The Utility of Blood Cultures in Post-operative Febrile Neurosurgical Patients

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Introduction

- Post-operative fever is a common occurrence

- Sepsis causes significant morbidity and mortality

- BSI in neurosurgery patients has been shown to be between 1.4% and 17.2%.

Introduction (cont.)

- Routine culturing is controversial and costly

- Contamination of blood cultures leads to increased hospital stay and cost

- Multiple studies have shown a protocol for ordering blood culture increased positive rates and decreases costs

Methods

- Retrospective chart analysis of all blood cultures drawn on Neurosurgical patients in 2011 obtained from SHANDS Infection Control Group
- Identified patients who underwent a procedure under anesthesia in the major operating room or angio suite
- Fever defined as 38.5 degrees Celsius or greater
- False positive
  - Staph aureus coagulase negative 1 of 2 cultures
  - Contaminant determined by Infectious Disease

Methods (cont.)

- Variables:
  - Maximum temperature 12 hours before or after culture
  - Known infection
  - Patient on antibiotics
  - Cranial vs. Spine procedure
  - Patient had a line
    - Arterial line
    - Ventilator
    - Foley catheter
    - Central Venous Line
    - Ventriculostomy
    - Chest Tube

Methods (cont.)

- Using R statistics software performed estimation equation to developed Odds Ratio for univariate analysis.

- We created a multivariate logistic regression model.

- Performed Mann Whitney U test to examine re-culturing of patients

Results: Negative Vs. All Positives

	Overall (n=798)	Negatives (n=764, 95.7%)	Positives (n=34, 4.3%)	Odds ratio for positive culture	p-value
Age					
mean±SD, median	50.9±17.9, 53.0	50.6±18.1, 53.0	56.2±10.7, 59.0	OR multiplies by 1.02 for each additional year; CI=[1.00, 1.03]	.058
Gender					
Female	392 (49.1%)	376 (95.9%)	16 (4.7%)	OR for F vs. M = 0.83; CI=[.344, 2.01]	.680
Male	406 (50.9%)	388 (95.6%)	18 (4.4%)		
Diagnosis					
Cranial	568 (71.2%)	547 (96.3%)	21 (3.7%)	OR cranial vs. spinal diagnosis =0.64; CI=[.315, 1.30]	.220
Spinal	230 (28.8%)	217 (94.3%)	13 (5.7%)		

Results: True Positives

	Overall (n=782)	Negatives (n=764, 97.7%)	Positives (n=18, 2.3%)	Odds ratio for positive culture	p-value
Age					
mean±SD, median	50.8±18.0, 53.0	50.6±18.1, 53.0	58.9±9.3, 61.0	OR multiplies by 1.02 for each additional year; CI=[.998, 1.04]	.84
Gender					
Female	382 (48.8%)	376 (98.4%)	6 (1.6%)	OR for F vs. M = 0.44; CI=[.115, 1.70]	
Male	400 (51.2%)	388 (97.0%)	12 (3.0%)		.236
Diagnosis					
Cranial	556 (72.3%)	547 (98.4%)	9 (1.6%)	OR for cranial vs. spinal dx = 0.40; CI=[.155, 1.01]	
Spinal	226 (27.7%)	217 (96.0%)	9 (4.0%)		.053

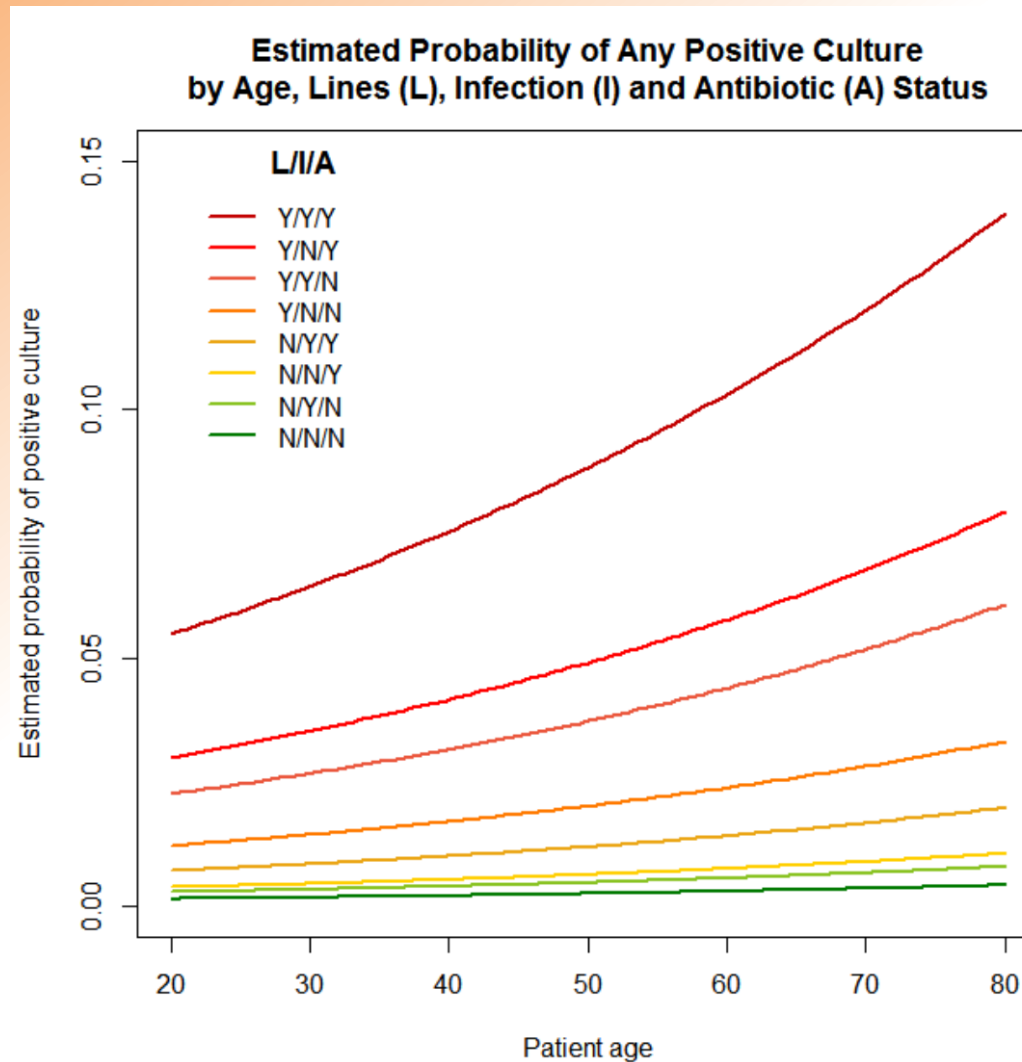# Results: Negative Vs. All Positives

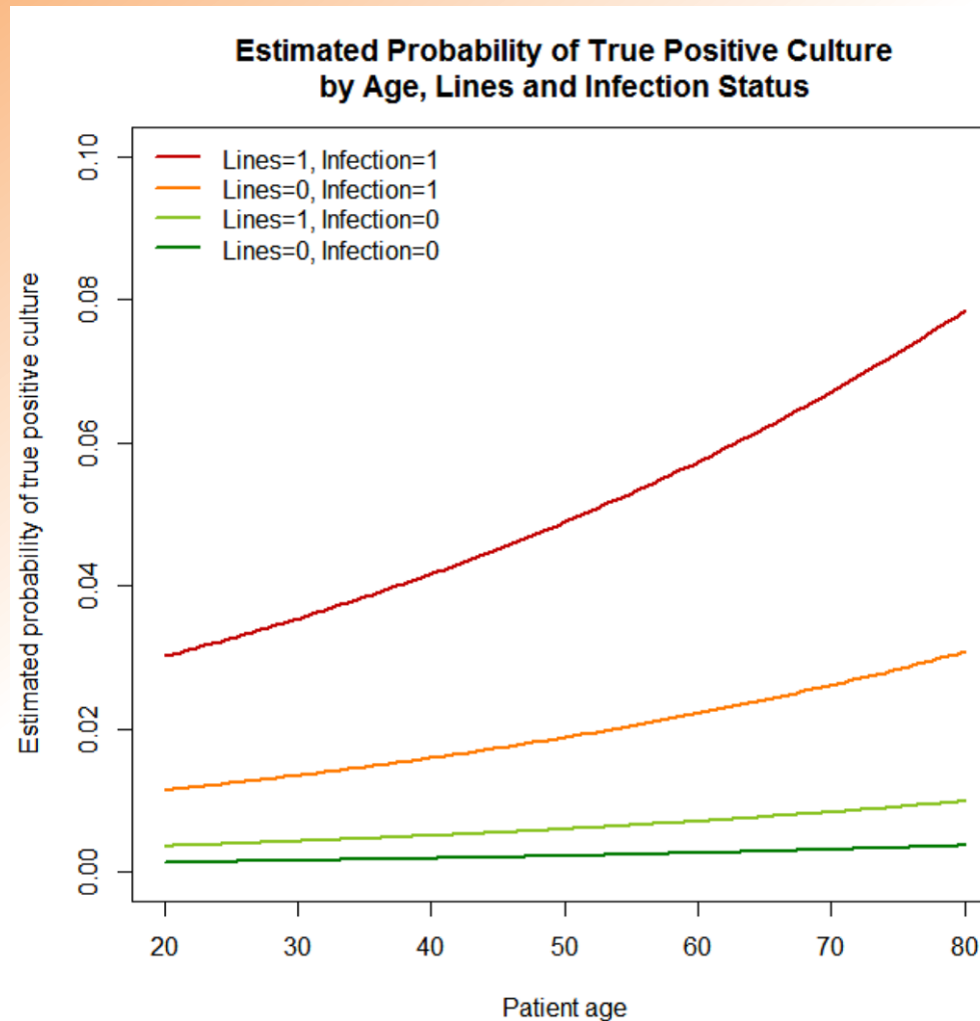|	Overall (n=798)	Negatives (n=764, 95.7%)	Positives (n=34, 4.3%)	Odds ratio for positive culture	p-value
T max					
mean±SD, median	38.9±0.40, 38.8	38.9±0.39, 38.8	38.9±0.41, 38.8	OR multiplies by 0.77 for each 1-degree increase; CI=[.278, 2.13]	.613
Number of Lines					
0	252 (31.6%)	251 (99.6%)	1 (0.4%)		
1	140 (17.5%)	132 (94.3%)	8 (5.7%)		
2	99 (12.4%)	89 (89.9%)	10 (10.1%)		
3	131 (16.4%)	125 (95.4%)	6 (4.6%)		
4	154 (19.3%)	145 (94.2%)	9 (5.8%)		
5	22 (2.8%)	22 (100%)	0 (0%)		
mean±SD, median	1.8±1.6, 2.0	1.8±1.6, 1.0	2.4±1.2, 2.0	OR multiplies by 1.3 for each additional line; CI=[1.01, 1.67]	.044
Lines					
No	251 (31.5%)	250 (99.6%)	1 (0.4%)	OR for lines vs. no lines = 13.0; CI=[1.82, 92.9]	
Yes	547 (68.5%)	514 (94.0%)	33 (6.0%)		0.11
Known infection					
No	421 (52.8%)	413 (98.1%)	8 (1.9%)	OR for inf vs. no inf = 4.3; CI=[1.68, 10.9]	
Yes	377 (47.2%)	351 (93.1%)	26 (6.9%)		0.002
Antibiotics					
No	380 (47.7%)	375 (98.7%)	5 (1.3%)	OR for abx vs. no abx = 4.9; CI=[1.40, 17.4]	
Yes	417 (52.3%)	388 (93.0%)	29 (7.0%)		0.13

Results: True Positives

	Overall (n=782)	Negatives (n=764, 97.7%)	Positives (n=18, 2.3%)	Odds ratio for positive culture	p-value
T max					
mean±SD, median	38.9±0.40, 38.8	38.9±0.39, 38.8	39.0±0.43, 39.0	OR multiplies by 1.4 for each 1-degree increase; CI=[.315, 6.55]	.640
Number of lines					
0	251 (32.1%)	251 (100%)	0 (0%)		
1	136 (17.4%)	132 (97.1%)	4 (2.9%)		
2	96 (12.3%)	89 (92.7%)	7 (7.3%)		
3	127 (16.2%)	125 (98.4%)	2 (1.6%)		
4	150 (19.2%)	145 (96.7%)	5 (3.3%)		
5	22 (2.8%)	22 (100%)	0 (0%)		
mean±SD, median	1.8±1.6, 2.0	1.8±1.6, 1.0	2.4±1.1, 2.0	OR multiplies by 1.4 for each additional line; CI=[.953, 2.13]	.085
Lines					
No	250 (32.0%)	250 (100%)	0 (0%)	OR not estimable (because 0 cases for Lines=0)	
Yes	532 (68.0%)	514 (96.6%)	18 (3.4%)		.001
Known infection					
No	415 (53.1%)	413 (99.5%)	2 (0.5%)	OR for inf vs. no inf = 9.8; CI=[1.55, 62.2]	
Yes	367 (46.9%)	351 (95.6%)	16 (4.4%)		.015
Antibiotics					
No	377 (48.3%)	375 (99.5%)	2 (0.5%)	OR for abx vs. no abx = 4.8; CI=[.502, 45.8]	
Yes	404 (51.7%)	388 (96.0%)	16 (4.0%)		.173

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Statistical Model for Positive Culture

Estimated Probability of Any Positive Culture by Age, Lines (L), Infection (I) and Antibiotic (A) Status

Statistical Model for a True Positive Culture

Estimated Probability of True Positive Culture by Age, Lines and Infection Status

Legend:
- Lines=1, Infection=1
- Lines=0, Infection=1
- Lines=1, Infection=0
- Lines=0, Infection=0

Y-axis: Estimated probability of true positive culture
X-axis: Patient age

Rates of Positive Cultures

- any positive culture is 34/798 or 4.26%

- true positive cultures is 18/798 or 2.26%

- false positives is 16/798 or 2.01%

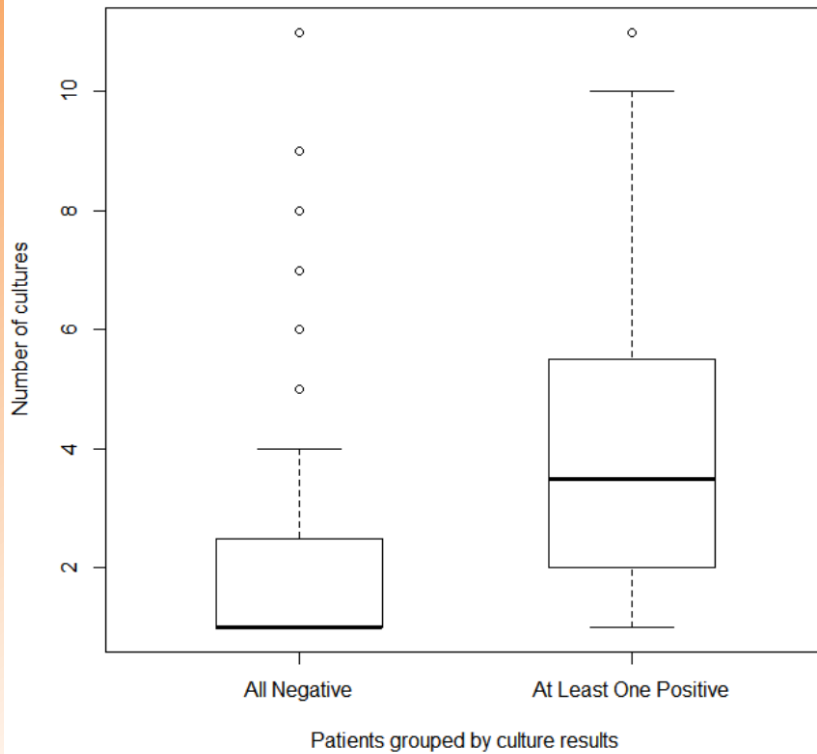- Rate of positive cultures that are true positives is 18/34 or 52.9%

Re-culturing

- Overall (231 patients)
  - 2.3±2.0
- Negative (207 patients, 89.6%)
  - 2.1±1.8
  - 43.5% >1 culture (average=3.4)
    - >6 cultures on 6.8 %
  - Range: 1-11
- Any Positive (24 patients, 10.4%)
  - 4.3±2.7 p<.0001
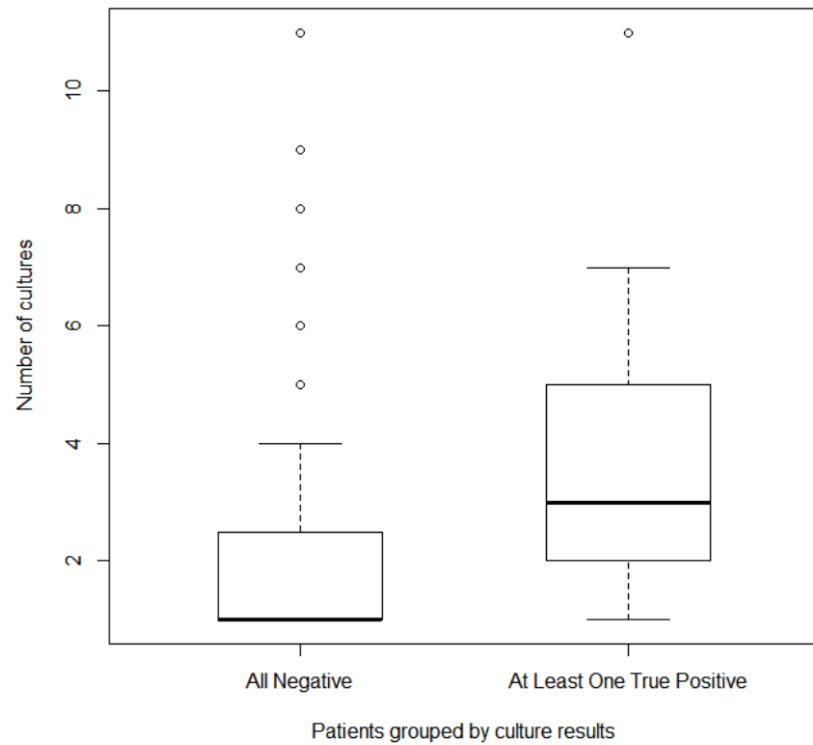- True Positive (9 patients, 3.9%)
  - 4.1±3.3 p=.013

Re-culturing

Re-culturing: Probability of a False Positive

# cultures drawn	Probability of false positive
1	2.01%
2	3.98%
3	5.91%
4	7.80%
5	9.65%
6	11.5%
7	13.2%
8	15.0%
9	16.7%
10	18.4%

True Positive

- 9 patients (3.9% of patients)
  - 5 cranial
  - 4 spinal
- Each had at least one line
- 5 patients with UTI of the same organism
- 2 with CVL associated infections by ID
- 1 without a known infection
  - Staph aureus coagulase negative 2 of 2

Cost Analysis

- SHANDS Hospital: blood culture $85.00
- Total Cost for Post operative Febrile Blood Cultures
  - $67,830
- Cost per positive culture
  - $1,995
- Cost per true positive culture
  - $3,768

Conclusions

- The rate of true positive blood cultures is extremely low in post operative febrile patients

- Majority of infectious causes due to some other identifiable source

- False positive rates approximately same as true positive rates

Recommendations

- Routine blood cultures should not be part of the post operative fever work up

- Blood cultures should be reserved for post operative patients of fever of unknown origin