COVID-19 Impact on Operative Management of Pediatric Neck Abscesses

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Abstract

Introduction For multiple reasons, elective pediatric otolaryngology surgical procedures have declined during the COVID-19 pandemic.

Objective The purpose of the present study was to assess whether the prevalence of pediatric neck abscesses managed with operative drainage decreased compared with previous years.

Methods Medical records of all pediatric cases at a tertiary care children's hospital diagnosed with abscess of the neck and treated with incision and drainage were evaluated between the dates of April 1 and November 30 from 2015 to 2020. Outcomes were compared for each year from 2015 to 2019 to 2020, which included location, abscess size, duration of antibiotic treatment, microbiology, and the number of cases per year.

Results A total of 201 cases were included. The mean ± standard deviation (SD) presenting age in the 2015 to 2019 group was 5.05 ± 5.03 years old and 2.24 ± 1.91 years old in the 2020 group. The mean number of cases between 2015 and 2019 was 35.6 ± 4.2, whereas the number of cases in 2020 was 23 ($p = 0.002$). Of those patients who underwent IV antibiotic therapy prior to presentation ($n = 43$), the mean number of days before admission was 1.98 ± 2.95 ($n = 40$) from 2015 to 2019 and 12.00 ± 10.39 ($n = 3$) in 2020 ($p = 0.008$). The percent of cases with multiple strains cultured between 2015 and 2019 was 13.4% versus 18.2% in 2020 ($p = 0.007$).

Conclusion There was a decrease in the number of operative neck abscesses in 2020 compared with the mean number per year from 2015 to 2019. COVID-19 mitigation strategies leading to reduced transmission of other viral and bacterial illnesses and a tendency toward prolonged medical management to avoid surgery are two possible explanations.

Keywords
- abscess
- pediatrics
- operative surgical procedure
- coronavirus
- pandemic

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Introduction

Pediatric head and neck masses most often stem from congenital and inflammatory processes.[1] In toddlers and later childhood, reactive lymphadenopathy predominates.[1] Once a diagnosis of abscess is confirmed following history, physical exam, and possibly imaging, the decision to proceed with medical versus surgical management falls on the consulting otolaryngologist.

There is no consensus as to which abscesses will respond to medical management and which will require surgical intervention; however, size is one variable that has frequently been studied. Studies that assess pediatric neck abscesses vary on the size that is recommended most to undergo surgical intervention. Souza Menezes et al.[2] and Nagy et al.[3] stated that although medical management is sufficient in uncomplicated cases, incision and drainage (I&D) along with intravenous (IV) antibiotics is effective when medical treatment fails. Wong et al.[4] and Côrte et al.[5] concluded that abscess size should be considered when deciding on management. Both studies reported that smaller abscesses can be treated with antibiotics alone while larger abscesses ($\geq$ 25 mm or $>$ 20 mm, respectively) require surgery.[4,5]

Age has also been considered. Harounian et al.,[6] who performed a retrospective analysis of 239 pediatric patients with cervical abscesses, reported that younger children are more likely to undergo surgery than older children (odds ratio [OR] = 2.38 in children $<$ 1 year old) despite smaller abscess sizes ($\geq$ 1 cm). These results suggest that abscess size expectations for surgery should be lowered for infants.

Microbiology, while most often distinguished following I&D, has helped direct antimicrobial intervention. The most common bacteria identified in unilateral cervical lymphadenitis are gram-positive organisms, including Staphylococcus aureus and Group A β-hemolytic Streptococcus (S. pyogenes).[7] Brook[8] performed a systematic review and listed cefoxitin, clindamycin, a carbapenem (i.e., imipenem, meropenem) and a penicillin with a β-lactamase inhibitor as common effective antibiotics. Average stays of 5 and 8 days in tertiary hospitals with an average duration of 7 days for IV antibiotics were reported.[9] Average durations of 1 to 2 weeks and of 2 to 3 weeks for oral antibiotics following discharge were also reported.[10]

The COVID-19 pandemic has changed medical decision-making in multiple domains across medical and surgical specialties alike. Medical centers implemented provisions to reduce the transmission of the virus and to ration resources for infected patients.[11] Several states reported a decrease in emergency department visits with hospital admissions increasing only when regional COVID-19 cases increased.[12] Specialties such as orthopedic, plastic, and oncological surgery reported a delay and/or reduction in procedures, with otolaryngology also reporting dramatic decreases in consultations and surgeries.[13,14] The main objective of the present comparative study was to evaluate whether the COVID-19 pandemic impacted the prevalence and surgical management of pediatric neck abscesses. We hypothesized that there would be a lower number of surgical cases because of pandemic mitigation strategies that led to decreased transmission of bacterial and viral infection in pediatric populations.

Methods

A protocol was approved by the Institutional Review Board (STUDY20060029). In a case series analysis, we reviewed medical records of all pediatric cases ages 0 to 18 years old diagnosed with abscess of the deep neck space and treated with incision and drainage at a large tertiary care children's hospital between the dates of April 1 and November 30 from 2015 to 2020. The date of April 1 was chosen due to the approximate start of COVID-19 pandemic mitigation strategies. Location of abscesses included all deep neck space abscesses (peritonsillar, deep parotid, parapharyngeal, and retropharyngeal spaces). We compared outcomes for each year from 2015 to 2019 to the same date range in 2020, which included demographics, location of the infection (deep neck), abscess size, symptoms, days of admission, duration of antibiotic treatment before and after operative intervention, microbiology, need for repeat surgical drainage, and the number of cases per year. Prior antibiotic administration was documented in the initial tertiary care emergency department visit. The size of the abscess was determined by the final radiology report if a neck computed tomography (CT) scan with contrast was obtained. Total volume of the abscess was calculated by multiplying the anteroposterior, transverse, and craniocaudal dimensions to obtain cm^3. Return to surgery indicated repeat incision and drainage. Success rates were determined by no return to surgery.

Statistical analyses were performed using IBM SPSS Statistics for Windows version 27 (IBM Corp., Armonk. NY, USA) with $p < 0.05$ denoting significance. Along with descriptive statistics, the Fisher Exact test was used for dichotomous variables and the Mann-Whitney U test was used for continuous variables for nonparametric data. Bonferroni correction was used for multiple analyses to adjust for Type 1 error. The Kruskal-Wallis test was used for nonparametric data with $>$ 2 levels of the independent variable.

Results

The total number of cases from 2015 to 2020 was 201 with 35 cases in 2015 (17.4%), 41 in 2016 (20.4%), 34 in 2017 (16.9%), 38 in 2018 (18.9%), 30 in 2019 (14.9%), and 23 in 2020 (11.4%). The mean $\pm$ standard deviation (SD) number of cases between 2015 and 2019 was 35.6 $\pm$ 4.2, whereas the number of cases in 2020 was 23 (p= 0.002).

Demographics are shown in ►**Table 1**. The mean $\pm$ SD presenting age in the 2015 to 2019 group was 5.05 $\pm$ 5.03 years old and 2.24 $\pm$ 1.91 years old in the 2020 group (p = 0.064). There were no differences in sex and insurance variables between groups ($p > 0.05$). Patient age was dichotomized into $\leq$ 5 and $>$ 5 years old. Patients in 2020 were 6.8 times more likely to be $\leq$ 5 years old (91.3%) compared with patients in in the 2015 to 2019 group ($\leq$ 5 years = 60.7%),

Table 1 Demographics of the neck abscess patients who presented in 2015 to 2019 compared with those in 2020

	All $n = 201$	2015–2019 $n = 178$	2020 $n = 23$	*p-value*
Age at presentation, years, mean ± SD	4.73 ± 4.85	5.05 ± 5.03	2.24 ± 1.91	0.064
Sex, *n* (%)				
Male	98 (48.8%)	84 (47.2%)	14 (60.9%)	0.270
Female	103 (51.2%)	94 (52.8%)	9 (39.1%)	
Insurance, *n* (%)				
Public	113 (56.2%)	103 (57.9%)	10 (43.5%)	0.264
Private	88 (43.8%)	75 (42.1%)	13 (56.5%)	

Abbreviation: SD, standard deviation.

(OR: 6.81, 95% confidence interval [CI]: 1.55–29.93; $p = 0.004$).

The mean anteroposterior (AP) dimension of the abscesses on CT from 2015 to 2019 was 2.19 ± 0.81 and 2.33 ± 0.90 in 2020 ($p = 0.518$). The mean transverse dimension of the abscesses on CT from 2015 to 2019 was 2.11 ± 0.86 and 1.99 ± 1.04 in 2020 ($p = 0.316$). The mean craniocaudal dimension of abscess on CT from 2015 to 2019 was 2.47 ± 1.17 and 2.66 ± 1.92 in 2020 ($p = 0.842$). There was no difference in total volume (cm^3) between groups (2015 to 2019: 15.28 ± 22.86 versus 2020: 15.58 ± 20.20; $p = 0.518$). ►**Table 2** shows the breakdown of specific I&D neck locations between years.

For symptom presentation, 132 out of 201 (65.7%) patients had fever, 40 out of 201 (19.9%) had pain when swallowing, 45 out of 201 (22.4%) had difficulty swallowing, and 157 out of 201 (78.1%) had neck stiffness or swelling. There were no differences in symptoms between year groups for fever, pain when swallowing, and difficulty swallowing; however, 100% (23/23) of the patients in 2020 had neck stiffness or swelling compared with 75.3% (134/178) from 2015 to 2019 (p = .003).

Of those patients who underwent IV antibiotic therapy prior to presentation at the tertiary care center ($n = 43$; 21.4%)), the mean ± SD number of days before admission was 1.98 ± 2.95 ($n = 40$) from 2015 to 2019 and 12.00 ± 10.39 ($n = 3$) in 2020 ($p = 0.008$). The total number of cases who underwent oral antibiotic therapy prior to presentation was 93 (46.3%) patients with 79 out of 178 (44.4%) from 2015–2019 versus 14 out of 23 (60.9%) in 2020 ($p = 0.182$). The mean ± SD number of days of oral antibiotics before admission to our hospital was 13.57 ± 44.96 from 2015 to 2019 and 5.07 ± 4.36 in 2020 ($p = 0.658$). The mean ± SD total days of admission in 2015 to 2019 was 4.29 ± 2.32, and in 2020 it was 4.96 ± 2.60, $p = 0.210$. The mean ± SD days of admission after operative intervention from 2015 to 2019 was 2.11 ± 2.18, and in 2020 it was 2.61 ± 1.78 ($p = 0.053$). There was no difference between groups for days of antibiotics at our hospital, 2015 to 2019: 4.50 ± 5.82 versus 2020: 6.35 ± 9.00 ($p = 0.064$).

There was a total of 194 cases with cultures recorded (►**Table 3**). All 22 out of 22 cases in 2020 were positive whereas 78.5% (135 out of 172) of cases from 2015 to 2019

Table 2 Comparison of the location of deep neck space abscesses

	All $n = 201$ *n* (%)	2015–2019 $n = 178$ *n* (%)	2020 $n = 23$ *n* (%)
Parapharyngeal (PPG) only	6 (3.0)	5 (2.8)	1 (4.3)
Peritonsillar (PTA) only	22 (10.9)	22 (12.4)	–
Retropharyngeal (RPA) only	42 (20.9)	37 (20.8)	5 (21.7)
Neck only	105 (52.2)	90 (50.6)	15 (65.2)
Parotid only	7 (3.5)	7 (3.9)	–
Neck and parotid	1 (0.5)	1 (0.6)	–
PPG and PTA	2 (1.0)	1 (0.6)	1 (4.3)
PPG and RPA	8 (4.0)	7 (3.9)	1 (4.3)
PPG and Neck	1 (0.5)	1 (0.6)	–
RPA and Neck	3 (1.5)	3 (1.7)	–
RPA and Other	1 (0.5)	1 (0.6)	–
Other*	3 (1.5)	3 (1.7)	–

*Other abscesses were oral, intratonsillar abscess, and prevertebral.

Table 3 Microbiology differences between 2015 and 2019 and 2020 groups

	All *n* (%)	2015–2019 *n* (%)	2020 *n* (%)	*p-value*
Microbiology, $n = 194$				
Negative	37 (19.1%)	37/172 (21.5%)	0/22 (0%)	**0.009**
Positive	157 (80.9%)	135/172 (78.5%)	22/22 (100%)	
Micro Strains, $n = 194$				
Negative	37 (19.1%)	37/172 (21.5%)	0/22 (0%)	**0.007**
Single strain	130 (67.0%)	112/172 (65.1%)	18/22 (81.8%)	
Multiple strain	27 (13.9%)	23/172 (13.4%)	4/22 (18.2%)	
Aerobic, $n = 194$				
Negative	47 (24.2%)	46/174 (26.4%)	1/22 (4.5%)	0.018
Positive	147 (75.8%)	128/174 (73.6%)	21/22 (95.5%)	
Anaerobic, $n = 168$				
Negative	147 (87.5%)	128/147 (87.1%)	19/21 (90.5%)	1.000
Positive	21 (12.5%)	19/147 (12.9%)	2/21 (9.5%)	

Bonferroni correction critical value, $p < 0.0125$, values less than this p-value are significant.
Bold indicates significance.

were positive ($p = 0.009$). Patients in 2020 had an increased likelihood of single and multiple strains ($p = 0.007$) but no differences were found between groups for positive aerobic strains ($p = 0.018$) and positive anaerobic cultures ($p = 1.000$) when Bonferroni statistical correction was used ($p < 0.0125$).

A total of 12 (6.0%) cases returned to surgery, 11 out of 178 from 2015 to 2019 (6.2%) versus 1 out of 23 in 2020 (4.3%) ($p = 0.728$). There was no difference in return to surgery rates between each year from 2015 to 2020 ($p = 0.122$). Success rates are seen in ►**Fig. 1**. Return to surgery was not predicted by abscess volume (cm^3) or positive microbiology ($p = 0.092$ and $p = 0.591$, respectively). There was no difference in likelihood of the need for repeat surgical drainage between age groups (> 5 years old, 6.9% versus ≤ 5 years old, 5.4%; $p = 0.759$).

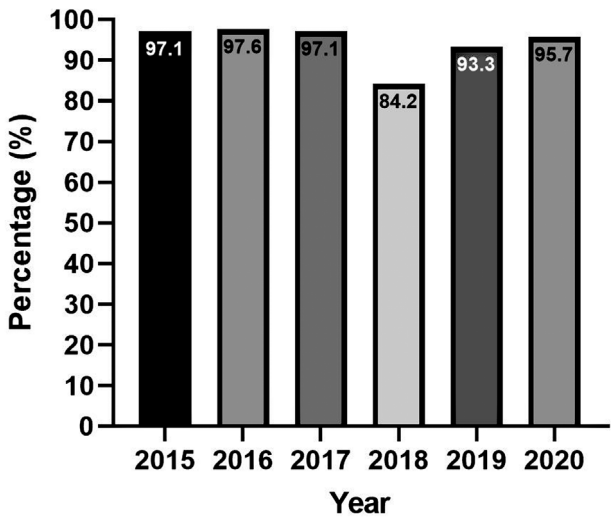

Fig. 1 Success rates of neck abscess surgical intervention determined by no return to surgery.

Discussion

The COVID-19 pandemic shifted the landscape of healthcare across multiple sectors. In particular, acute care surgery saw a decrease in emergency room presentations explained, in part, by fear of COVID-19 exposure resulting in more severe clinical conditions.[15] Our study assesses the incidence of acute management of pediatric deep neck space abscesses. There was a statistically significant decrease in the number of operative neck abscesses in 2020 during the COVID-19 pandemic compared with the mean number per year from 2015 to 2019 within the same date range. The present study demonstrates a novel comparison between incidence of surgically managed neck abscesses pre-COVID-19 pandemic and during it.

We thoughtfully chose the time period to compare with prior years. Many of COVID-19 strategies were implemented between March and April 2020 at the same time case numbers were initially spiking in our region.[16] Strategies included, but were not limited to, school closings, out of state travelers quarantine, restriction of nonessential business operations and mask wearing.[16] We chose April to November as a suitable time period to capture the maximum impact these efforts had prior to the first vaccine administration in December 2020.

COVID-19 mitigation strategies may have contributed to multiple shifts in treatment and presentation. A fear among people early in the pandemic regarding transmission of the virus limited social interaction and, unfortunately, delayed medical care.[17] We also consider surgeon hesitancy to operate early in the course of an abscess due to concerns for aerosol-generating procedures. The number of non-COVID-19-related emergency visits decreased during the pandemic and several studies have revealed worsening disease severity on presentation.[17–19] However, the present study reveals no significant

change in the size of the abscess documented on CT scan. Interestingly, the mean age decreased during the pandemic. While not statistically significant, this presents a question of whether older children were more likely to be treated with outpatient or telecommunication medical management, thus avoiding the hospital and fear of a higher transmission rate of COVID-19 within the acute care setting. This suggests that parents or referring providers were not as willing to delay medical care for their younger patients during the pandemic.

Studies suggest that the common mean age reported for surgical intervention is 4 years old.[4,6,7] Interestingly, the Center for Disease Control and Prevention (CDC) recommended that children < 2 years old should not wear a mask in public during the pandemic.[20] Also, daycares maintained in-person operations more often than primary and secondary schools were held virtually.[21,22] Considering these factors, younger children, closer to 2 years old, were likely more susceptible to an infection which aligns with our decrease in the mean age of operative cases during the pandemic. Of note, there were no peritonsillar abscesses (PTAs) alone surgically treated during the pandemic, whereas, pre-pandemic, they made up $\sim 12\%$ of the abscesses. The mean age of patients presenting with PTA is school-aged, previously reported as 12.07 ± 4.75 years old.[2] As previously discussed, this age group wore masks during the pandemic, possibly contributing to a lower incidence of surgically-treated PTAs. In addition, while unrecorded, patients presenting during the pandemic with a PTA may have been drained in the emergency department more frequently.

In addition, a larger percentage of cases during the pandemic were treated with oral antibiotics prior to presentation at the hospital, implying an attempt to treat the infection outpatient at a higher rate. However, all cases during the pandemic had positive microbiology results with a higher rate of multiple strains speciated, suggesting a higher severity presenting during the pandemic. Similar studies prior to the pandemic analyzing the microbiology of operative abscesses report single strain or negative results, again suggesting pediatric deep neck space abscesses presenting during the pandemic had more severe infections.[4,6,9] It is worth noting that our management of neck abscesses before and during the pandemic remained unchanged. Patients remained in the hospital postoperatively for similar amounts of time and the decision to proceed with surgery considered the same variables: antibiotic use preoperatively, size of the abscess, and severity of associated clinical symptoms.

The present study has several strengths. All patients were seen at the emergency department of a large tertiary care children's hospital accepting transfers from a large geographic location spanning multiple bordering states. This enabled a large sample size providing a comprehensive dataset of multiple variables contributing to the diagnosis and management of pediatric neck abscesses.

The present study also has limitations. Not all patients underwent neck CT with contrast, therefore limiting a comprehensive review of the difference in size between the two study date ranges. In addition, exact start dates of antibiotic management prior to presentation depended on appropriate and accurate documentation. Comparing the number of operative cases with the total number of nonoperative deep neck space abscesses diagnosed in this time period would provide a valuable understanding to the shift in incidence of operative cases; however, this was not possible. There exists no collective data pool that identifies the total number of diagnosed deep neck space abscesses in the geographic region served by our tertiary care center. This is difficult to assess as it would require data collection from all community hospitals, urgent cares, and primary care offices in the region. Our hospital is the only tertiary care hospital in the tri-state region and does, however, captured most if not all surgically-managed deep neck space abscesses during this time. None of these limitations impact the gross number of cases undergoing operative intervention.

There are several future studies worth mentioning. Assessing the qualitative and other quantitative variables contributing to the severity of an abscess should be considered. This could help reveal whether severity of abscess and delay of medical care contributed to the overall decrease in operative management of pediatric neck abscesses. Extending the date range to include peak months of respiratory illnesses over the winter will strengthen the sample size and possibly statistical significance. We may also consider analyzing case numbers of antibiotic treatment alone versus this cohort to capture a larger picture of the total number of abscesses presenting and assess whether more were treated medically during the COVID-19 pandemic. Additionally, as vaccine administration increases, future studies may aim to analyze changes in the incidence of surgically-managed pediatric neck abscesses postmitigation strategies. It is possible the incidence returns to prepandemic levels as masks and social distancing are no longer required.

Conclusion

The present case series review reveals a statistically significant decrease in the number of operative pediatric neck abscesses in 2020 during the COVID-19 pandemic compared with the mean number per year from 2015 to 2019 within the same date range. This novel comparison suggests that COVID-19 mitigation strategies leading to reduced transmission of other viral and bacterial illnesses and a tendency toward prolonged medical management to avoid surgery.

Conflict of Interests

The authors have no conflict of interests to declare.

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