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The changing microbiology of neck abscesses in children: implications for antibiotic therapy

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Abstract

Objectives
To provide an update on the microbiology, sensitivity rates and antibiotic prescribing patterns of superficial neck lymph node abscesses at Scotland’s largest paediatric tertiary centre. Findings were compared to historical data from our institution.

Methods
A retrospective case series of paediatric patients undergoing incision and drainage of a superficial neck lymph node abscess at the Royal Hospital for Children in Glasgow, 2018-2021.

Results
Thirty-nine abscesses were identified. Methicillin-susceptible *Staphylococcus aureus* was the commonest micro-organism (28%), followed by *Streptococcus pyogenes* (13%). 82% of patients were administered a drug regimen containing co-amoxiclav. Only 3 children required a change in their antibiotics.

Conclusion
There was a significant change in causative micro-organisms, including a decrease in *Staphylococcus aureus* and an increase in the *Streptococcus anginosus* group. We recommend the use of co-amoxiclav empirically. In abscesses showing no clinical improvement, second-line options such as clindamycin, cefotaxime and vancomycin should be considered.

Keywords: Paediatrics; Children; Neck abscess; Lymphadenitis
Introduction

Superficial lymph node abscesses in the neck are a common cause of hospital admission and emergency surgery in children. Conservative management is often sufficient for cases of minor cervical lymphadenopathy. However, when these progress to form pockets of pus, surgical incision and drainage (I&D) may be required. Suppuration may occur in various tissue spaces in the neck, so a superficial lymph node abscess must be distinguished from infection in a deeper location such as the retropharyngeal, parapharyngeal and prevertebral spaces. Depending on severity and location, complications may include bacteraemia, airway compromise and Lemierre’s syndrome (septic thrombophlebitis of the internal jugular vein). Definitive management usually involves intravenous anti-microbial therapy.

Having up-to-date information on local patterns of microbiology and antibiotic sensitivity is helpful for initiating empirical antibiotic therapy. This is particularly important given the rapidly-growing rates of resistance among commonly encountered isolates.

Our hospital published a report detailing the microbiology of neck abscesses in children between January 1996 and December 2000. Here, we present an updated series in which we aim to compare our more recent findings with these historical data to highlight any changes in microbiology, sensitivity rates and antibiotic prescribing patterns for superficial lymph node abscesses. As the largest children’s hospital in Scotland and the busiest paediatric unit in the United Kingdom for emergency work (unpublished data from Civil Eyes Ltd, 2017), our results may be useful across the UK and beyond.
Materials and methods

This study reports a retrospective review of all patients admitted to the Royal Hospital for Children (RHC) in Glasgow between April 2018 and April 2021 with a superficial lymph node abscess of the neck requiring I&D. Patients were primarily identified from the hospital’s electronic operating theatre database, cross-referenced by manually searching an archive of the department’s daily ward round handover sheets.

Patients were only included if they had culture and sensitivity testing performed on a sample obtained intra-operatively, were prescribed antibiotics, and were aged 16 years or younger.

Deep neck space abscesses (retropharyngeal, parapharyngeal and prevertebral abscesses) were excluded, as were peritonsillar, pre-auricular, mastoid and dental abscesses. Infection in a pre-existing congenital cyst (such as a thyroglossal cyst or lymphatic malformation) was excluded. Furthermore, patients with underlying malignancy or immunodeficiency were also excluded. Finally, patients with microbiological data from swabs taken without surgical intervention and those with lymphadenopathy undergoing excisional biopsies to exclude malignancy were excluded.

The patients’ electronic records were reviewed for age, sex, diagnosis, antibiotic therapy, length of stay and microbiological culture results. All microbiologic data was based on local conventional protocols for culture and sensitivity testing following guidelines published by the European Committee on Antimicrobial Susceptibility Testing (EUCAST). This includes the
agar types inoculated, incubation periods and thresholds for Minimal Inhibitory Concentrations (MICs) or zone diameters.

Comparisons were made with the previously-published study from our own hospital 1996-2000.⁴
Results

Patient characteristics

Thirty-eight children underwent 39 I&D procedures for a superficial lymph node abscess of the neck, a mean of 13 per year. One patient presented with a recurrence of the abscess requiring a repeat I&D procedure. The children ranged in age from 3 months to 15 years (median 2 years, mean 3 years 2 months) and 22 (58%) were female. 31 patients (82%) underwent surgical management within 24 hours of admission.

Culture results

The most common micro-organism identified was Methicillin-susceptible *Staphylococcus aureus* (MSSA) in a total of 11 cases (28%), followed by *Streptococcus pyogenes* (5 cases, 13%). Four abscesses (10%) had species from the *Streptococcus anginosus* group isolated (which includes *Streptococcus anginosus*, *Streptococcus intermedius* and *Streptococcus constellatus*). Mixed anaerobic organisms were identified in 3 cases. The patient with the recurrent neck abscess had the same micro-organism isolated both times (MSSA). All remaining micro-organisms are summarised in Table I. A graphical comparison with the historical series is depicted in Figure I.

Antibiotic sensitivity and resistance

Sensitivity testing results for the commonest bacteria, *Staphylococcus aureus* and *Streptococcus pyogenes*, are presented in Table II. Of note, there was a single case of
Methicillin-resistant *Staphylococcus aureus* (MRSA) and another of *Streptococcus pyogenes* resistant to both clarithromycin and clindamycin. Other resistances encountered among less common pathogens include ampicillin/amoxicillin-resistant *Haemophilus influenzae*, and *Eikenella corrodens* resistant to both metronidazole and clindamycin.

**Empirical antibiotic therapy**

All initial antibiotic regimens are presented in table III, the most common being IV co-amoxiclav (28 cases, 72%). 1 patient had their regimen changed before I&D (co-amoxiclav switched to clindamycin and cefuroxime). 2 patients had their antibiotics changed after a ‘no growth’ microbiology result due to a lack of clinical response: addition of metronidazole to co-amoxiclav in the first, and substitution of co-amoxiclav with ceftriaxone in the other.

**Clinical outcomes**

Length of stay ranged from 1 to 5 days with a mean of 2.8 days. At discharge from hospital, 36 patients (92%) were prescribed ongoing oral antibiotic therapy. This consisted of co-amoxiclav in 34 children, with the remaining children receiving clindamycin (1 child) and clarithromycin (1 child). One child had a recurrence of their abscess requiring readmission and repeat I&D. The child with the abscess due to non-tuberculous mycobacterial infection had ongoing discharge for approximately 5 months.
Discussion

**Strengths and weaknesses of the study**

Strengths include the availability of historical data for comparison and thorough ascertainment by cross-referencing two sources of data. The main limitation is the study’s retrospective design. Additionally, inclusion criteria meant that only drained abscesses were analysed. Although medical records were all manually reviewed (meaning no relevant cases have been missed), some patients had their care continued at a different institution which might have led to missing data on outcomes and complications. Also, variability in clinician documentation of diagnosis, operative procedures and outcomes may have led to ascertainment bias. Finally, since most patients had antibiotics administered prior to drainage, the presence of certain pathogens may have been underestimated.

**Patient characteristics**

When compared to the historical data from 1996-2000, there was a drop in the mean number of abscesses drained from around 24 to 13 per year.\(^4\) This may be attributed to earlier identification of abscesses and prompt antibiotic management. Furthermore, lower thresholds for referrals by General Practitioners might mean that only abscesses caused by highly virulent micro-organisms are proceeding to I&D. Nevertheless, the role of the COVID-19 pandemic, which significantly overlapped with the study’s timeframe, cannot be negated. Social distancing undeniably blunted the transmission of common upper respiratory tract infections, which predispose to head & neck abscesses.\(^6\)
The relatively short mean length of admission (2.8 days) compares favourably to historical data from our hospital (5 days) and reports from other UK centres. This may be attributed to the exclusion of abscesses managed conservatively, which often require a lengthier period of hospitalisation.

**Microbiology**

We are pleased to see that almost all I&D procedures resulted in a swab being sent to the microbiology department for culture, in contrast to the situation in the original report from our hospital 20 years ago when it was stated that it is “disappointing that incision and drainage procedures did not always result in the submission of a bacteriology swab for culture and sensitivity, the results of which could aid in the choice of antibiotic cover in difficult cases.”

There was a significant number of samples reported as “no growth” in our study population (36% of abscesses). This is similar to the 1996-2000 cohort, but slightly higher than reported elsewhere. In some cases this may be because of a failure to culture organisms that require special media, such as mycobacteria, but it is more likely simply due to the fact that most patients received a dose of antibiotics from their General Practitioner prior to admission.

Sensitivity reporting has evolved over the past two decades, so direct comparison between our series and historical data is not always straightforward. For example, benzylpenicillin resistance is less often reported given its limited role in today’s practice and erythromycin has largely been replaced in clinical practice by clarithromycin.
The predominance of *Staphylococcus aureus* and *Streptococcus pyogenes* in cultures from paediatric neck abscesses is common in published reports from the early 2000s, from the UK and elsewhere, including the historical series from our own hospital.\(^4,9,10,11\) Although Methicillin-susceptible *Staphylococcus aureus* remains the most common cause of superficial neck abscesses in children, this study has shown a decline from a rate of 46% to 28% over the past 20 years. Similarly, there was a fall in the proportion of *Streptococcus pyogenes*, although less substantial. This was met by a shift towards a variety of rarer organisms.

Despite the shorter study period, 14 different pathogens were isolated between 2018 and 2021, whereas only 8 isolates were reported from 1996 to 2000. Bacteria solely identified in the more recent cohort include *Escherischia coli*, *Eikenella corrodens*, *Enterococcus faecalis*, *Streptococcus constellatus* and *Streptococcus anginosus*.

Among the less common micro-organisms, an increased prevalence of the *Streptococcus anginosus* group (SAG, formerly known as *Streptococcus milleri*) is most noticeable, which includes *Streptococcus anginosus*, *Streptococcus intermedius* and *Streptococcus constellatus*. Abscesses caused by SAG have reportedly increased over the last 2 decades, with recent studies highlighting their true pathogenic role.\(^12,13,14\) This is likely to represent improved laboratory diagnostic techniques, as in the past SAG micro-organisms were frequently mistaken for commensal contamination, especially in polymicrobial abscesses.\(^15\) A study conducted at Texas Children’s Hospital in 2019 showed an unexplained rise in SAG infections among children with complicated sinusitis.\(^16\) A UK-based case series concluded that approximately 67% of intracranial abscess and sinusitis cultures grew SAG species.\(^17\) Thus, although the specific role of SAG in neck abscesses has not yet been addressed in the
literature, their prevalence in paediatric otolaryngological infections seems to be on the rise. This is of particular concern as *Streptococcus intermedius* may be associated with haematogenous spread and *Streptococcus anginosus* poses a risk of Lemierre’s syndrome (in addition to the more widely-known *Fusobacterium necrophorum*).18,19

*Streptococcus pneumoniae* and *Mycobacterium tuberculosis* were the only 2 micro-organisms detected in the historical study but not in the current study. Over the past two decades, the UK has benefitted greatly from the widespread administration of the pneumococcal vaccine to children,20 and fortunately, tuberculosis remains rare.21

The rate of MRSA was relatively low in this series with only 1 case identified. This is significantly lower than rates reported elsewhere, with some hospitals finding MRSA in up to 58% of paediatric neck abscesses.22 Nevertheless, it is well-established that MRSA incidence remains low across Europe.23

**Implications for antibiotic therapy**

A lack of consensus regarding first-line antibiotic choices still exists. Previous studies have proposed the use of flucloxacillin empirically.7

However, with the recent shift in microbiology, an anti-staphylococcal penicillin may not be always appropriate. Since the majority of children given co-amoxiclav monotherapy did not require a change in their regimen (89%), we recommend that it continues to be used as first-
line. Its wide coverage (including empirical anaerobic coverage) is advantageous with the increased prevalence of virulent microbes.

Nevertheless, strict policies on de-escalation are needed after microbiology results become available. A step-down approach would be reasonable in some instances to avoid the unnecessary administration of broad-spectrum antibiotics.

Overall, metronidazole was overused; it was administered to 6 patients although mixed anaerobes were cultured in only 3 instances (8% of abscesses – a significantly lower rate than suggested in the literature).\(^7\)\(^24\) Metronidazole was not discontinued post-op in any of the remaining cases.

The occasional presence of relatively uncommon organisms in this context (including \textit{Enterococcus faecalis}, \textit{Escherichia coli}, and \textit{Eikenella corrodens}), as well as virulence factors in common organisms, should be borne in mind if the child is not responding to standard empirical antibiotic therapy. Alternative antibiotics should be considered for second line use. These may include agents such as vancomycin, clindamycin (which can suppress toxin production in some organisms), cefotaxime or other Gram negative-active agents depending on culture results.

**Conclusion**

Our case series highlights a significant decline in the number of yearly drained abscesses. Similarly, the incidence of micro-organisms previously considered common is falling, including
*Staphylococcus aureus* and *Streptococcus pyogenes*. We now recommend co-amoxiclav monotherapy as first line.
**Ethical considerations**

As an anonymised, retrospective review of patient records, this study does not require formal ethical committee in our institution.

**Funding**

No external funding was required for this study

**Conflict of interest**

None of the authors has any conflict of interest to declare

**Data availability**

Study data are available from the corresponding author upon reasonable request
References


## TABLE I

Microbiology results (2018-2021 and 1996-2000 study periods)

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<tr>
<th></th>
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<tbody>
<tr>
<td>No growth</td>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td>Staphylococcus aureus (MSSA)</td>
<td>11</td>
<td>48</td>
</tr>
<tr>
<td>Streptococcus pyogenes</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Mixed anaerobic organisms</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Streptococcus constellatus</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Staphylococcus aureus (MRSA)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Enterococcus faecalis</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Streptococcus intermedius</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Streptococcus anginosus</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Staphylococcus epidermidis</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Eikenella corrodens</td>
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<td>-</td>
</tr>
<tr>
<td>Atypical mycobacteria</td>
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</tr>
<tr>
<td>Staphylococcus haemolyticus</td>
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<td>-</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
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<td>2</td>
</tr>
<tr>
<td>Mycobacteria TB</td>
<td>-</td>
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</tr>
</tbody>
</table>
**TABLE II**

Antibiotic sensitivities and resistances for *Staphylococcus aureus* and *Streptococcus pyogenes* (2018-2021)

<table>
<thead>
<tr>
<th></th>
<th>Sensitive</th>
<th>Resistant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staphylococcus aureus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flucloxacillin</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Streptococcus pyogenes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Initial antibiotic regimen</td>
<td>Number of cases</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Co-amoxiclav + Metronidazole</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Flucloxacillin</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Flucloxacillin + Benzylpenicillin</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Flucloxacillin + Metronidazole + Cefotaxime</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Clindamycin + Gentamicin</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Clindamycin + Cefotaxime</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone + Metronidazole</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
FIGURE I

Microbiology results (2018-2021 and 1996-2000), expressed as a percentage of all microbes reported.