Epidemiology and Trends of Pertussis among Infants: United States, 2000–2015

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Session: 20. Identification, Treatment, and Prevention of Pediatric Bacterial Pathogens Thursday, October 5, 2017: 8:30 AM

Background. Pertussis, a cyclic respiratory disease, causes the greatest morbidity and mortality among infants, particularly those too young to be vaccinated. Following a resurgence of pertussis in the 1990s, a recommendation was made in 2012 to vaccinate during every pregnancy in order to prevent infant disease. We describe pertussis trends from 2000–2015 among U.S. infants aged <1 year.

Methods. We analyzed infant pertussis cases reported through the National Notifiable Diseases Surveillance System from 2000 to 2015. Incidence rates (cases per 100,000 population) among various age groups (<2, 2–<4, 4–<6, and 6–<12 months) were calculated using National Center for Health Statistics population estimates as denominators. Negative binomial regression was used to estimate the annual average percent change with a linear trend; P < 0.05 was significant.

Results. From 2000 to 2015, 48,909 infant pertussis cases and 255 deaths were reported; infants aged <2 months accounted for 38.7% of cases. The age distribution of infant cases was stable from 2000 to 2009 but changed from 2010 to 2015 (Fig. 1), as the proportion of cases aged 4–<12 months increased annually on average by 4.7% (P < 0.001). Annual incidence was highest among <2 month olds; however, rates increased among older infants (Fig. 2): 7% average annual increase among infants aged 4–<6 months and 11% among infants aged 6–<12 months (P < 0.001 for each). The proportion of infants hospitalized decreased over time in each age group (P < 0.001 for all) with the largest annual average declines among 4–<6 (<5.1%) and 6–<12 month (<5.9%) olds. For all age groups, hospitalization rates were relatively stable, but non-hospitalization rates increased (P < 0.05 for all). The case-fatality ratio (CFR) was highest among <2 month olds (1.6%); CFRs decreased over time among <2 and 2–4 month olds (P < 0.05 for each).

Conclusion. Pertussis incidence remains highest among infants aged <4 months, although the age distribution appears to be changing. Decreasing proportions of infants hospitalized may suggest a true decline in disease severity or an increase in reporting of less severe disease. Ongoing monitoring of infant pertussis is needed to better understand the impact of vaccinating pregnant women to prevent pertussis in young infants.

Disclosures. All authors: No reported disclosures.

88. Risk Factors for Early Hip or Knee Prosthetic Joint Infection (PJI): Analysis of a Nationwide American Insurance Claims Dataset

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Session: 30. It’s not just Bones: Skin and Bones Thursday, October 5, 2017: 8:30 AM

Background. While several studies have identified risk factors for PJI using insurance claims data, these data sets have been limited to a single regional insurance dataset or to the Medicare population. We sought to investigate risk factors for early PJI among patients undergoing total hip or knee arthroplasty (THKA).

Methods. All patients who underwent primary THKA between January 1, 2004 and July 31, 2014 with 12 months of continuous preceding medical and pharmacy insurance coverage were included in the study. The primary outcome of PJI required both a compatible procedure code and a diagnostic code during an inpatient stay from the time of THKA through 90 days after discharge. Comorbidities were based on ICD-9 codes in the preceding 12 months and patients with a prior diagnosis of PJI during that time period were excluded. Univariate and multivariate analysis was performed using logistic regression.

Results. A total of 147,053 patients underwent THKA during the study period, including 97,448 patients with TKA and 49,605 with THA. PJI occurred in 754 (0.5%) patients. Female gender was independently associated with lower odds of PJI (Figure). A number of biologically plausible factors were associated with increased risk, including chronic skin ulcer, obesity, substance use disorders, joint sarcoma, and malnutrition. The adjusted odds of PJI increased in a stepwise fashion with each increase in the Charlson comorbidity index (CCI), with those with a score of 4 or more having a nearly 2-fold increased odds of PJI compared to a score of 0 (OR 1.91; 95% CI 1.29–2.82). Previously observed risk factors diabetes mellitus, rheumatoid arthritis, and chronic renal failure were associated with increased odds of PJI on univariate analysis, but not after adjustment.

Conclusion. These data identify several potentially modifiable risk factors for preoperative optimization, including obesity, malnutrition, chronic skin ulcers, and substance-use disorders. The level of comorbidity as assessed by the CCI provides a rough estimate of the increasing risk of PJI. The pathobiology of additional risk factors observed here deserves further study.

Disclosures. All authors: No reported disclosures.

89. U.S. Combat-related Invasive Fungal Wound Infection (IFI) Epidemiology and Wound Microbiology: Afghanistan Theater 2009–2014

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Session: 30. It’s not just Bones: Skin and Bones Thursday, October 5, 2017: 8:30 AM

Background. Culturing combat-related wounds often yields both fungi and bacteria. It is difficult to differentiate fungal contamination from infection, and objective criteria that identify patients at risk for IFI are needed. This study was designed to characterize IFI among US combat casualties in the Afghan theater.

Methods. This retrospective study includes subjects with any laboratory evidence of fungi (either histopathology or cultures). Wounds with ongoing necrosis and laboratory evidence of infection were classified as IFI. Wounds with laboratory evidence of fungal infection, but without ongoing necrosis were classified as either highly suspicious wounds based
on objective clinical criteria (i.e., presence of systemic and local signs of infection and use of antibiotics for ≥10 days) or non-IFI wounds if they failed to meet clinical criteria.

**Results.** Of 1932 subjects, 246 (12.7%) had laboratory evidence of fungal infection. There were a total of 143 IFI wounds (n = 94), 157 non-IFI wounds (n = 96), and 113 high suspicion wounds (n = 56). IFI subjects had significantly higher injury severity scores (ISS median: 39.5 vs. 33); Sequential Organ Failure Assessment (SOFA) scores (7 vs. 2) and were more likely to require mechanical ventilation (66 vs. 28%). IFI patients also had higher ISS (93 vs. 84% with ISS >25) and SOFA scores (7 vs. 4) compared with the subjects with high suspicion wounds. IFI wounds often grew molds belonging to the order *Mucorales*, whereas fungi with high suspicion (19 vs. 10%, P = 0.04) and non-IFI wounds (19 vs. 7%, P = 0.02). About half of the IFI wounds grew fungi of the order *Mucorales* either isolated alone or in conjunction with other fungi, in comparison, 25% of the high suspicion wounds and 11% of the non-IFI wounds grew fungi of the order *Mucorales*. Three groups of fungi belonging to the order *Mucorales*, *Aspergillus* and *Fusarium* accounted for 83% of the IFI wounds and 74% of the high suspicion wounds.

**Conclusion.** Laboratory evidence of fungal infection is common among combat casualties. Clinical characteristics and wound microbiology allows us to group subjects into groups at low and high risk of IFI. Fungi of the order *Mucorales*, genus *Aspergillus* and *Fusarium* should not be considered contaminants. The presence of these fungi should obligate close clinical follow-up and debridement as needed.

**Disclosures.** All authors: No reported disclosures.

### 90. Increasing *Kingella* Identification in Bone and Joint Infections in Young Children

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**Session:** 30. It’s not just Bones: Skin and Bones

**Thursday, October 5, 2017: 8:30 AM**

**Background.** *Kingella kingae* is an increasingly recognized pathogen among young children with bone and joint infections. Antibiotics given to cover methicillin-resistant *Staphylococcus aureus* (MRSA) and *Escherichia coli* are common in young children’s hospital that called for early imaging, focal sampling, and polymerase chain reaction (PCR) testing for culture-negative specimens. The goal was to increase identification in Bone and Joint Infections in Young Children.

**Methods.** We implemented a bone and joint infection guideline at a free standing children’s hospital that called for early imaging, focal sampling, and polymerase chain reaction (PCR) testing for culture-negative specimens. The goal was to increase identification of *Kingella* and other pathogens to improve targeted antimicrobial therapy. Children 6 to ≤ 60 months of age with uncomplicated acute hematogenous osteomyelitis or septic arthritis between January 1, 2008–December 31, 2016, were included in this study. Outcomes of bacterial identification were measured.

**Results.** Charts for 49 cases that met criteria were reviewed. Prior to the algo- rithm, we identified *Kingella* in 4% (1/25) of cases. Following routine use of updated sampling and testing techniques, including PCR testing, *Kingella kingae* identification increased to 28% of cases (7/24; P = 0.02) and, in fact, was the predominant pathogen identified in this age group.

**Conclusion.** Identification of *Kingella* was enhanced as a result of changes to sampling and testing, including PCR testing (Figure 1). Post-implementation, *Kingella* was more commonly identified than *Staphylococcus aureus*. Widespread availability of PCR testing in the future may allow for the use of narrowed antibiotic therapy and targeted transition to oral antibiotics in young children with bone or joint infection.

**Disclosures.** All authors: No reported disclosures.

### 91. Microbiology of Vertebral Osteomyelitis and Implications on Empiric Therapy

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**Session:** 30. It’s not just Bones: Skin and Bones

**Thursday, October 5, 2017: 8:30 AM**

**Background.** The management of vertebral osteomyelitis (VO) includes empiric antibiotic therapy while clinical cultures are being processed. Optimal antimicrobial therapy for VO, particularly when Gram-negative (GN) organisms are involved, is an area of ongoing debate. Narrow spectrum and oral antimicrobial therapy are preferred. The objective of this study was to identify characteristics of local pathogens and to formulate an institution-specific antibiotic protocol for empiric treatment of VO.

**Methods.** We conducted a retrospective case series study of adults diagnosed with VO from August 1, 2010 to August 31, 2015 at Palmetto Health Hospitals in Columbia, South Carolina. Cases identified by ICD-9 codes were included in the analysis if they met medical, imaging and microbiological criteria. A total of 113 patients (97.7%) 86 patients (85 concordant and 1 discordant), followed by streptococcus and *Streptococcus sanguis* (26/66 were methicillin-resistant), coagulase-negative staphylococci (20.18%) and *Streptococcus sanguis* sp. (17.15%). *Enterobacteriaceae* accounted for 13/17 Gram-negative bacilli (GNB), with only one isolate of *Pseudomonas aeruginosa*. Of the GNB, 11/17 were susceptible to either ceftriaxone or ciprofloxacin. Of those, the majority was *Staphylococcus aureus*. (66.59% (26/66) were methicillin-resistant), coagulase-negative staphylococci (20.18%) and *Streptococcus sanguis* sp. (17.15%). *Enterobacteriaceae* accounted for 13/17 Gram-negative bacilli (GNB), with only one isolate of *Pseudomonas aeruginosa*. Of the GNB, 11/17 were susceptible to either ceftriaxone or ciprofloxacin.

**Conclusion.** There was a predominance of VO due to GPC suggesting that intra- venous vancomycin monotherapy may be reasonable for empiric therapy in noncritically ill patients while awaiting Gram stain and clinical culture results. Addition of either ceftriaxone or ciprofloxacin to vancomycin would increase cumulative antimicrobial coverage from 84 to 92%.

**Disclosures.** All authors: No reported disclosures.

### 92. Concordance of Results of Blood and Tissue Cultures from Patients with Pyogenic Spondylodiscitis

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**Session:** 30. It’s not just Bones: Skin and Bones

**Thursday, October 5, 2017: 8:30 AM**

**Background.** The aim of this study was to investigate the concordance of results of blood and tissue cultures in patients with pyogenic spondylodiscitis.

**Methods.** We searched the patients with pyogenic spondylodiscitis in whom micro-organisms were isolated from both blood and tissue cultures by retrospective review of medical records in three tertiary university-affiliated hospitals between January 2005 and December 2015. The species and antimicrobial susceptibility patterns of isolates from blood and tissue cultures were compared with each other.

**Results.** Among 141 patients with pyogenic spondylodiscitis in whom micro-organisms were isolated from both blood and tissue cultures, the species of blood and tissue isolates were identical in 135 patients (95% patients; 135/141). Excluding the four anaerobic isolates, we investigated antimicrobial susceptibility patterns of 131 isolates of same species from blood and tissue cultures. Antibiotic susceptibility patterns were identical in 128 patients (97.7%, 128/131). The most common isolates were *Staphylococcus aureus* (86 patients; 85 concordant and 1 discordant), followed by streptococcus (24 patients; 22 concordant and 2 discordant), and *Escherichia coli* (8 patients; all concordant).

**Conclusion.** We suggest that a positive blood culture from patients with pyogenic spondylodiscitis could preclude the need for additional tissue cultures, especially when *S. aureus* and streptococcus grew in blood cultures.

| Micro-organisms isolated from blood and tissues in 135 patients with pyogenic spondylodiscitis |
|---------------------------------------------------------------|
| **Concordant (n = 135)** |
| *Staphylococcus aureus* | 85 |
| Viridans streptococci | 11 |
| *Streptococcus agalactiae* | 8 |
| *Escherichia coli* | 8 |
| Enterococcus faecalis | 4 |
| Klebsiella pneumonia | 2 |
| Others | 17 |
| **Discordant (n = 6)** |
| Blood | **Coagulase-negative staphylococcus** |
| *Streptococcus constellatus,* | *Actinomyces meyeri* |
| *Streptococcus epidermidis,* viridans | *Staphylococcus epidermidis* |
| *Staphylococcus aureus* | *Staphylococcus aureus,* Nontuberculous mycobacteria |

**Figure 1.** Bacterial identification pre and post guideline among children aged 6–60 months.

**Disclosures.** All authors: No reported disclosures.