Discussion

mShapiro’s rule better than SIRS

Blood cultures reduced by at least a third

Low specificities

False negatives – 10 (3.9%) patients for mShapiro’s, 34 (13.3%) patients for SIRS

Contamination rate – 3.7% of all blood cultures collected

- Retrospective study
- Assumptions
- Biases

Conclusion

- mShapiro’s rule performed better
- Blood cultures can be reduced in young individuals with viral infections, LRTI, UTI and tonsillitis