

Main Article

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Myringotomy tube placement: understanding the impact of the coronavirus disease 2019 pandemic

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Abstract

Objective. Otolaryngologists perform bilateral myringotomy and tube placement for surgical management for otitis media with effusion. This retrospective study aimed to address the extent to which the coronavirus disease 2019 pandemic and season impact the number of bilateral myringotomy and tube placement procedures performed at a tertiary care centre.

Methods. A total of 1248 charts of children who underwent bilateral myringotomy and tube placement from January 2018 through February 2021 were reviewed.

Results. The cohort included 41.6 per cent females and 58.4 per cent males, with 63.7 per cent having private insurance. The median age at surgery was 2.6 years. The spring season had the most bilateral myringotomy and tube placement procedures per week. The number of bilateral myringotomy and tube placement procedures performed per week after the onset of the coronavirus disease 2019 pandemic was significantly lower compared to the years prior. There was no difference in number of intra-operative effusions pre-pandemic versus after the pandemic onset.

Conclusion. This study sheds light on the impact of the coronavirus disease 2019 pandemic and seasonality on the rates of tympanostomy tube procedures, vital for understanding the temporality of ear infections.

Introduction

Otitis media is one of the most encountered paediatric health conditions seen in the USA, with approximately 2.2 million cases each year.¹ About 80 per cent of children have had one or more episodes of otitis media with effusion (OME) by the age of 10 years.² Chronic otitis media is relatively common in children aged 6–24 months, with most cases occurring in children before the age of 5 years.³ Indications for bilateral myringotomy and tube placement include chronic otitis media, recurrent otitis media and Eustachian tube dysfunction, though this list is not exhaustive.

Previous studies have demonstrated several risk factors for developing OME, one of which is seasonality, which was investigated in this study.⁴ One of this study's main objectives was to evaluate how typical seasonal variations in the number of bilateral myringotomy and tube placement procedures persisted or varied upon the onset of the coronavirus disease 2019 (Covid-19) pandemic.^{5,6}

Studies have shown increased rates of acute otitis media when there are higher rates of respiratory viruses including respiratory syncytial virus, influenza and parainfluenza virus.⁷ Therefore, it is reasonable to infer there would be higher rates of acute otitis media secondary to the Covid-19 virus, but this does not account for the extensive mitigation measures that have accompanied the pandemic. To this effect, it has been shown that the Covid-19 pandemic has created substantial changes in the pattern and incidence of common paediatric viral and bacterial infections, including notably low rates of respiratory syncytial virus, as well as OME.⁸

Hullegie *et al.*, in a study of over 67 000 children aged 0–12 years in the Netherlands, found that episodes of otitis media significantly decreased during the pandemic, as did the number of prescriptions of oral antibiotics for acute otitis media.⁹ Aldè *et al.*, in a study of 932 children aged 6 months to 12 years in Italy, found a significant decrease in the prevalence of paediatric OME when comparing May–June 2020 with May–June 2019.¹⁰ They also put forth recommendations to suggest that children have a two-month break from group settings to facilitate the resolution of severe and resistant chronic OME.¹⁰ Both articles cited increased hand washing and social distancing as potential reasons for the decreased incidence of otitis media.^{9,10} These studies shed light on potential lessons from the pandemic that could have longitudinal positive effects on paediatric health, an area of study that should continue to evolve as the pandemic itself does.

This study addresses several questions in order to understand the impact of not only the Covid-19 pandemic, but also seasonality, on the number of children undergoing

bilateral myringotomy and tube placement procedures in Upstate New York at a large tertiary medical centre. Seasonal factors play a role in numerous paediatric health conditions, and one major aim of this study was to shed light on the interplay between seasonality and the surgical management of OME. Specifically, we aimed to address whether the number of bilateral myringotomy and tube placement procedures completed per week varied from before to after the onset of the Covid-19 pandemic. Secondly, we evaluated whether the number of bilateral myringotomy and tube placement procedures per week varied by season. Lastly, we investigated whether there was a change in the proportion of effusions seen intra-operatively by season or in relation to the Covid-19 pandemic. We hypothesised that there was an overall reduction in the number of children with OME, chronic otitis media and recurrent otitis media during the Covid-19 pandemic. As a result of fewer infections, we hypothesised that there were fewer bilateral myringotomy and tube placement procedures performed upon the onset of the Covid-19 pandemic, deviating from the baseline seasonal variation that was seen pre-pandemic. In addition, we hypothesised that there were fewer effusions noted during bilateral myringotomy and tube placement procedures performed during the Covid-19 pandemic.

Materials and methods

A retrospective study (exempt from institutional review board review) was completed of all patients who presented to ENT out-patient clinics at a single tertiary care centre in New York state, from January 2018 to February 2021, with International Classification of Diseases 10th Revision codes H60–H95. Patients aged less than 18 years were included in this study.

Electronic medical records were utilised to extract the following information from those patients: gender, ethnicity, race, age, type of insurance, referring diagnosis, month and year of first ENT visit, past medical history, date of tympanostomy tube placement, complications from tube placement, and presence of effusion at the time of ear tube placement. No distinction was made between unilateral or bilateral effusion at the time of surgery, as either was considered a positive effusion.

Many patients had multiple bilateral myringotomy and tube placement procedures performed during the study period. Each procedure was counted as a unique data point. If any portion of the chart had ambiguous wording or the data were not recorded, the value in the dataset was marked as unknown.

The onset of the Covid-19 pandemic for the purposes of this study was 1 March 2020. This date was used as it was the date of the first officially confirmed case of Covid-19 in the state of New York.¹¹

Assessment of seasonal variation in the frequency of bilateral myringotomy and tube placement procedures at baseline was conducted to better elucidate the typical variation seen without the influence of a global pandemic. Seasonal analyses were conducted with the following dates used to mark the seasons: winter as 1 December to 29 February, spring as 1 March to 31 May, summer as 1 June to 31 August, and autumn as 1 September to 30 November.

Statistical analyses of the number of bilateral myringotomy and tube placement procedures per week, the number of effusions per week, and the proportion of effusions (ratio of

effusions per month to bilateral myringotomy and tube placement procedures per month) were conducted by two-way analyses of variance, with fixed effects of the Covid-19 pandemic (before or during the pandemic), the season (winter, spring, summer and autumn) and their interaction. The interaction effect tests whether the effect of the coronavirus pandemic was different depending upon season. Multiple comparisons were made using the Tukey test.

Results

A total of 1248 bilateral myringotomy and tube placement procedures were included in the final dataset among 1192 patients. The median age at the procedure date was 2.6 years, with an age range of 0.3–16.5 years. Most patients were male (58.4 per cent), Caucasian (88.5 per cent) and privately insured (63.7 per cent). Of the procedures, 87.2 per cent were performed by a single otolaryngologist and 28.9 per cent of procedures had a resident present.

The demographics of patients in the pre-Covid-19 period and after the onset of the Covid-19 pandemic, with the threshold being 1 March 2020, are shown in Table 1. There was a greater relative proportion of male patients than females, both before and after the onset of the Covid-19 pandemic. Additionally, most patients before and after the pandemic onset were Caucasian, with the smallest proportion of patients identifying as Asian. Most patients had private insurance relative to other insurance models evaluated, for both time-points (before and during the pandemic). Lastly, the average age at surgery after the pandemic onset was 3.9 years, and the average age pre-pandemic was 3.8 years, which is comparable. The *p*-values for each demographic variable are

Table 1. Demographics of study participants

Variable	Before Covid-19 pandemic	After onset of Covid-19 pandemic	<i>P</i> -value
Gender* (<i>n</i> (%))			0.70
– Female	414 (41.32)	105 (42.68)	
– Male	588 (58.68)	141 (57.32)	
Race* (<i>n</i> (%))			0.46
– Caucasian	891 (88.92)	214 (86.99)	
– Black	32 (3.19)	13 (5.28)	
– Asian	12 (1.20)	4 (1.63)	
– Unknown	66 (6.59)	15 (6.10)	
Ethnicity† (<i>n</i> (%))			0.75
– Hispanic	45 (4.49)	12 (4.88)	
– Non-Hispanic	955 (95.31)	231 (93.90)	
– Unknown	2 (0.20)	3 (1.22)	
Insurance† (<i>n</i> (%))			0.21
– Public	345 (34.43)	102 (41.46)	
– Private	652 (65.07)	143 (58.13)	
– Tricare	3 (0.30)	1 (0.41)	
– Unknown	2 (0.20)	0 (0)	
Age at surgery (mean (SD); years)	3.77 (3.20)	3.89 (3.63)	0.64

*Gender and race were analysed using chi-square tests; †ethnicity and insurance were analysed using Fisher's exact tests. Covid-19 = coronavirus disease 2019; SD = standard deviation

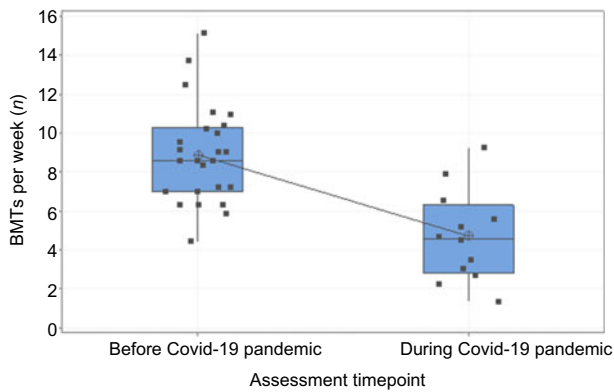


Figure 1. Bilateral myringotomy and tube placement (BMT) procedures per week. Covid-19 = coronavirus disease 2019

depicted in Table 1; these demonstrate no statistically significant change in the pre-pandemic versus post-pandemic-onset timepoints.

There was a significant difference in the number of bilateral myringotomy and tube placement procedures performed before and after the onset of the Covid-19 pandemic. The average number of bilateral myringotomy and tube placement cases per week decreased significantly, by 4.2 (95 per cent confidence interval (CI) = 2.7–5.5; $p < 0.001$) cases per week, from 8.9 (standard deviation (SD) = 2.5) to 4.7 (SD = 2.4) (Figure 1).

For bilateral myringotomy and tube placement procedures per week, there were significant main effects of the Covid-19 pandemic ($p < 0.001$) and seasonality ($p = 0.004$). There was no significant interaction effect ($p = 0.07$), indicating there was no evidence that the coronavirus pandemic influenced the seasonality effect; that is, the impact of the Covid-19 pandemic and seasonality were additive. The least-squares mean effect of the Covid-19 pandemic was to reduce bilateral myringotomy and tube placement procedures by 4.2 cases per week (95 per cent CI = 2.71–5.54; $p < 0.001$) after adjusting for seasonality (Figure 2). The spring season was associated with the highest number of bilateral myringotomy and tube placement procedures per week, at 9.1, significantly higher than winter at 6.0 ($p = 0.02$) and autumn at 5.3 ($p = 0.004$). The number of procedures conducted in summer, at 6.7, was not significantly different from that at any other season (Figure 2).

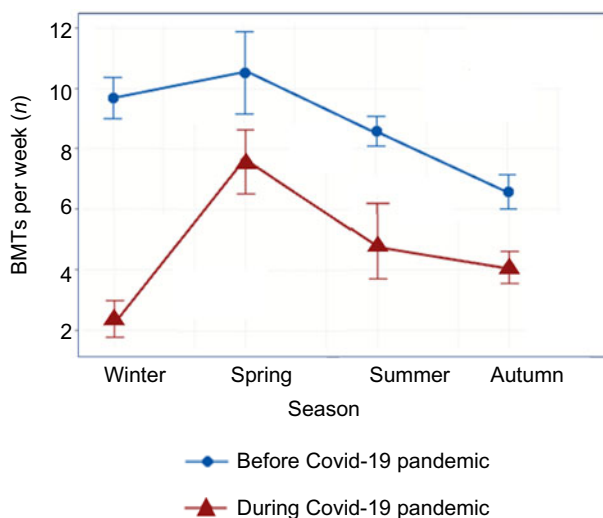


Figure 2. Bilateral myringotomy and tube placement (BMT) procedures per week by season. Bars are 1 standard error from the mean. Covid-19 = coronavirus disease 2019

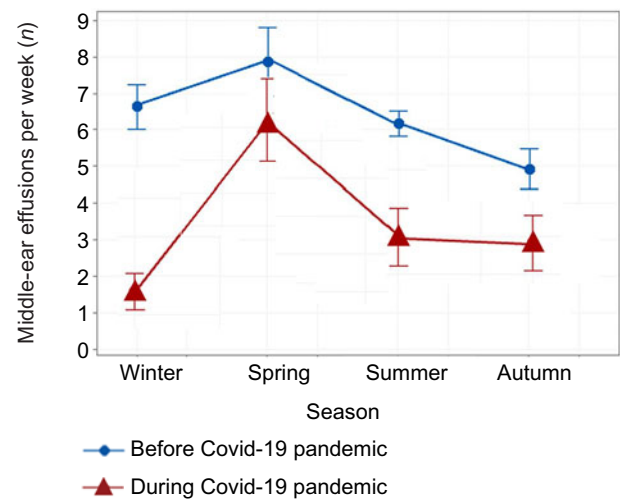


Figure 3. Middle-ear effusions per week by season. Bars are 1 standard error from the mean. Covid-19 = coronavirus disease 2019

Similarly, for the number of effusions per month, there were significant main effects of the Covid-19 pandemic ($p < 0.001$) and seasonality ($p = 0.001$) (Figure 3), without a significant interaction ($p = 0.15$), indicating that the coronavirus pandemic did not change the effect of seasonality on effusions per month. The least-squares mean effect of the Covid-19 pandemic was to reduce intra-operative effusions by 13.0 cases per month (95 per cent CI = 8.2–17.8; $p < 0.001$). Spring was associated with the highest number of effusions, at 30.7 per month, significantly higher than at autumn at 16.8 ($p = 0.001$), winter at 17.5 ($p = 0.002$) and summer at 20.0 ($p = 0.017$), which were not statistically different from each other (Figure 3). The ratio of total effusions per month to total bilateral myringotomy and tube placement procedures per month was not influenced by either the coronavirus pandemic or seasonality (data not shown).

Discussion

We found a statistically significant decrease in the number of bilateral myringotomy and tube placement procedures performed per week after the onset of the Covid-19 pandemic. It is essential to discuss some of the factors contributing to this decline and its connection to the prevalence of otitis media with effusion (OME) in children.

One of the most pronounced effects that the Covid-19 pandemic had on patients across the USA was a significant decline in the use of out-patient care.¹² One study found that the concerns of possibly contracting Covid-19 led 41 per cent of US adults to delay or avoid medical care.¹³ This likely translated to the paediatric population, where parents and caregivers may have had an increased apprehension regarding contracting illness at their child's office visit. Given that our research focused on paediatric patients who must be brought to clinic by their adult caretakers, an adult's hesitation to seek care can likely explain – at least partially – the decreased prevalence of bilateral myringotomy and tube placement procedures.

Other studies outlined the effect that the period of quarantine had on patients experiencing OME. One study noted that, of children who were initially scheduled for tympanostomy tube placement for acute or chronic middle-ear effusion, only 31 per cent still met the indications for the procedure after a home quarantine period.¹⁴ Other studies observed

similar effects, and attributed the decrease in indications for surgery to Covid-19-related precautionary measures. It is well known that children who attend day-care centres or are part of large classrooms are more frequently exposed to organisms such as *Streptococcus pneumoniae*. This bacterial upper respiratory infection is often linked with chronic otitis media development.¹⁵ The closure of schools, reduced child-to-child contact, physical distancing and heightened hygienic behaviours were all linked to a decline in the development and persistence of OME, thus significantly reducing the need for bilateral myringotomy and tube placement procedures.¹⁰

It is also important to note that the mandate for schools across the state of New York to switch to remote learning went into effect on 18 March 2020, and schools did not return to in-person sessions until September 2021.^{16,17} These dates overlap with a considerable portion of our study period.

In all, reduced community exposure to peers because of social distancing measures, increased precautionary behavioural changes such as hand hygiene, and greater caregiver hesitation to seek out-patient care have contributed substantially to the observed reduction in the number of bilateral myringotomy and tube placement procedures completed since the onset of the Covid-19 pandemic in our study cohort.

In addition, we found a higher prevalence of bilateral myringotomy and tube placement procedures performed in males than in females in our study population, which infers a higher proportion of males with otitis media. This echoes the findings of Aldè *et al.*, who found a higher prevalence of OME amongst males, irrespective of the Covid-19 pandemic.¹⁰ The demographics of children undergoing bilateral myringotomy and tube placement before versus during the Covid-19 pandemic did not change.

Seasonality of otitis media with effusion

Many factors increase the likelihood of a child developing otitis media, including day-care attendance, pacifier usage, exposure to cigarette smoke, socioeconomic status and age of less than two years.^{4,18} Seasonality also plays a significant role as a risk factor for OME. Previous literature demonstrates that acute otitis media has a higher incidence in the autumn and winter months in the paediatric population.⁴ One study investigating children in the New York Metropolitan area demonstrated that middle-ear effusions detected in the autumn were less likely to resolve by the next clinic visit. In contrast, effusions detected in the summer had a far greater resolution rate by the next visit.¹⁸ This demonstrates a seasonal and monthly variability in the incidence of OME, and in the potential course of illness and resolution.

There was no change in seasonal variability when comparing pre-pandemic and post-pandemic-onset seasonal rate. Although there were fewer bilateral myringotomy and tube placement procedures performed per week, the seasonal proportions remained unchanged (Figure 2). Our study found that spring had both the highest proportion of effusions (Figure 3), which was significant, and the highest proportion of bilateral myringotomy and tube placement procedures. Even though the diagnosis of OME is frequently made in the autumn and winter, it is possible that surgical management is being deferred for these patients until the spring, after attempting conservative management. Alternatively, surgical scheduling timelines may create a time delay between determination of the candidacy for, and the actual placement of, ear tubes.

Strengths and limitations

This is the first study to our knowledge to evaluate the impact of the Covid-19 pandemic and seasonality on the rates of bilateral myringotomy and tube placement procedures. This adds to the existing literature to enhance understanding of the effect of the Covid-19 pandemic on OME, a common paediatric health condition.

One limitation of this study is that the rate of bilateral myringotomy and tube placement procedures was not analysed in the setting of co-morbidities, which are known to influence rates of OME. Further subgroup analysis would be important to understand how the pandemic affected the rates and management of OME in various populations. We are restricted by the retrospective nature of this study, with reliance on data captured from electronic medical records.

In addition, at our institution in Upstate New York, a single surgeon performed bilateral myringotomy and tube placement procedures during this study's time course, limiting the generalisability of our findings to tertiary care institutions with more than one surgeon and to populations of children with OME who reside in other climates.

- Previous literature demonstrates that season is a risk factor for otitis media with effusion, a common paediatric illness in those aged under five years
- The study showed fewer bilateral myringotomy and tube placement procedures performed per week during the coronavirus disease 2019 pandemic
- There was no difference in the number of middle-ear effusions found intra-operatively, during compared to pre-pandemic
- The highest proportion of middle-ear effusions was seen during the spring months
- The highest proportion of bilateral myringotomy and tube placement procedures was seen during the spring months
- This paper highlights the impact of the pandemic on bilateral myringotomy and tube placement procedures and the role of seasonality

Finally, the exact reduction in clinical capacity, both out-patient and in-patient, during various periods within the pandemic is not fully delineated in this study. In addition, there were operating theatre restrictions on elective procedures at the academic institution studied during various periods throughout the pandemic, after which there was a gradual increase in elective caseload with concurrent shifts in staffing and available faculty.

Future directions

Follow-up studies can be performed to explore whether there was an increase in medical versus surgical management for otitis media after the onset of the Covid-19 pandemic.¹⁵ Future work should also address the influence that co-morbidities, including genetic syndromes and allergies, had on the rates of bilateral myringotomy and tube placement procedures, especially during the pandemic. A multicentre study on the effects of seasonality and the Covid-19 pandemic on bilateral myringotomy and tube placement procedures would increase external validity. Comparing the impact of the Covid-19 pandemic in states with and without school and operating theatre closures would provide additional insight.

Conclusion

There was a significant reduction in the rate of bilateral myringotomy and tube placement procedures performed before versus during the Covid-19 pandemic. In addition, the proportion of

middle-ear effusions found intra-operatively was higher in the spring, which was the season with the highest proportion of bilateral myringotomy and tube placement procedures. This study lays the foundation for future work on the longitudinal impact of the Covid-19 pandemic on one of the most common paediatric health conditions. Perhaps some of the mitigation strategies used to limit the spread of Covid-19 also helped prevent otitis media with effusion (OME) – both inadvertently and intentionally. Therefore, we should take these lessons forward in order to decrease OME incidence in our communities.

Competing interests. None declared

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