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Understanding Reasons Clinicians Obtained Endotracheal Aspirate Cultures and Impact on Patient Management to Inform Diagnostic Stewardship Initiatives

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Keywords

Ventilator-associated pneumonia; endotracheal aspirate cultures; diagnostic stewardship

Introduction

Endotracheal aspirate cultures (EACs) are commonly obtained in the evaluation of suspected ventilator-associated infections (VAIs),¹ an important cause of nosocomial infections.² Over-utilization of EACs may contribute to over-treatment for VAI because EACs cannot distinguish between bacterial colonization and infection,^{3,4} and positive EAC results prompt treatment with antibiotics.^{1,5,6} There is site-specific variability of EAC utilization and interpretation of results.¹ As part of a quality improvement project, we aimed to better understand local practices as a formative step in the development of a guideline to standardize EAC utilization in the pediatric intensive care unit (PICU).

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Twitter tweet: Clinicians had low thresholds for endotracheal cultures & many cultures were not helpful. There are opportunities to improve culture use.

Previous presentation: Portions of these results were previously presented in a poster abstract at IDWeek, San Francisco, CA. October 2018.

Conflicts of Interest:

Authors report no conflicts of interest relevant to this article.

Methods

We prospectively identified a convenience sample of EACs obtained from mechanically ventilated patients (endotracheal tube or tracheostomy) from November 21, 2017 to February 4, 2018 in the Johns Hopkins Children's Center PICU. We surveyed clinicians caring for patients with EACs using a 2-part written survey comprised of 10 multiple choice or Likert-scale questions (Supplement 1). Survey part 1 occurred within 1–2 days of EAC collection to capture clinicians' reasons for and expectations of the culture results. Survey part 2 occurred after EACs resulted (5 days) to examine how results contributed to patient management. We defined VAI as clinician-diagnosed ventilator-associated pneumonia or tracheitis because these entities are often treated interchangeably.^{7,8} We retrospectively performed chart review. Descriptive analyses were completed using Stata version 14.0 (Stata Corp, College Station, TX). The Johns Hopkins Institutional Review Board acknowledged this evaluation as part of a quality improvement project.

Results

Description of EACs and patients

We conducted surveys and reviewed 25 EACs of 107 EACs obtained. The median patient age was 1.0 years (IQR 0.92–5.0), and 52% were female. The majority, 72%, had been ventilated for 4 weeks (n=18) and 44% had a tracheostomy (n=11). EACs were collected concurrent with blood cultures in 76% (n=19), or “pan cultures” (ETA, blood and urine) in 60% (n=15). Of the 25 EACs, 23 had a previous EACs (92%) and seven were repeated within 3 days (28%), of which only 1 clinician recalled. The median time to repeat culture was 6 days. Repeated EACs often grew the same or fewer bacteria (72%, n=17).

Results of Survey Part 1: Provider perceptions at time of culture

There was 100% completion of the 25 two-part surveys. Surveys were primarily completed by the first-call clinician; nurse practitioner (72%-two thirds of first-call providers are nurse practitioners in this unit), resident (22%) or fellow (6%). The team member reported to have suggested an EAC was the nurse (4%), attending (15%), fellow (24%), nurse practitioner (32%), or not known (24%). The most frequent clinical change triggering EACs was fever (Table 1). Forty-four % of EACs were obtained for non-specific clinical changes (e.g. fever alone) (n=11). The remainder had multiple clinical changes consistent with possible VAI (e.g. increased secretions, fever, and increased ventilator settings). Clinicians expected the EAC would help with the diagnosis of VAI (n=17, 68%) and antibiotic selection (n=20, 80%). Clinicians reported expected contribution of EAC to patient management as not at all 4% (n=1), a little 30% (n=9), very 60% (n=15), or essential 0%.

Results of Survey Part 2: Impact of EACs on clinical management

Clinicians reported subsequent value of the EAC data to patient management as not at all 16% (n=4), a little 40% (n=10), very 28% (n=7), or essential 16% (n=4). Ten patients were diagnosed with a VAI (40%), of which 9 reported the EAC helped inform the diagnosis and 7 reported the bacterial culture result was the most informative component. Following the EAC result, the empiric antibiotic treatment was discontinued in 12% (n=3) or modified in

16% based on the EAC result (n=4), changed based on a non-EAC result (e.g. urine studies) in 20% (n=5), or not changed in 52% (n=13, 2 cases never received antibiotics).

Discussion

Results of the survey part 1 demonstrated a relatively low threshold to obtain EACs in response to non-specific clinical changes (e.g. fever alone), fever was the primary indication, and EACs were often obtained concurrent with other cultures. Results of the survey part 2 indicated most patients were not diagnosed with VAI, antibiotics were infrequently changed in response to the EAC result and more than half of clinicians surveyed subsequently felt the EACs were of little to no help in the overall patient management. Notably, the EAC lead to antibiotic modifications and was considered essential in a few cases. Our findings are congruent with a multi-center survey with hypothetical scenarios revealing PICU physicians would commonly obtain EACs as part of “rule out sepsis or infection evaluation”, and the culture data supporting “bacterial pathogenicity” was most important.⁶ Longitudinal studies are needed to better understand the clinical value of repeated EACs, particularly among chronically ventilated patients.

A limitation of this evaluation is that we primarily surveyed first-call clinicians from a single-center with a modest sample size. There is likely variability between clinicians and institutions and therefore findings may not be generalizable to other units. However, they could be used to develop local assessments. Surveys were conducted as soon as feasible after EACs, but there may be recall bias. Lastly, participation in the first survey could have influenced responses in the second survey.

There may be opportunities to improve EAC utilization. Judicious use of EACs has the potential to reduce antibiotic use and aligns with the national Choosing Wisely Campaign to reduce medical overuse.⁹ Additional studies are needed to clarify the indications and role of EACs in the management of mechanically ventilated patients.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Clinician reported reasons prompting endotracheal aspirate cultures

Reasons	Frequency ^a	Proportion
Fever	17	0.68
Decreased O2 saturation	11	0.44
More frequent desaturations	10	0.40
Increased FIO2	10	0.40
Change in secretions	10	0.40
Rising WBC	8	0.32
Increased end tidal CO2	6	0.24
New opacity	5	0.20
Rising CRP	4	0.16
Increased ventilator pressure	3	0.12
Re-intubated	2	0.08
Don't know	2	0.08
Bandemia	2	0.08

Clinicians were surveyed after 25 endotracheal aspirate cultures were obtained regarding clinical changes that prompted obtaining the culture.

^aThe survey allowed selecting all possible options, therefore the sum is >25. Eleven EACs (44%) had isolated or non-specific clinic changes reported: fever alone (n=4), hypotension alone (n=2), increase in ventilator settings alone (n=2), or fever with rising WBC or rising CRP without other clinic changes (n=3). The other 14 EACs had multiple clinical changes.

Abbreviations: O2- oxygen, FIO2- fraction of inspired oxygen, WBC- white blood cell count, CO2- carbon dioxide, CRP-C-reactive protein.