Published in final edited form as:

Pediatr Infect Dis J. 2013 September ; 32(9): 1034–1036. doi:10.1097/INF.0b013e31829331f2.

Predictors for successful treatment of pediatric deep neck infections using antimicrobials alone

Michael Bolton, MD¹, Wei Wang, MS², Andrea Hahn, MD¹, Octavio Ramilo, MD¹, Asuncion Mejias, MD, PhD¹, and Preeti Jaggi, MD¹

¹Department of Pediatrics, Division of Infectious Diseases, Nationwide Children's Hospital, Columbus Ohio

²Biostatistics Core, Columbus Ohio

Keywords

Retropharyngeal abscess; parapharyngeal abscess; deep neck infection

Introduction

For reasons not completely understood, the incidence of deep neck infections (DNI) is increasing¹. These infections, specifically parapharyngeal and retropharyngeal infections, can be associated with significant morbidity and mortality, especially when the diagnosis is delayed².

The timing and need for surgical intervention remains controversial. Some have advocated for and showed success by treating retropharyngeal infections (RPI) and parapharyngeal infections (PPI) only with antibiotics, postponing and even avoiding the need for immediate surgical intervention and its associated complications^{3–5}, while others suggest the need for an initial surgical approach^{6,7}. We reviewed our experience with RPI and PPI to identify the factors associated with successful treatment with antibiotics alone and/or an uncomplicated clinical course.

Materials and Methods

With Institutional Review Board approval, a list of hospitalized patients from Nationwide Children's Hospital (NCH), was generated using ICD-9 (International Classification of Diseases, Ninth Revision) diagnosis codes 478.21–25 between October 2004 - February 2009. Information on patients with RPI and PPI, defined as infections in the deep neck spaces such as phlegmon/cellulitis/developing abscess or abscess by radiologic report, was collected as were demographic, clinical and radiographic data. Complications of the clinical course were defined as airway obstruction, sepsis/shock requiring intensive care, internal jugular vein thrombosis, and treatments required in addition to antibiotic administration and/or initial surgical drainage of a deep neck space during the initial hospitalization (e.g.,

other needs for intensive care, readmission, intubation, pleural empyema). Increased work of breathing that did not require intensive care for management was not considered a complication.

Univariate analysis, followed by multivariable logistic regression was conducted to identify/determine which factors independently predicted the association with the following primary outcomes: successful treatment with antibiotics alone, absence of complications, and shorter length of hospitalization (<3 days). Covariates were included in the model if they had a p 0.05 in univariate analysis and/or if they were clinically relevant. Predictor variables with a p value of <0.05, and multivariate odds ratios and 95% confidence intervals that did not include 1 were considered significant. Statistical analyses were performed by using SAS 9.3 (SAS Institute, Inc., Cary, NC).

Results

Demographic, Clinical and Microbiologic Characteristics

During the study period 135 patients were identified: Five patients were excluded due underlying immunodeficiency, previous trauma or surgery, or anatomic abnormalities. Seventy patients with RPI, 48 with PPI and 12 with infection in both deep neck spaces were included in the analysis. Clinical and demographic data are included in supplemental table 1.

Blood cultures were obtained in 68% of patients; one patient had bacteremia caused by MRSA and 2 by Group A streptococcus. A computed tomography (CT) scan was performed in all patients; 27 (21%) patients received more than one CT scan because of lack of improvement.

Patient Management and Complications

All patients received intravenous antibiotics upon admission (supplemental table 1). Of 31 children with DNI and apparent abscess on CT scan, 12 had a largest dimension of 2 cm and 10 of these 12 (83%) underwent surgical drainage; all had drainable pus at surgery. Of 27 children with apparent phlegmon with a largest dimension size 2 cm on CT scan, 15 (55%) ultimately underwent surgical drainage and all had drainable pus. Of all children who underwent a surgical procedure, 50/57 had drainable pus at the time of surgery. Previous CT reading of those **without** drainable pus at surgery included: 6 children with phlegmon (all < 2 cm), and one child with an apparent abscess less than 2 cm in largest diameter. MRSA infection was documented in 4 patients, ages 7, 16, 18 and 89 months of age. One patient with MRSA presented in septic shock. No other complications were documented in the other three patients with MRSA disease.

Complications in the entire cohort were documented in a total of 14 patients [10 with RPI, 3 with PPI, and one with mixed disease]. Four patients were re-admitted due to persistence of symptoms (median of 4.5 days, range 1–13 between hospital stays). Only one of these patients had an initial surgical drainage; 3 re-admitted patients required surgical drainage on the second admission. A total of eight patients required intensive care (6 patients required intubation for respiratory distress, one patient with MRSA had associated mediastinal extension/pleural empyema, pericarditis and septic shock, and one other had septic shock).

One other patient had a documented internal jugular vein thrombus associated with a retropharyngeal infection that eventually grew mixed anaerobic bacteria. Finally, one patient required repeat surgical drainage during the same hospitalization. Cultures ultimately yielded Group A streptococcus.

Predictors of Uncomplicated Course

Multivariate analyses were performed on 112 children who had complete data available and are shown in Table 1. After adjusting for other covariates, patients with lower white blood cell count (WBC) (per 1,000 cells/ μ L) were associated with increased odds of being in the hospital <3 days. Older age was found in univariate but not in multivariable analyses to be associated with shorter LOS. Also, older patients had a significantly higher probability of treatment with antimicrobials alone independent of other covariates. In addition, children with evidence of abscess on CT scan had a significantly lower probability of treatment with antimicrobials alone. Finally, after correcting for other covariates, patients with no stridor or increased work of breathing were less likely to have complications than those patients with these symptoms.

Discussion

In this study of children with deep neck infections we found only one variable, older age at presentation, which was independently associated with successful treatment with antimicrobials alone. After correcting for other variables, for every increase in age by one month, the odds for requiring surgery decreased by 1%. Our data also demonstrated a tendency for complications and longer length of stay in younger children. It has previously been reported that younger children with deep neck infections present with drooling, stridor, and respiratory distress more often than older children^{8,9,10}, and that they have shorter duration of symptoms prior to presentation, which may suggest that they have more rapid presentation of illness. In our cohort among children who presented with increased work of breathing or stridor (n=7), only one child was older than 24 months; the presence of these findings was also independently associated with a more complicated clinical course. In addition to these findings, we also found that an elevated WBC was associated with longer length of stay in multivariate analysis. WBC elevation has been reported in infants/toddlers who develop mediastinitis; four of four children under 18 months in one case series with retropharyngeal abscess that progressed to mediastinitis had elevated WBCs (15,000–44,900 cells/ μ L)¹¹. Finally, similar to the series by Abdel-Haq¹² et al., which demonstrated an increased risk of MRSA in children under two years of age and an association of MRSA causing mediastinitis, three of four children with MRSA DNI in our cohort were less than two years of age and one had mediastinal extension. This aggregate data suggests that children under the age of 2 years should be monitored more closely for complications, for presence for MRSA infection, and for the need for surgical intervention.

The exact percentage of MRSA causing disease in this cohort is difficult to define due to empiric use of antibiotics to which MRSA tends to be sensitive and also because less than half of the patients underwent surgical drainage. Another recent retrospective study of otherwise healthy patients hospitalized with retropharyngeal infections demonstrated that

MRSA was recovered in 16% of isolates cultured¹², though there was a higher rate of surgical drainage (65% of patients) than in our cohort. We recovered MRSA from only 8% of the cultured specimens, but MRSA was identified in about half of our total *S. aureus* isolates, which is similar to our hospital's overall MRSA rate. Because the majority of children included in the study did not undergo surgical drainage, we attempted to analyze empiric antimicrobial MRSA coverage as a factor that may have altered outcomes, however neither univariate nor multivariate analyses demonstrated improved outcomes in children who received empiric treatment for MRSA versus those who did not. We believe it is critical to culture all drainable DNI to optimally target the identified pathogens, and to provide empiric coverage for MRSA in those children with airway compromise, for young children, for ill-appearing patients, for those with mediastinal extension, and for those requiring intensive care. One should also likely account for prior or family history of MRSA infection when considering empiric MRSA treatment. Approximately 14% of the 2010 *S. aureus* isolates from our laboratory were reported (Marcon, personal communication) as constitutively resistant to clindamycin, and therefore we recognize that empiric treatment with clindamycin for DNI in our area may also fail to treat *S. aureus* infections.

All patients underwent CT scan evaluation with 21% undergoing a second CT scan evaluation during their hospitalization. It has been previously suggested that CT scan is not always accurate in determining if drainable pus will be recovered at surgery¹³. The appearance of abscess on CT scan was associated with need for surgical intervention, although due to this study's retrospective nature, we were unable to determine if this affected the clinician's decision to proceed with surgery. As in prior studies¹, on univariate analysis, the size of abscess or phlegmon <2 cm was associated with increased likelihood of successful treatment with antibiotics alone, though we did not include this in the multivariate analysis due to lack of availability of complete data in the entire cohort. For the 7 patients that underwent surgical drainage and did not have drainable pus, all had lesions less than 2 cm in largest size diameter, suggesting that smaller size dimension may be predictive of successful treatment with antibiotics alone. For the older, non-ill-appearing patient who has no respiratory distress, a CT scan may provide more useful information when performed after the first 24–48 hours of medical therapy if the child is not improving, as more than half of children in our cohort improved with antimicrobial therapy alone.

Limitations of this study include its retrospective, uncontrolled design. Both timing of surgical intervention and decision to operate were likely affected by the preference of the individual attending otolaryngologist caring for the patients. Empiric antimicrobial coverage may have affected the microbiologic findings, but in the majority of patients that underwent surgical drainage, we did isolate a causative pathogen.

In summary, in this cohort of children with deep neck infections and adjusting for several covariates, we found that older patients were more likely associated with successful treatment with antimicrobials alone. The majority of children identified with MRSA were under 2 years of age. Over half of the children in this cohort of deep neck infections who underwent CT scans ultimately did not require surgical drainage. Further studies are needed to determine the need and optimal timing for CT scans evaluation in children with DNI.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This work was partially presented at the Infectious Diseases Society of America Meeting, October, 2010. No financial support was received for this work.

References

1. Page NC, Bauer EM, Lieu JE. Clinical features and treatment of retropharyngeal abscess in children. *Otolaryngol Head Neck Surg.* 2008; 138:300–6. [PubMed: 18312875]
2. Philpott CM, Selvadurai D, Banerjee AR. Paediatric retropharyngeal abscess. *J Laryngol Otol.* 2004; 118:919–26. [PubMed: 15667676]
3. Sichel JY, Dano I, Hocwald E, Biron A, Eliashar R. Nonsurgical management of parapharyngeal space infections: a prospective study. *Laryngoscope.* 2002; 112:906–10. [PubMed: 12150626]
4. Craig FW, Schunk JE. Retropharyngeal abscess in children: clinical presentation, utility of imaging, and current management. *Pediatrics.* 2003; 111:1394–8. [PubMed: 12777558]
5. Broughton RA. Nonsurgical management of deep neck infections in children. *Pediatr Infect Dis J.* 1992; 11:14–8. [PubMed: 1549402]
6. Lalakea M, Messner AH. Retropharyngeal abscess management in children: current practices. *Otolaryngol Head Neck Surg.* 1999; 121:398–405. [PubMed: 10504595]
7. Kirse DJ, Roberson DW. Surgical management of retropharyngeal space infections in children. *Laryngoscope.* 2001; 111:1413–22. [PubMed: 11568578]
8. Cmejrek RC, Coticchia JM, Arnold JE. Presentation, diagnosis, and management of deep-neck abscesses in infants. *Archives of otolaryngology--head & neck surgery.* 2002; 128:1361–4. [PubMed: 12479720]
9. Coticchia JM, Getnick GS, Yun RD, Arnold JE. Age-, site-, and time-specific differences in pediatric deep neck abscesses. *Archives of otolaryngology--head & neck surgery.* 2004; 130:201–7. [PubMed: 14967751]
10. Elsharif AM, Park AH, Alder SC, Smith ME, Muntz HR, Grimmer F. Indicators of a more complicated clinical course for pediatric patients with retropharyngeal abscess. *Int J Pediatr Otorhinolaryngol.* 2010; 74:198–201. [PubMed: 19963280]
11. Shah RK, Chun R, Choi SS. Mediastinitis in infants from deep neck space infections. *Otolaryngol Head Neck Surg.* 2009; 140:936–8. [PubMed: 19467419]
12. Abdel-Haq N, Quezada M, Asmar BI. Retropharyngeal abscess in children: the rising incidence of methicillin-resistant *Staphylococcus aureus*. *Pediatr Infect Dis J.* 2012; 31:696–9. [PubMed: 22481424]
13. Daya H, Lo S, Papsin BC, et al. Retropharyngeal and parapharyngeal infections in children: the Toronto experience. *Int J Pediatr Otorhinolaryngol.* 2005; 69:81–6. [PubMed: 15627452]

Table 1

Multivariate Analysis for Outcomes: Length of Stay (LOS)<3 days, Successful Treatment With Antimicrobials Alone, No Complications

	Outcomes					
	LOS <3 days		Antimicrobial Treatment Alone		No complications	
	OR [95% CI]	p value	OR [95% CI]	p value	OR [95% CI]	p value
Predictors						
Age (per month older)	1.009 [1.00–1.02]	0.059	1.014 [1.00–1.03]	0.01	1.02[0.999–1.052]	0.06
Stridor or documented increased work of breathing	0.41 [0.4–4.3]	0.46	0.409 [0.04–4.3]	0.87	0.077 [0.10–0.61]	0.02
Drooling	NA *	NA *	2.47 [0.44–13.7]	0.30	0.533 [0.17–3.9]	0.53
WBC (per 1,000 cells/ μ l)	0.936 [0.88–.99]	0.02	1.023 [0.972–1.076]	0.39	1.026 [0.95–1.11]	0.51
Prior Antibiotics	1.72 [0.74–3.99]	0.21	1.435 [0.62–3.346]	0.40	0.519 [0.14–2.0]	0.34
Empiric MRSA coverage	1.044[0.42–2.60]	0.93	0.396 [0.15–1.03]	0.06	0.283 [0.05–1.68]	0.16
Abscess vs. phlegmon	0.936 [0.33–2.63]	0.90	0.343 [0.13–0.93]	0.04	3.9[0.64–24.75]	0.14

* Not Applicable. There were no patients who had a history of drooling and also had LOS <3 days.