



Delays in surgery for cholesteatoma due to COVID-19: is there an impact on rates of recidivism and major complications?

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Abstract

Purpose To evaluate the relationship between the waiting time for surgery, and cholesteatoma recidivism rates and major complications. The secondary aims were to identify any other prognostic factors for cholesteatoma recidivism.

Methods A retrospective single-centre study of 312 patients who underwent cholesteatoma surgery under the care of a single surgeon, between 2004 and 2018, was performed. Waiting times for surgery were categorised into ≤ 90 days, 91–180 days, 181–270 days and > 271 days. The outcome measures were cholesteatoma recidivism and major complications (facial nerve palsy or intracranial complications).

Results The mean age was 36.1 years ± 21.5 with 242 adults (77.6%) and 70 children (22.4%). The mean waiting time for surgery was 126.2 days (4.1 months) ± 96.0 days and the overall rate of recidivism was 11.2% (35/312 patients). No instances of facial nerve palsy or intracranial complications were identified. Rates of recidivism by waiting time for surgery were: 15.3% for 118 patients who waited ≤ 90 days, 9.7% for 134 patients who waited 91–180 days, 6.7% for 30 patients who waited 181–270 days and 4.3% for 23 patients who waited > 271 days. There was no significant difference amongst the different waiting time groups for rates of recidivism ($p = 0.266$).

Conclusion Increased waiting times for cholesteatoma surgery do not appear to be associated with increased rates of recidivism or major complications. Clinical judgement will always be required for complicated disease or patients with additional risk factors. The other prognostic factors for recidivism identified in this study were age (< 15 years) and congenital cholesteatoma.

Keywords Cholesteatoma · Recidivism · Recurrence · Mastoid · Time factors

Introduction

Mastoid surgery for cholesteatoma has the primary aim of creating a safe, dry and disease-free ear [1]. Despite this, reported incidence of cholesteatoma recidivism is as high as 70% in some studies [2]. This process can occur in two ways: residual disease that originates from cholesteatoma remnants left at original surgery or recurrent cholesteatoma

which usually stems from deep retraction created by the tympanic membrane or the reconstructed ear canal [3].

Certain factors have been identified as predictors for recidivism. These include age, mastoid involvement of disease, ossicular erosion, mastoidectomy technique and the surgeon's experience [2, 4–8]. Identification of these factors is important for both risk-stratification and pre-operative counselling of patients.

The current worldwide COVID-19 pandemic has presented additional challenges that may affect outcomes from cholesteatoma surgery. The diversion of resources towards the management of COVID-19 as per national directive [9], and concerns around aerosolization of particles from the middle ear mucosa [10] have resulted in the temporary cessation of elective otology surgery. To our understanding, no elective mastoid surgery for cholesteatoma was performed in the UK between 23/3/20 and 8/6/20.

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The ramifications of COVID-19 on future healthcare delivery will be widespread [11, 12]. The ENT UK working group has released a blueprint for graduated return to elective ENT surgery within the COVID-19 pandemic [13]. One unquestionable result will be increased waiting times in an already stretched healthcare system. These pressures have led to recent recommendations on the categorisation of cholesteatoma cases and the subsequent prioritisation in terms of surgical intervention [14].

The primary outcome of this study was to evaluate whether an increased time interval from diagnosis to surgery might result in poorer outcomes, specifically a higher rate of recidivism and major complications. The secondary aims were to identify whether there were any prognostic indicators for recidivism amongst: age, type of cholesteatoma (congenital/acquired), type of surgery (primary/revision), syndromic concurrence, surgical approach (CWU/CWD), subsequent contralateral disease, and number of previous ipsilateral mastoid operations.

Materials and methods

This retrospective study was approved by the audit department at the University Hospitals of Leicester NHS Trust. Electronic theatre records (ORMIS and HISS) were used to identify all mastoid-coded operations over a 15-year period between 01/01/2004 and 31/12/2018 under the care of a single surgeon. The medical records of the identified patients were examined.

The collective term ‘recidivistic’ cholesteatoma has been used in this study to include both recurrent and residual cholesteatoma, which can be difficult to differentiate. Recidivistic cholesteatoma, by definition, describes disease occurring on the ipsilateral side to the debuting cholesteatoma. Mastoid operations not performed for cholesteatoma and cases of external canal cholesteatoma were excluded from this study.

The following parameters were recorded: demographic details, waiting time for surgery, significant complications, type of surgery (primary/revision), type of cholesteatoma (congenital/acquired), cholesteatoma recidivism, number of previous ipsilateral mastoid operations and subsequent contralateral disease. For each patient, details of any revision surgery and surgery for contralateral disease were recorded.

Waiting time for surgery was defined as the time from surgical booking to the date of surgery. Patients were classified into 4 categories: waiting time ≤ 90 days, 91–180 days, 181–270 days and ≥ 271 days. Major complications were recorded and defined as facial nerve palsy or otogenic intracranial complications.

Statistical analysis was performed using SPSS V25 (Chicago, Illinois). Demographic data and established risk factors of recidivism were analysed using Chi-squared

statistical testing. Where multi-nominal data were present, the Kruskal–Wallis test was used. Significance was determined when p value was found to be < 0.05 .

Results

Over a 15-year time frame, between 01/01/2004 and 31/12/2018, 601 mastoid-coded operations were identified for the lead surgeon. All these operations were performed at a tertiary otolaryngology unit. Cases where the full medical records were not accessible were excluded. Cases of mastoid surgery not performed for cholesteatoma were also excluded.

Demographic data

A total of 312 patients were identified for this study with a mean age of 36.1 years ± 21.5 (Range 3–88). There were 242 adults (77.6%) and 70 children (22.4%), aged < 15 years. Right-sided operations accounted for 46.5% (145/312) and left, 53.5% (167/312). There were 182 males (58.3%) and 130 females (41.7%). The vast majority were acquired cholesteatoma, 305/312 (97.8%). There were 7 cases of congenital cholesteatoma (2.2%). Syndromic conditions were identified in 12 patients (3.8%). The mean follow-up, from data for 303 patients, was 58.4 months (4.9 years) ± 45.5 months. Table 1 displays patients’ characteristics.

Waiting times for surgery

The overall rate of recidivistic disease requiring surgery was 11.2% (35/312 patients). The mean waiting time for surgery, from available data of 305 patients, was 126.2 ± 96.0 days (18.0 weeks; 4.1 months). Rates of recidivism by waiting time for surgery are displayed in Table 2. The Kruskal–Wallis test was performed which identified no significant statistical difference between the recidivism rates for the different waiting time groups ($p = 0.266$). There was no significant difference in patient demographics between the various waiting time groups, as is demonstrated in Table 3.

Major complications

There were no instances of facial nerve palsy or otogenic intracranial complications.

Other prognostic factors for recidivism

Rates of recidivism for various patient characteristics are displayed in Table 1. There was no statistically significant difference in rates of recidivism based on; gender, side of surgery, type of surgery (primary/revision), concurrence of syndrome, surgical approach (CWU/CWD), subsequent

Table 1 Patient characteristics and recidivism rates

Characteristic	Patients (n)	Proportion of all patients (%)	Cases of recidivism (n)	Rate of recidivism (%)
Gender <i>n</i> = 312				
Male	182	58.3	19	10.4
Female	130	41.7	16	12.3
Age <i>n</i> = 312				
Adult	242	77.6	22	9.1
Children (< 15)	70	22.4	13	18.6
Side of Surgery <i>n</i> = 312				
Right	145	46.5	18	12.4
Left	167	53.5	17	10.2
Cholesteatoma <i>n</i> = 312				
Acquired	305	97.8	32	10.5
Congenital	7	2.2	3	42.9
Original Surgery <i>n</i> = 312				
Primary	256	82.1	28	10.9
Revision	56	17.9	7	12.5
Comorbidities <i>n</i> = 312				
Syndromic	12	3.8	2	16.7
Not	300	96.2	33	11.0
Surgical Approach <i>n</i> = 256*				
CWU	56	21.9	7	12.5
CWD	200	78.1	21	10.5
Contralateral Disease <i>n</i> = 312				
Yes	19	6.1	3	15.8
No	293	93.9	32	10.9
Previous ipsilateral operations** <i>n</i> = 56				
1	40	71.4	6	15.0
≥ 2	16	28.4	1	6.3

Mean follow up: 58.4 months (4.9 years) ± 45.5 months

* Does not total 312 as mixed techniques excluded

** Only applies to patients where first operation by lead author was revision surgery (*n* = 56)

Table 2 Recidivism of disease by waiting time for surgery

Waiting time for surgery (days)	Patients (n) total: 305	Cases of recidivism	Rate of recidivism (%)	(K–W test) <i>p</i> value
≤ 90	118 (38.7%)	18	15.3	0.266
91–180	134 (43.9%)	13	9.7	
180–270	30 (9.8%)	2	6.7	
> 271	23 (7.5%)	1	4.3	

contralateral disease and number of previous ipsilateral mastoid operations (applicable only to revision cases).

There was a statistically significant difference in recidivism rates between children aged less than 15 compared to adults (18.6% vs. 9.1%, $p = 0.027$) and in congenital cholesteatoma compared to acquired (42.9% vs. 10.5%, $p = 0.007$) as is displayed in Table 4. However, the sample size for congenital cholesteatoma was small with 7 cases.

Discussion

In active squamous chronic otitis media, keratinous debris may either remain active or become inactive. If active, the natural history is for anatomical expansion which may ultimately involve the ossicular chain or the labyrinth and which may potentially cause intracranial and intratemporal

Table 3 Distribution of patient characteristics amongst waiting time groups

Characteristics	Waiting time to surgery: data available for 305 patients				<i>p</i> value
	≤ 90 days <i>n</i> = 118 (%)	91–180 days <i>n</i> = 134 (%)	181–270 days <i>n</i> = 30 (%)	≥ 271 days <i>n</i> = 23 [<i>n</i> (%)]	
Sex: male	59.3	56.0	53.3	78.3	0.221
Age: > 15 years	77.1	75.4	80.0	87.0	0.653
Side of surgery: right	47.5	45.5	56.7	34.8	0.457
Cholesteatoma: acquired	97.5	97.8	96.7	100	0.869
Original surgery: primary	83.1	79.1	90.0	87.0	0.468

Table 4 Odds ratio (OR) and 95% CIs for rates of recidivism based on various prognostic indicators

Characteristics	Odds ratio	95% CI	<i>p</i> value
Gender: male	0.83	0.41–1.68	0.606
Age: < 15 years	2.28	1.08–4.08	0.027
Side of surgery: right	1.25	0.62–2.53	0.533
Cholesteatoma: congenital	6.40	1.37–29.88	0.007
Original surgery: revision	1.16	0.48–2.82	0.737
Comorbidities: syndromic	1.62	0.34–7.71	0.542
Surgical approach: CWU	1.22	0.49–3.03	0.672
Contralateral disease: Yes	1.53	0.42–5.54	0.515
Previous operations: ≥ 2	0.38	0.04–3.42	0.371

complications. The specific factors which trigger anatomical extension are unclear [15, 16].

Anatomical expansion and the destructive nature of cholesteatoma appear to be mediated by the presence of a heavy immune cell infiltrate releasing increased amounts of cytokines and growth factors [15]. Several studies have demonstrated dysregulation of epidermal growth factor in cholesteatoma [17, 18]. The resultant release of interleukins (IL-1α and IL-8) mediates bone destruction and osteoclast activity [19].

The surgical management of cholesteatoma requires a highly individualised approach which accounts for anatomical, social and clinical factors to determine the optimum treatment strategy [20]. In addition, technique and choice of surgical approach will depend on surgical experience and preference. Analysis of these combined factors is important for the pre-operative counselling and consent of patients.

Factors, such as age, mastoid involvement, ossicular erosion and choice of operation, have been well documented to have an impact on surgical outcomes in cholesteatoma surgery [2, 4–8]. The current COVID-19 pandemic has brought into light additional factors that may also impact surgical outcomes. The cessation of elective surgery in otology during the COVID-19 pandemic has led to an increase in waiting times for cholesteatoma surgery and there is concern that this will have an adverse effect on outcomes in terms of major complications or risk of recidivism.

This study demonstrates that longer waiting times for cholesteatoma surgery do not appear to be associated with a higher risk of recidivism or major complications in selected patient groups. There was no statistically significant difference in the recidivism rates amongst the 4 categories of waiting time groups ($p = 0.266$).

There are no studies to date which evaluate the relationship between waiting time for surgery and risk of recidivism. The findings from this study are pertinent in reassuring patients in the current climate that outcomes from cholesteatoma, in terms of risk of recidivism and major complications, may not be affected by delay to surgery up to 12 months in selected patient groups. The findings from this study correlate to the understanding that in the short term, many patients live with active squamous epithelial disease with minimal disability or inconvenience [16].

Clinical judgement will always be required when assessing the risk of prolonged waits. Cholesteatoma surgery may still be an emergency. Cases complicated by a cerebral abscess, meningitis, facial palsy or a Bezold abscess will require immediate intervention [14]. In other cases, the presence of tegmen dehiscence or lateral canal fistulae will require surgical prioritisation.

Despite this, most cases of cholesteatoma are uncomplicated [21] and can be managed on an elective basis. What this study demonstrates is that in a period of high surgical risk to both patient and surgeon, the risk of deferring cholesteatoma surgery by several months appears to be low for cholesteatoma that would not normally be prioritised.

A limitation of our study is the lack of true randomisation in terms of waiting times for surgery. Patients with significant risk factors for complications, such as lateral canal fistulae or tegmen erosion, would have been placed on a higher priority waiting list. This introduces a selection bias which we recognise. This also potentially explains why patients who waited longer for surgery had a lower rate of recidivism, as is shown in Table 2. It should be reiterated that this difference was not statistically significant.

This does not negate the significant findings of this study. In most cholesteatoma patients, who do not require surgical prioritisation, there seems to be no increased risks of recidivism or major complications with waiting times of up to one

year. A formal way of stratifying risk of cholesteatoma could be the staging system proposed in the EAONO/JOS consensus statement on staging of middle ear cholesteatoma [22]. Patients who have not progressed to stage III/IV disease do not seem to be at risk from increased waiting times.

Several other prognostic factors for recidivism were evaluated in this study. The overall rate of recidivism was significantly higher in children compared to adults (18.6% vs. 9.1%), with an odds ratio (OR) of 2.28 (95% CI 1.08–4.08; $p=0.027$. Figure 1 and Table 4). Rates of recidivism were also significantly higher in congenital cholesteatoma compared to acquired (42.9% vs. 10.5%), with an OR of 6.40 (95% CI 1.37–29.88; $p=0.007$. Figure 1 and Table 4). This correlates with other studies that have demonstrated that the risk of recidivism in childhood cholesteatoma is 2–3 times higher than in adult disease [23–26].

Proposed theories for this difference include: better aerated mastoids in children allowing cholesteatoma to access deeper cells within the temporal bone; increased rates of infective otitis media stimulating the cholesteatoma cells, and finally increased circulating growth factors in childhood resulting in hyper-proliferation of childhood cholesteatoma. Irrespective of the exact aetiology, keratinocytes in childhood cholesteatoma have innately distinctive features to those found in adult disease [18, 23].

The relationship between surgical technique and recidivism in cholesteatoma has been extensively explored in

several studies. A meta-analysis of 4720 patients demonstrated a relative risk of 2.87 (CI 2.45–3.37) of recidivism with CWU procedures compared to CWD approaches [2]. In our study, most operations performed for cholesteatoma were CWD approaches (78.1%). The rate of recidivism was higher in CWU approaches (12.5%) compared to CWD approaches (10.5%) although there was no significant statistical difference between the 2 groups ($p=0.672$).

The risk of developing recidivistic disease, which by definition occurs on the same side, based on the emergence of contralateral disease has not been evaluated, to our knowledge, by any previous studies. The proportion of patients with ipsilateral recidivistic disease was higher in those who developed subsequent contralateral disease (15.8%) compared to those that did not (10.9%), although not statistically significant ($p=0.515$).

Conclusion

This study demonstrates that increased waiting times for cholesteatoma surgery of up to 1 year are not associated with increased rates of recidivism or major complications. Clinical judgement will always still be required for complicated disease requiring immediate intervention or patients with additional risk factors requiring prioritisation.

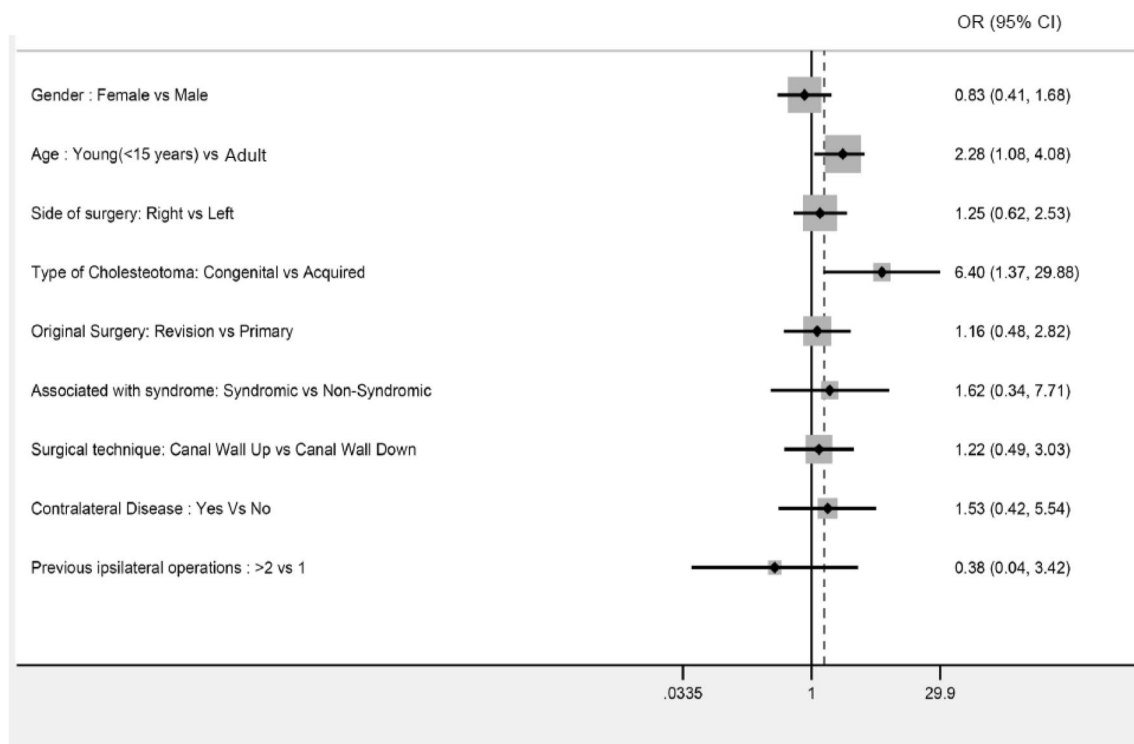


Fig. 1 Forest plot showing odds ratio (OR) and 95% CIs for rates of recidivism based on various prognostic indicators

The prognostic indicators for recidivism identified in this study were age at diagnosis and type of cholesteatoma. Children aged under 15 years and patients with congenital cholesteatomas were at increased risk. Conversely, the following factors were not statistically significant predictors of recidivism: primary surgery for debuting cholesteatoma or revision surgery for recidivistic disease; concurrence of a syndromic condition; the preservation of the posterior canal wall; the emergence of contralateral disease; and the number of previous mastoid operations.

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Author contribution MHH: data collection, data interpretation and drafting of manuscript. MM: data interpretation, data collection. SM: data collection, revision of manuscript. GS: revision of manuscript. DMR: data collection, revision of manuscript. FJR: data interpretation. EI: data collection. PR: Initial concept, design of study, review of final manuscript.

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Availability of data and material The data that support the findings of this study are available on request from the corresponding author.

Compliance with ethical standards

Conflicts of interest The authors declare that they have no conflict of interest.

Ethical approval This retrospective study was approved by the Clinical Audit Team at University Hospitals of Leicester NHS Trust (Ref no.10356).

Consent to participate Not applicable.

Consent for publication Not applicable.

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