Intravenous Antibiotic Therapy for Deep Neck Abscesses Defined by Computed Tomography

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Objective: To determine the effectiveness of using intravenous antibiotics alone to treat clinically stable children with clearly defined deep neck abscesses diagnosed by contrast-enhanced computed tomography (CT).

Design: Retrospective chart and CT scan review.

Setting: Tertiary care children’s hospital.

Patients: The study comprised clinically stable pediatric patients who presented with signs and symptoms of a deep neck infection and who had CT scans demonstrating an abscess in the parapharyngeal space, retropharyngeal space, or both that included (1) a well-formed ring enhancement around a nonenhancing density consistent with fluid and (2) a size greater than 1 cm in every dimension.

Main Outcome Measure: Clinical resolution of the signs and symptoms of the deep neck abscess after treatment with intravenous antibiotics.

Results: Over a 22-month period (May 1999 to March 2001), 11 children ranging in age from 4 months to 16½ years who had contrast-enhanced CT evidence of deep neck abscess and no clinical evidence of severe symptoms or significant airway compromise were initially treated with intravenous antibiotics. Ten (91%) of the 11 children responded to intravenous antibiotic therapy as their only treatment. All 10 responders began to improve clinically by 48 hours. The symptoms resolved in 5 children by treatment day 3. Five to 8 days of treatment were required to completely resolve the symptoms in the other 5 patients. The 1 child who did not respond to intravenous antibiotic therapy underwent surgical drainage of her deep neck abscess within 12 hours of admission, with purulence discovered at the time of surgery.

Conclusion: In a select number of clinically stable children, deep neck abscesses diagnosed on contrast-enhanced CT scans using strict radiographic criteria can be effectively treated with intravenous antibiotics alone.


Published reports on the management of deep neck abscesses (retropharyngeal or parapharyngeal abscesses) in children are conflicting. Treatment options vary between immediate surgical drainage of the abscess1,2 to instituting a trial of intravenous antibiotics in every stable case or in select cases.2-6 Confusion regarding appropriate treatment of children with deep neck abscesses has arisen from imperfect diagnostic tests,7-9 from combining pediatric and adult patients in published reviews,10-12 and from the diagnostic criteria used to clinically define the abscesses.2,13 Therefore, a current standard of care in treating pediatric deep neck infections has not been established.

Lalakea and Messner1 attempted to determine standard practices in treating retropharyngeal abscesses (RAs) by polling members of the American Society of Pediatric Otolaryngology in 1997. In that poll, 138 (77.5%) of 178 members responded. Of the respondents, 51% thought that in 20% to 40% of the cases the RAs would resolve with intravenous antibiotic therapy alone, while 13% thought that there would be resolution in 60% to 100% of the cases. Fourteen percent of the members did not respond to that question, and 22% thought that RAs would never respond to treatment with intravenous antibiotics alone.

Furthermore, 31% of respondents said that they routinely institute a trial of intravenous antibiotics before considering surgical drainage, and an additional 31% said that they use this strategy occasionally, stating that the results of computed tomographic (CT) scanning may be falsely positive. In fact, in 3 large recent studies that reviewed at least 30 patients each, the false-positive rate of contrast-
enhanced CT (CECT) in evaluating deep neck abscesses ranged from 11.8% to 25.0%.
Because of the reported inaccuracy of CECT and our own experience with negative findings on surgical explorations for deep neck abscesses, we began to electively treat stable children with classically described deep neck space abscesses on CECT with intravenous antibiotics alone.

**METHODS**

We reviewed the charts of pediatric patients who had deep neck space infections on CECT scans from May 1999 to March 2001. Children who were clinically stable and initially treated with intravenous antibiotics alone, without surgical drainage, were included in the study. Clinical stability was judged by the lack of significant clinical airway compromise and mild to moderate symptoms of neck immobility, dysphagia, and odynophagia. Any patient who underwent immediate surgical drainage was excluded from the analysis. The CECT scans of the study patients' necks were then reviewed retrospectively. For the infection to be declared an abscess and to qualify for this study, the deep neck infection had to meet the following CECT criteria: the abscess had to have a well-formed ring enhancement around a nonenhancing density consistent with fluid, and it had to be larger than 1 cm in every dimension.

The CECT scans were performed by obtaining volumetric images through the neck using a helical technique. Collimation ranged from 3 to 5 mm, depending on the child's age, with a pitch of 1. Intravenous contrast was administered by hand injection for all examinations. Precontrast images were obtained when possible. Density measurements were obtained on both precontrast and postcontrast images when available. Abscess measurements were obtained by using the computer-generated measuring tool inherent to the scanner.

Once intravenous antibiotic therapy was initiated, surgical intervention was considered if the patient's clinical symptoms or signs worsened or if no response was seen after 48 hours of treatment. Lack of response to antibiotic therapy included no improvement of neck mobility; increasing or continuation of fever; worsening of the child's disposition, with no improvement in physical activity; and no improvement in oral intake. Antibiotic therapy consisted of clindamycin alone or clindamycin with cefuroxime axetil. Duration of intravenous antibiotic therapy, subsequent duration and type of oral antibiotic therapy, and length of hospital stay were determined by the clinical response of the patient and the clinical judgment of the treating physician, with no specific guidelines.

**RESULTS**

Eleven patients fit the inclusion criteria of the study: (1) deep neck abscess defined by the above-mentioned CECT criteria and (2) clinically stable on initial physical examination. Ten patients responded to intravenous antibiotic therapy alone. The age range for the 10 responders was 4 months to 8.7 years (average age, 3.8 years). (The nonresponder was 16 years old.) There were 7 boys and 3 girls. Five children were white, 2 were African American, and 3 were Hispanic. Three patients presented in the fall, 2 in the winter, 3 in the spring, and 2 in the summer.

The patients had symptoms for 1 to 6 days (average, 4.2 days) before presentation, including some history of fever (temperatures up to 41°C), neck tenderness, decreased neck mobility, and decreased oral intake. The actual fever recorded on initial visit ranged from 36.7°C to 38.9°C (average, 38°C). Nine of 10 responders had either an active history of an upper respiratory tract infection (n = 7) or pharyngitis/tonsillitis (n = 2). The 10th responder had a rapid (<24 hour) presentation of high fever, neck tenderness, decreased neck mobility, and decreased oral intake. Only 4 of 10 responders had prior antibiotic treatment: 1 with oral amoxicillin alone, 1 with intramuscular ceftriaxone sodium (Rocephin) alone, and 2 with oral amoxicillin–clavulanate potassium (Augmentin) and intramuscular ceftriaxone. White blood cell counts ranged from 15.2 to 30.3 × 10^9/µL (mean, 21.8 × 10^9/µL) on presentation, with more segmented neutrophils than lymphocytes.

All 10 responders had some degree of tenderness and decreased mobility of the neck. The range of motion in the neck of 2 of the patients, both infants, was mildly decreased, and their heads were flexed to the side of the neck with the infection. None of the responders had erythema of the neck. There was no mention of a bulge in the posterior oropharyngeal wall of 3 responders. Six responders had a bulge described on examination, and the seventh had trismus, preventing evaluation of the oropharynx.

The CECT scans of all 11 patients revealed a deep neck abscess based on the inclusion criteria. Among the

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**Table 1. Patient Characteristics and Computed Tomographic Features**

<table>
<thead>
<tr>
<th>Patient No./Age, y/Sex</th>
<th>Race</th>
<th>Shape of Abscess</th>
<th>Size, cm</th>
<th>Location</th>
<th>Dot*</th>
<th>Nodal Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/5/3/M</td>
<td>Black</td>
<td>Scalloped</td>
<td>2.5 × 1.4 × 2.5</td>
<td>Lat retro</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>2/1.5/M</td>
<td>Hispanic</td>
<td>Scalloped</td>
<td>1.7 × 1.1 × 3.0</td>
<td>Retro</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>3/0.5/M</td>
<td>Hispanic</td>
<td>Scalloped</td>
<td>2.6 × 1.3 × 3.0</td>
<td>Retro</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>4/5.5/M</td>
<td>Hispanic</td>
<td>Smooth</td>
<td>2.3 × 1.3 × 3.0</td>
<td>Lat retro</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>5/8.7/M</td>
<td>White</td>
<td>Smooth</td>
<td>2.2 × 1.9 × 3.5</td>
<td>Lat retro</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>6/6.3/F</td>
<td>Black</td>
<td>Smooth</td>
<td>1.6 × 1.6 × 1.5</td>
<td>Lat retro/para</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>7/2.5/F</td>
<td>White</td>
<td>Scalloped</td>
<td>3.0 × 1.1 × 3.0</td>
<td>Retro</td>
<td>Yes</td>
<td>Yes, ruptured</td>
</tr>
<tr>
<td>8/1.5/M</td>
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<td>Scalloped</td>
<td>2.1 × 1.2 × 3.5</td>
<td>Lat retro</td>
<td>Yes</td>
<td>Yes, ruptured</td>
</tr>
<tr>
<td>9/4.5/M</td>
<td>White</td>
<td>Scalloped</td>
<td>3.0 × 1.9 × 3.0</td>
<td>Lat retro</td>
<td>Yes</td>
<td>Yes, ruptured</td>
</tr>
<tr>
<td>10/0.4/F</td>
<td>White</td>
<td>Scalloped</td>
<td>2.5 × 2.0 × 4.0</td>
<td>Lat retro/para</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>11/16.5/F</td>
<td>Hispanic</td>
<td>Scalloped</td>
<td>3.3 × 3.9 × 3.5</td>
<td>Submax, retro</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Abbreviations: Lat, lateral; para, parapharyngeal; retro, retropharyngeal; submax, submandibular.

*Dot indicates “dot” of enhancement noted in the center of the abscess.
responders, 8 of 10 abscesses were located in the retropharyngeal space alone, and 2 of 10 abscesses involved a combination of the retropharyngeal and parapharyngeal spaces. The size of the abscess in the responders ranged from 1.6/11003 to 3.0/11003 cm.

Seven responders underwent CT scanning both before and after the administration of intravenous contrast. The entire center portion of the abscess did not enhance in the scans of 4 of these 7 responders, and there was a center area of enhancing density (termed the dot) (Figure 1), surrounded by the nonenhancing density, in the scans of the other 3. The scans of the 3 responders who did not undergo CT before the administration of intravenous contrast demonstrated well-defined abscess rims without center enhancement noted by appearance or by density measurements in Hounsfield units.

The CECT scans of 7 of the 10 responders revealed ring enhancement that appeared scalloped (Figure 2 and Figure 3), and 3 revealed smooth ring enhancement similar to that of a lymph node (Figure 4). Two of the 7 scans with scalloped ring enhancement demonstrated the smooth appearance of a lymph node that had ruptured, causing a scalloped appearance (Figure 1).

All 10 responders were treated with clindamycin. Eight also received cefuroxime. Intravenous antibiotics were used for 3 to 10 days (average, 6.4 days), depending on symptoms and the discretion of the surgeon or infectious disease specialist. The length of hospital stay averaged 5.3 days, with a range of 2 to 8 days.

The nonresponder was a 16 1⁄2-year-old Hispanic girl who had CECT evidence of 2 abscesses—a 3.0/11003 × 2.0/11003 × 1.5-cm scalloped ring–enhanced RA and a 3.3/11003 × 3.9/11003 × 3.5-cm scalloped ring–enhanced submandibu-

Table 2. Clinical Features of Patients on Presentation

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Season</th>
<th>Preceding Disease</th>
<th>No. of Days Symptoms Were Present</th>
<th>Temperature, °C</th>
<th>WBC, ×10³/µL</th>
<th>Neck Erythema</th>
<th>Neck Tenderness</th>
<th>Neck Immobility</th>
<th>OP Fullness</th>
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<tbody>
<tr>
<td>1</td>
<td>Fall</td>
<td>None</td>
<td>1</td>
<td>38.3</td>
<td>22.6</td>
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<td>Yes</td>
<td>Yes</td>
<td>Trismus</td>
</tr>
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<td>2</td>
<td>Summer</td>
<td>URI</td>
<td>3</td>
<td>38.6</td>
<td>30.3</td>
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<td>Yes</td>
<td>Yes</td>
<td>NM</td>
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<tr>
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<td>Fall</td>
<td>URI</td>
<td>6</td>
<td>36.7</td>
<td>28.5</td>
<td>No</td>
<td>Unsure*</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>Fall</td>
<td>URI</td>
<td>5</td>
<td>38.9</td>
<td>21</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>NM</td>
</tr>
<tr>
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<td>Winter</td>
<td>URI</td>
<td>3</td>
<td>38</td>
<td>25.2</td>
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<td>Yes</td>
<td>Yes</td>
<td>NM</td>
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<td>38.3</td>
<td>ND</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
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<td>Spring</td>
<td>URI</td>
<td>5</td>
<td>38</td>
<td>15.5</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
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<td>URI</td>
<td>3</td>
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<td>23.8</td>
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<td>Yes</td>
<td>Yes</td>
<td>NM</td>
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<tr>
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<td>36.7</td>
<td>15.2</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>Winter</td>
<td>URI</td>
<td>3</td>
<td>37.3</td>
<td>23.7</td>
<td>No</td>
<td>Unsure*</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>11</td>
<td>Winter</td>
<td>Pharyngitis</td>
<td>6</td>
<td>38.9</td>
<td>17.4</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>NM</td>
</tr>
</tbody>
</table>

Table 3. Hospital Course

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Antibiotics Used</th>
<th>Day Neck Mobility Improved</th>
<th>Day Neck Mobility Resolved</th>
<th>Day Fever Resolved</th>
<th>Day Oral Intake Was Tolerated</th>
<th>Day Normal Diet Was Tolerated</th>
<th>No. of Days on Intravenous Antibiotics</th>
<th>Total Hospital Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clindamycin, cefuroxime axetil</td>
<td>2</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Clindamycin</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Clindamycin, cefuroxime</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Clindamycin</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Clindamycin, cefuroxime</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Clindamycin, cefuroxime</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Clindamycin, cefuroxime</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Clindamycin, cefuroxime</td>
<td>1</td>
<td>2</td>
<td>Afebrile*</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
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<td>2</td>
<td>5</td>
<td>Afebrile*</td>
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<td>3</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>Clindamycin, cefuroxime</td>
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<td>2</td>
<td>Afebrile*</td>
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<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>Clindamycin</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2. Clinical Features of Patients on Presentation

Abbreviations: ND, not done; NM, not mentioned; OP, oropharynx; URI, upper respiratory tract infection; WBC, white blood cell count.

*Difficult to diagnose because patient was younger than 6 months.

Table 3. Hospital Course

Abbreviation: NA, not applicable.

*On presentation.
lar abscess (Figure 5)—and who had dysphagia, trismus, neck fullness, neck erythema, and temperatures as high as 39°C for 5 days before presentation. Her symptoms worsened over an 8-hour period during intravenous clindamycin therapy, and she was found to have 10 mL of purulence at the time of surgical drainage.

On discharge, 8 of the 10 responders were given oral clindamycin for 7 to 9 days, usually depending on the length of intravenous antibiotic therapy and the persistence of symptoms. The other 2 were given either oral amoxicillin-clavulanate or cefuroxime. Although, as a rule, long-term follow-up was not performed in these patients once the infection had cleared, no patient had recurrence of the acute infection requiring antibiotic therapy. One of the 10 responders had some persistent neck fullness, without limitation of movement, that prompted fine-needle aspiration 3 months after the initial acute neck infection: the results were negative for malignancy and chronic infection. The patient was then unavailable for follow-up.

The response to treatment was measured by the improvement and resolution of neck tenderness and mobility, the ability of the patient to ingest oral fluids and a regular diet, and time to defervescence. Neck tenderness and mobility improved in all 10 patients by 48 hours, re-
solved in 6 patients by 3 days, and resolved in the other 4 patients by 5 to 8 days. Oral intake improved in 8 patients by 24 hours and resolved to normal diet in all patients by 3 days. Three patients started their hospital course afebrile and remained afebrile. Five patients became afebrile by 48 hours; 1 became afebrile by 3 days; and 1 became afebrile by 4 days.

Three of the 10 responders underwent follow-up CT scans, all while in the hospital. One scan was performed to evaluate a very slow clinical response, and the other 2 scans were obtained to define improvement of the abscess radiographically in children who were clinically improving or had improved (Figure 6). All 3 showed a resolving or resolved deep neck infection.

COMMENT

Treating children with deep neck space infections can be challenging. In the preantibiotic era, mortality rates ranged from 7% to 15% and complication rates were as high as 25%.14-18 However, children more commonly presented later in their disease course,18 and often with significant airway symptoms.15,16 Surgical drainage was the only method of treatment.

The incidence, morbidity, and mortality decreased as a result of the development of intravenous antibiotics in the 1930s and 1940s and the earlier recognition of the disease, both clinically and radiographically.1 In the middle part of the 20th century, lateral neck x-ray films helped localize the disease process to the neck and retropharynx, but did not delineate abscess from phlegmon, unless air was present. In the 1980s, CT of the neck better delineated the soft tissues of the neck, helping to define the presence of an abscess. In fact, because of the reported near-perfect accuracy of CT in differentiating abscesses from phlegmons in some early reports of small case series in the 1980s and early 1990s, physicians began to rely heavily on CECT results to dictate their management.

However, more recent reports over the last several years have shown the shortcomings of CECT. In differentiating deep neck abscesses from phlegmons, several large series have reported the false-positive rate to range from 8% to 25%.7,9,21 Furthermore, Broughton5 and Sichel et al6 describe children who responded to treatment with intravenous antibiotics alone with significant CECT evidence of RAs defined by classic radiographic criteria of ring enhancement and large size. Many of the cases reported by Sichel and colleagues showed scalloped rim enhancement, thought by Kirse and Roberson1 to be an important predictor of abscess formation.

All of our cases fit the classic CECT description of abscesses: ring enhancement around nonenhancing central density consistent with fluid. All of our patients’ abscesses were large (>1 cm in all dimensions), helping to ensure they were not small suppurative nodes. However, based on the smooth appearance of the entire abscess or a portion of it, nodal suppurration does appear to play a role in the pathogenesis of some pediatric neck infections, as previously described.5,14,17,21

Because abscesses are often polymicrobial, we used both clindamycin and cefuroxime as empiric therapy. Several authors not only state that the gram-positive aero-

bic species of Staphylococcus and Streptococcus are important pathogens, they also mention that anaerobes, gram-negative organisms, and β-lactamase–producing organisms are not infrequently found.11,13,23,24

Treating possible purulence without physically removing it can lead to the development of complications such as airway obstruction, mediastinitis, internal jugular vein thrombosis, and carotid artery rupture. Such complications may be less likely in children than adults, because more true fascial plane infections may be seen in adults. Neck infections arising from infected lymph nodes seem to occur more often in children4 and may be more self-contained highly vascular entities, allowing a better chance of safe, nonsurgical management. We saw no complications in our patients who were treated with intravenous antibiotics alone.

CONCLUSIONS

The signs and symptoms of abscesses may resolve in children with CECT evidence of a deep neck abscess who are treated with intravenous antibiotics alone. Whether CECT was inaccurate in diagnosing abscesses in our 10 patients who responded to intravenous antibiotic therapy or whether intravenous antibiotics can actually penetrate an abscess to truly treat these infections is unknown. What is known is that these children responded to nonsurgical treatment quickly, without surgical drainage. We believe that a trial of intravenous antibiotic therapy could be considered before immediate surgical intervention is performed in children who are clinically stable. However, it is important to note that each child with a neck infection should be treated individually and that the type of treatment to use in each case is always the decision of the treating physicians and surgeons.

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REFERENCES