



The prophylactic use of antibiotics in submandibular gland excision: an audit and review of risk factors

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Background: Submandibular gland excision is a common procedure in head and neck surgery. The current evidence-based guideline does not support the routine use of antibiotic prophylaxis for this procedure.

Methods: A retrospective review of all patients who underwent submandibular gland excision over a 9-year period (2010 to 2018) at a tertiary Victorian hospital was conducted. Data relating to demographic, comorbidities, antibiotic use and surgical complications was collected. The aim was to identify key indicators associated with the development of wound related complications in the presence or absence of antibiotic prophylaxis.

Results: Fifty-four patients met the selection criteria. Forty-seven (87.0%) received prophylactic antibiotic therapy. Complications reviewed were wound related complications, including seroma, haematoma, and wound infection. Nine (16.7%) patients developed one of these complications. Seven (13.0%) patients received antibiotics and developed a complication. Two (3.7%) patients developed a complication and did not receive antibiotics.

Conclusions: Our data demonstrates that there is variation in practice with regards to antibiotic prophylaxis. A majority of patients received prophylactic antibiotics. The introduction of new guidelines has not drastically changed surgeons' attitude. Compliance with the guideline was inconsistent, with a trend of decreasing antibiotic use in the last two years. Infection rates were in keeping with the literature. No specific risk factors were identified to be associated with surgical complications, in the presence or absence of antibiotic prophylaxis.

Keywords: Submandibular gland excision; antibiotics; surgical complications; wound infection; body mass index (BMI); diabetes mellitus; smoking

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Introduction

Submandibular gland excision is a common procedure in head and neck surgery (1). The main indications are sialadenitis or tumors of the gland (1-3). Excision of submandibular gland is considered a clean procedure, as defined by the American National Academy of Science and

National Research Council. This is defined as a surgical wound with no violation of septic technique, no signs of infection or inflammation and no mucosal barrier or hollow viscous breached. This implies no manipulation of the gastrointestinal, genitourinary or respiratory system (4,5). The current evidence-based guideline suggests

that antibiotic prophylaxis is not warranted for clean otolaryngology procedures such as salivary gland excision. However, patients undergoing submandibular gland excision were often prescribed antibiotics.

This study was conducted following a recent significant surgical wound infection post submandibular gland excision. A retrospective review of the post-operative outcomes from the unit was performed, with pattern of antibiotic prophylaxis utilization also noted. This review aims to identify key indicators associated with the development of complications in the presence or absence of antibiotic prophylaxis. Certain patient populations could be at an increased risk of developing a wound related complication; and may benefit from antibiotic prophylaxis.

Current literature suggests that risk factors such as an increased body mass index (BMI), immunosuppression, history of smoking and alcoholism increase risk for surgical wound complications. Diabetes, although not a direct risk factor for infection, has been associated with the development of prolonged and more severe infections (5-7). The use of antibiotics in the peri-operative period may be indicated in these patients. We present the following article in accordance with the STROBE reporting checklist (available at <http://dx.doi.org/10.21037/ajo.2019.11.01>).

Methods

Ethics

Ethics approval was granted from the health institutions ethics board (LNR/19/Austin/23). Data was stored securely in a password protected Microsoft Excel spreadsheet.

Patients and method

A retrospective review of data from a single Victorian tertiary centre was undertaken. Data pertaining to patients who underwent salivary gland excision over a nine-year period (January 2010 to December 2018) was collected. Fifty-six patients were identified by the qualifying ICD code relating to submandibular gland excision. The inclusion criterion was patients who underwent a submandibular gland excision over this time period; the exclusion criterion was submandibular gland excision as part of a neck dissection.

Data to stratify the risk of developing an infection such as demographics, BMI, smoking status, alcohol intake, diabetes, immunosuppression and other co-morbidities was collected. The study also looked into the indication for the

procedure, as well as the histological status of the gland.

Furthermore, utilization of antibiotic prophylaxis was recorded. Specifically, the timing of the antibiotics (intra-operative, post-operative or both), type, dose and duration of the course of the antibiotic was recorded. Complications recorded include post-operative surgical wound infection, wound hematoma and seroma. Detail regarding the timing of, and management of the complication was also noted.

Results

Patient demographics

Fifty-four patients were included in this study. The age of patients ranged from fourteen to eighty-seven years-old, with a median age of fifty-one years-old. The male to female ratio is 3:2.

Indications and histopathology

The most common indication for excision of the submandibular gland was recurrent sialadenitis, followed by gland enlargement. Chronic sialadenitis with sialolithiasis was the most common histopathological result, followed by chronic sialadenitis without sialolithiasis. This data is summarized in *Tables S1* and *S2*.

Antibiotic prophylaxis

Antibiotic prophylaxis was utilized in the majority of patients. Forty-seven patients (87.0%) received prophylactic antibiotics. Seven patients (13.0%) did not receive antibiotics. Data relating to antibiotic prophylaxis and complications is summarized in *Table 1*.

The most common antibiotic prescribed on induction of anesthesia was intravenous (IV) cephazolin. The antibiotic commonly prescribed for post-operative prophylaxis was oral cephalexin, followed by Augmentin Duo Forte. Four patients received IV cephazolin immediately post-operatively without any oral antibiotics on discharge. The majority of patients (85.7%) who received antibiotics postoperatively, received antibiotics both as an inpatient as well as on discharge.

One of fourteen patients who underwent surgery prior to January 2013, received antibiotics. Among the eighteen patients treated between January 2013 to December 2015, two did not receive antibiotics. Finally, of the twenty-three patients treated between January 2016 to December 2018, four patients were managed without antibiotics.

Table 1 Antibiotic prophylaxis and complications

Timing of antibiotic prophylaxis	Number of patients	Antibiotic prophylaxis	Complication rate	Total
Study total	54			9/54 (16.7%)
Antibiotics total	47			7/47 (14.9%)
Induction only	19	Cephalosporin: 18/19 (94.7%) Lincosamide: 1/19 (5.26%)	4/18 (22.2%) 0/1 (0%)	4/19 (21.1%)
Induction and postoperative	27	Cephalosporin only: 21/27 (77.8%) Cephalosporin and Augmentin Duo Forte: 4/27 (14.8%) Vancomycin and clarithromycin: 1/27 (3.70%) Ampicillin and cephalosporin: 1/27 (3.70%)	2/21 (9.52%) 1/4 (25.0%) 0/1 (0%) 0/1 (0%)	3/27 (11.1%)
Postoperative only	1	Cephalosporin 1/1 (100%)	0/1 (0%)	0/1 (0%)
No antibiotics	7	Not applicable	2/7 (28.6%)	

Table 2 Description of complications

Complication	N (%), N=9	Antibiotic prophylaxis, N [%]		Intervention, N [%]	
		Yes	No	Yes	No
Wound infection	5 (55.6)	4 [80]	1 [20]	3 [60]	2 [40]
Haematoma	2 (22.2)	2 [100]	0 [0]	1 [50]	1 [50]
Seroma	2 (22.2)	1 [50]	1 [50]	2 [100]	0 [0]

Complications

Postoperative complications documented were all related to wound integrity, specifically, wound infection, hematoma and seroma (see *Table 2*). In total, only nine (16.7%) patients developed one of these complications.

Five patients developed a wound infection. Two were superficial wound infections that required re-admission and treatment with IV antibiotic therapy. Both of these superficial wound infections were detected within the first week and both of these patients had received antibiotics on induction only. A further two patients developed more significant wound infections. One patient developed an abscess, which was drained on the ward, and managed with intravenous antibiotics and regular dressing changes. Another wound abscess required drainage in theatre under general anesthetic. Both patients formed an abscess after the first week postoperatively, but within the first month. These two patients received antibiotics on induction of anesthesia and post-operatively. Most significantly,

one patient developed necrotizing fasciitis and required return to theatre multiple times for wound debridement, prolonged intravenous antibiotics, and transfer to statewide hyperbaric oxygen therapy center. This patient did not receive antibiotic prophylaxis.

Two patients developed a haematoma. One patient required drainage in theatre. This patient received antibiotic prophylaxis on induction of anesthesia only. The other patient was managed conservatively and had received antibiotics both intra-operatively and post-operatively.

Two patients developed a seroma. Both patients were able to be managed with drainage on the ward. One had been given antibiotic prophylaxis on induction only. The other received no antibiotic prophylaxis.

Risk factors

The result of the data on risk stratification is summarized in *Table 3*.

Table 3 Risk factor prevalence

Risk factor	No complication (N=45), N (%)	Complication (N=9), N (%)
BMI		
Normal (18–24.9)	20 (44.4)	4 (44.4)
Overweight (25–29.9)	12 (26.7)	1 (11.1)
Obese (≥ 30)	13 (28.9)	4 (44.4)
Smoking status		
Never smoked	29 (64.4)	4 (44.4)
<15 pack years	3 (6.67)	2 (22.2)
15–29 pack years	7 (15.6)	3 (33.3)
≥ 30 pack years	6 (13.3)	0 (0)
Diabetes		
Yes	8 (17.8)	2 (22.2)
No	37 (82.2)	7 (77.8)
Immunosuppression		
Yes	3 (6.7)	2 (22.2)
No	42 (93.3)	7 (77.8)
Alcoholism		
Yes	1 (2.2)	0 (0)
No	44 (97.8)	9 (100.0)

BMI, body mass index.

BMI

In the nine patients who developed a wound related complication, just over half had an elevated BMI of greater than 25. The overweight BMI is from 25 to 29.9, obese is defined as a BMI of equal or greater than 30. Those with a complication had an average BMI of 28 compared those without a complication whose average BMI was 27. Relatively more patients in the complication group were obese compared to the group with no complications. The patient who developed necrotizing fasciitis had the highest BMI, which was 40.

Diabetes

Two patients who developed a complication suffered from diabetes. Both patients were type 2 diabetics managed with oral hypoglycemic medication. One patient developed a seroma, another patient developed a wound abscess. Surprisingly, the patient that was morbidly obese with BMI of 40 and developed necrotizing fasciitis did not have

diabetes and did not have impaired glucose tolerance.

Smoking

Five of the nine patients who developed a complication had smoking history. Three patients had smoked between 15 to 29 pack years. Two patients had smoked less than 15 pack years. None of the patients that smoked 30 pack years or more developed a complication. All of the four patients who developed a seroma or a hematoma had a smoking history. Only one patient who developed a wound infection was a smoker.

Immunosuppression

Two patients who developed a complication were immunosuppressed. One patient was on long term prednisone for temporal arteritis and developed a hematoma, which was conservatively managed. The other, was on immunosuppressant for renal transplantation and developed a wound abscess requiring drainage in theatre. Three patients who were immunocompromised did not develop a complication.

Alcoholism

No patient who developed a complication had co-morbidities associated with misuse of alcohol or documented alcohol abuse.

Discussion

Among fifty-four patients analyzed over a nine-year period, nine patients (16.7%) developed a complication; this includes: five (9.3%) with wound infection, two (3.7%) with hematoma, and two (3.7%) with seroma. The findings were consistent and comparable with rates reported in other literature, where risk of wound infection, is reported to be from 0% to 14% post submandibular gland excision (3).

There is no obvious association seen between surgical complication and elevated BMI in this study. Many with complications had a normal BMI. The most significant complication being a necrotizing fasciitis, was seen in the patient with BMI of 40. A review of head and neck literature failed to elicit any articles reviewing elevated BMI and development of complications post submandibular gland excision. However, a few studies have looked into BMI and complications post-parotidectomy. In a retrospective study of 400 parotidectomies, no significant relationship between BMI and surgical complications were seen. (8). Similarly, in a larger cohort of 3,000 parotidectomies (9), increased BMI

did not significantly increase the risk of complications. In fact, they concluded that a low BMI could be contributing to the development of complications. The mechanism for this is poorly understood and likely multifactorial (9). Loss of muscle mass related to old age, malnutrition and undiagnosed chronic illnesses are possible explanations (8,9). No patient in this study had a low BMI.

Non smokers dominated the group with no complications. In comparison, the majority of the complication group were smokers. The majority of the smokers in the complication group had smoked between 15–29 pack years. No member of the complication group had smoked for 30 or more pack years. All of the heaviest smokers were in the no complication group. Therefore, no relationship between smoking history and the development of complications can be established. The relationship between smoking status and complications post submandibular gland excision has also not been reported. In relation to parotidectomy, however, the relationship has been examined. Kim *et al.* (9) found that status as a current smoker was a significant risk factor for the development of a complication following parotidectomy rather than number of pack years. This can be attributed to toxins in tobacco smoke and nicotine that impair oxygen carrying capacity and capillary blood flow with a subsequent reduction in oxygenation of the undermined facial tissue (9).

Immunosuppression, presence of diabetes and heavy alcohol intake were not frequently observed amongst the complication group. Diabetics have been established as possibly at a higher risk for the development of a facial nerve palsy post parotidectomy (8), however, diabetes has not been shown to specifically impact wound healing and wound related complications (8,9). Diabetics are at an increased risk for more severe infection, compared to nondiabetics (5-7).

In this study, a majority of the patients were prescribed antibiotics. However, current evidence does not support the routine use of antibiotic prophylaxis in submandibular gland excision (4,10,11). One of the earliest to describe this was Johnson and Wagner (10). In 1987, they undertook a retrospective, single centre review of over 400 patients who had thyroidectomy, parotidectomy and submandibular gland excision. They found no benefit was achieved with antibiotic prophylaxis in these procedures (10). A comprehensive antibiotic guideline in otolaryngology that was recently published (11) established no significant evidence to suggest antibiotic prophylaxis is warranted in submandibular gland excision for the prevention of wound infection (grade A

recommendation) (11). In general, infection rates are low following this surgery (11) No observable benefit has been found with randomized control trials when comparing complication rates between those who did and did not receive antibiotics, with infection rates equivalent amongst both populations (11). Comparatively in this study, infection occurred in both the presence and absence of antibiotic prophylaxis.

Johnson *et al.* (10) noted that only 10% of surgeons were utilizing prophylactic antibiotics. On the contrary, in this audit, the rate of antibiotic prophylaxis was highest in the earliest years included in this study. A gradual decline in utilization of antibiotic prophylaxis was observed over the period studied. Possible explanation for this pattern is the presence of junior consultants who are more familiar with recent evidence-based literature and less likely to prescribe antibiotics. Other explanations include a failure to differentiate this procedure from a clean contaminated surgery given the glands' relation to the oral cavity; perceived lack of side effects from antibiotic use; surgeons' anxiety and possible medico-legal ramifications (10).

Limitations

The main limitation of this study is the retrospective nature of the study. Data collected was obtained from reliable electronic medical records. Some of the information utilized was obtained from patient completed pre-admission questionnaires, this includes alcohol intake, smoking history and height and weight. Moreover, this study has a small patient size. Numbers were not significant to allow for statistical analysis to draw concrete conclusions. A larger, prospective randomized control trial should be performed to evaluate the value of antibiotic prophylaxis patients with risk factors for wound complications post submandibular gland excision.

Conclusions

Current literature indicates that there is no benefit from the administration of antibiotic prophylaxis in submandibular gland excision. There are variations in the practice of antibiotic prophylaxis at this tertiary centre. Infection and complication rates, however, were in keeping with the literature. Surgical complications occurred regardless of antibiotic prophylaxis. No risk factors were noted to dominate amongst those who developed complications. With a larger prospective study, further risk stratifications

can be established to highlight the risk groups that may benefit from prophylactic antibiotics.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <http://dx.doi.org/10.21037/ajo.2019.11.01>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/ajo.2019.11.01>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Austin Health Human Research Ethics Committee (HREC). The HREC reference number is LNR/19/Austin/23. Patient consent was not necessary due to the retrospective nature of this review.

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Supplementary

Table S1 Indications for submandibular gland excision

Indication for procedure	No complication (N=45), N [%]	Complications, N [%]		
		Wound Infection (N=5)	Seroma (N=2)	Haematoma (N=2)
Recurrent sialadenitis	22 [48.9]	3 [60]	1 [50]	1 [50]
Submandibular gland enlargement	20 [44.4]	2 [40]	1 [50]	1 [50]
Removal of hypoglossal nerve stimulator	2 [4.4]	0 [0]	0 [0]	0 [0]
Recurrent branchial cyst infection	1 [2.2]	0 [0]	0 [0]	0 [0]

Table S2 Gland histopathology

Histopathology results	No complications (N=45), N [%]	Complications, N [%]		
		Wound infection (N=5)	Seroma (N=2)	Haematoma (N=2)
Chronic sialadenitis with sialolithiasis	17 [37.8]	2 [40]	0 [0]	1 [50]
Chronic sialadenitis	12 [26.7]	1 [20]	1 [50]	1 [50]
Benign pathology including pleomorphic adenoma	8 [17.8]	1 [20]	0 [0]	0 [0]
Malignant pathology	5 [11.1]	0 [0]	0 [0]	0 [0]
Normal gland	2 [4.4]	0 [0]	1 [50]	0 [0]
Normal gland with associated abscess	1 [2.2]	1 [20]	0 [0]	0 [0]