

A study of haemostasis following tonsillectomy comparing ligatures with diathermy

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Abstract

The use of diathermy to achieve haemostasis after tonsillectomy remains controversial. We have reviewed the English language literature, and found no convincing evidence that diathermy is any more likely to cause post-operative haemorrhage than the use of ligatures. The results of a prospective, randomized study of 1036 consecutive tonsillectomies are presented. No significant difference was found in post-operative haemorrhage rates when either diathermy or ligatures were used. Diathermy was found to reduce operating time compared to ligatures. The possibilities for day-case tonsillectomy are discussed.

Key words: Tonsillectomy, complications, haemorrhage

Introduction

It is believed that the first known tonsillectomy was performed by Cornelius Celsus almost 2000 years ago. After enucleating the tonsil with his fingernail, he suggested 'the fossae should be washed out with a vinegar and painted with a medication to reduce bleeding' (M^cAuliffe-Curtin, 1987). This technique was presumably less than completely reliable, as the operation fell into disrepute for many centuries due to the risk of post-operative haemorrhage. Modern tonsillectomy began in the early years of this century, with the development of dissection tonsillectomy in Baltimore by Worthington (1907) and in London by Waugh (1909 a, b) and guillotine tonsillectomy in Newcastle by Whillis and Pybus (1910). Ligature of bleeding vessels within the tonsillar fossa was considered an extremely difficult manoeuvre around the turn of the century and was first employed on a regular basis by Cohen (1909). Diathermy was described by Haase and Noguera (1962) and also Johnson (1962) as a suitable method for obtaining haemostasis after tonsillectomy: the introduction of halothane as a replacement for ether made this safe. Since that time, debate has persisted over the relative merits of the two techniques, particularly with regard to the incidence of post-operative haemorrhage.

The use of diathermy rather than ligatures to secure haemostasis after tonsillectomy remains controversial in the UK (Murty and Watson, 1990). Forty-four per cent of UK otolaryngologists were found to use diathermy and 56 per cent did not. Those who used diathermy thought it was a fast, safe technique; those who did not thought it increased post-operative haemorrhage rates and patient morbidity. Many retrospective studies have addressed this issue, with particular regard to the safety and speed of the

technique, but have produced conflicting results. Carmody *et al.* (1982) suggested that diathermy increased the incidence of secondary haemorrhage but reduced the incidence of primary bleeds. Siodlak *et al.* (1985) found that diathermy greatly increased the rate of secondary haemorrhage. In both of these studies many more patients received ligatures than diathermy but it is not clear on what grounds the patients were allocated to each group.

We have only been able to trace six prospective studies comparing diathermy and ligatures published in the English language. Papangelou (1972) in Athens studied 579 patients and found little difference between the techniques, but a mixture of local and general anaesthetic procedures were included and there was no statistical analysis. In addition, cases of secondary haemorrhage that were ascribed to trauma, menstruation, infection or blood dyscrasia were not included in the figures and therefore the true incidence of haemorrhage is not clear. Roy *et al.* (1976) in Panama looked at 376 procedures, equally split between ligatures and diathermy. They found no differences in haemorrhage rates but a 40 per cent reduction in operation time with diathermy. All of their operations were carried out using local anaesthesia with vasoconstrictors, which may mean their results are not directly applicable to UK practice. Malik *et al.* (1982) conducted a well-designed trial in India which compared ligatures to diathermy (spot or zonal) in 450 operations. They found no significant difference in haemorrhage rates, but diathermy was 'considerably' faster than ligation. Unfortunately most of their patients were more than 11 years old, so again this may limit the application of their findings to UK practice.

MacKenzie *et al.* (1983) in Edinburgh reported 172

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patients who had ligatures on one side compared to diathermy on the other side. Only one primary bleed occurred (on the ligated side), compared to seven secondary bleeds (all on the diathermy side). However, this study was only published in abstract form and this fact, combined with the small numbers studied, makes interpretation of the findings difficult. Phillips and Thornton (1989) studied 100 patients who received either ligatures or diathermy and found no difference in haemorrhage rates, although due to the very small numbers involved only one patient in each group actually suffered a post-operative bleed. They found that the use of diathermy reduced operation time by 26 per cent.

Roberts *et al.* (1992) studied 1090 patients prospectively. They found a slight excess of primary haemorrhage associated with the use of ligatures, and a slight excess of secondary bleeds associated with diathermy, but the differences did not reach statistical significance. Unfortunately the study design was non-randomized, and a mixture of guillotine and dissection excision techniques were used. Their results may therefore be comparing the performance of different surgeons rather than different techniques.

In order to clarify the issue, we performed a randomized, prospective study of over 1000 patients. This number was chosen on statistical grounds, as we estimated that 500 patients would be required in each group to show a significant difference between post-operative haemorrhage rates of five and ten per cent (70 per cent power for a 5 per cent test).

Patients and methods

One thousand and thirty six consecutive patients undergoing tonsillectomy by one of the participating surgeons were studied. Any patient with a known clotting disorder or who was taking anticoagulant drugs was not enrolled: only one patient was thus excluded (a three-year-old with von Willebrand's disease undergoing an emergency operation for spontaneous haemorrhage). Full details of age, sex, indication for surgery, medications, past medical history and occurrence of quinsy were recorded.

All operations were performed under endotracheal anaesthesia using a standard technique of blunt dissection with snare to the lower pole after any other procedures (e.g. adenoidectomy, myringotomy) had been completed. Each patient was randomized to receive either diathermy or ligature haemostasis. Ethical committee approval was obtained. The technique used, date and duration of operation (from first incision to gag removal), technical difficulty due to fibrosis (graded as 0, +, ++ or +++ for each side) and any concomitant procedures were recorded. The operating surgeon (who had been performing tonsillectomy

regularly for at least six months) was free to use any additional haemostatic measures he felt necessary if the allocated method did not succeed, but full details were recorded.

Post-operatively, all patients underwent careful observation and recording of vital signs to detect post-operative haemorrhage. A haemorrhage was defined as any episode of actual or potential bleeding to which the attention of medical staff was drawn by the nursing staff, patients or their relatives. Each bleed was graded as either false alarm (no actual evidence of haemorrhage), minor bleed (no action required apart from observation), moderate bleed (active non-surgical intervention required such as drip, cross-match, clot removal, intravenous antibiotics, etc.), or major bleed (operation and/or transfusion needed). Primary bleeds were those which occurred within 24 hours of the operation, and secondary bleeds were those which happened more than 24 hours after the procedure. All details of post-operative haemorrhage were recorded on the patients' data forms. At the time of discharge, patients were advised to contact the hospital if they suffered bleeding at home. We are certain that none of our patients with secondary haemorrhage were admitted to other units as we provide the sole ENT service to a large geographical area.

All patient data was entered onto a microcomputer data base and then subjected to statistical analysis using the χ^2 or *t*-test as appropriate.

Results

Diathermy haemostasis was used in 523 patients, of whom 228 (44 per cent) were male. Ligatures were used in 513 patients, of whom 208 (41 per cent) were male. Median age was 9 years for both groups, with a range of 2 to 64 years for diathermy and 1 to 50 years for ligatures. Interestingly, male patients tended to be younger (median seven years; range 1 to 50 years) than females (median 11 years; range 2 to 64 years). Further analysis of the difference between the sexes shows that below the age of ten years equal numbers of males and females have their tonsils removed, but above this age females predominate in a ratio of 2:1.

Indications

The indications for surgery are shown in Table I. The vast majority (97 per cent) of operations in both groups were performed for recurrent tonsillitis, with other conditions occurring only rarely.

Past history

Most of the patients in the study were fit and healthy, with no history of previous disease. The only systemic illness which occurred in a few patients was asthma, which

TABLE I
INDICATIONS FOR SURGERY

	Diathermy	Ligatures
Recurrent tonsillitis	512	498
Sleep apnoea	5	11
Acute quinsy	4	1
Dysphagia	1	1
Unilateral hypertrophy	1	—
Snoring	—	1
Crypt debris	—	1

TABLE II
PAST HISTORY OF PERITONSILLAR ABSCESS

	Diathermy	Ligatures
None	495	494
Single quinsy	24	16
Recurrent or bilateral quinsy	4	3

TABLE III
CONCOMITANT PROCEDURES PERFORMED

	Diathermy	Ligatures
Adenoidectomy	209	208
Myringotomy ± grommet	111	94
Ear wax removal	26	15
BSERA	–	1
Antral lavage	12	13
Nasal cautery	7	7
Septal surgery	–	1
Turbinate surgery	–	3
Dental extraction	2	3
Tongue tie division	1	–
Nasal papilloma removal	1	1
Endoscopy	6	4
UPPP	–	1
Lymph node biopsy	2	–

was present in 10 out of 523 (1.9 per cent) diathermy patients and 9 out of 513 (1.7 per cent) ligature patients.

Specific attention was paid to previous history of peritonsillar abscess (see Table II). Slightly more diathermy patients had suffered a single episode of quinsy than ligature subjects, but the difference did not reach statistical significance.

Medications

As would be expected from past medical history, few of the patients in this study were taking medication at the time of surgery. Seven patients in each group were taking inhaled therapy for asthma. Five women in the diathermy group and four in the ligature group were taking the oral contraceptive pill. Nine diathermy patients and five ligature patients were receiving antibiotics. One patient in each group was taking a nasal steroid spray, and cimetidine, insulin and propranolol were each taken by one patient.

Concomitant procedures

Altogether 259 diathermy patients and 254 ligature patients underwent one or more surgical procedures in addition to tonsillectomy. Details of these other procedures are shown in Table III. No significant differences were found between the two groups.

Fibrosis

For each patient, a fibrosis score was derived by adding up the number of '+' on the grading system described earlier. The mean score (\pm SD) was 1.3 ± 1.7 for the diathermy patients and 1.2 ± 1.5 for the ligature patients (range 0–6 in both cases). This difference is not significant.

Duration of operation

The shortest tonsillectomy in the series took four min-

utes and the longest 37 minutes. The overall mean (\pm SD) duration of operation was 10.3 ± 4.6 minutes. For diathermy patients the mean time was 9.2 ± 4.0 minutes, compared to 11.5 ± 4.8 minutes for ligatures. This difference is statistically significant (Student's *t*-test; $p < 0.0001$).

Success of haemostasis

Diathermy failed to achieve adequate haemostasis in 10 out of 523 patients, and ligatures were unsuccessful in 18 out of 513 cases, giving a relative risk (odds ratio) of failure when ligatures are used of 1.86 (95 per cent confidence limits 0.85 to 4.08). There is therefore no major difference between the two groups.

Two patterns of failure were noted: diathermy occasionally failed to control active spurting from a large vessel, whereas ligatures tended to fail when there was diffuse oozing from a scarred tonsillar fossa – the tissues could not be easily drawn into an artery clip.

Seven of the diathermy failures were treated by ligatures alone, but three required the faucial pillars to be sutured together. Eleven of the ligature failures responded to the use of diathermy, with pillar suturing necessary in the other seven.

Post-operative haemorrhage

The occurrence of post-operative haemorrhage from the tonsillar fossa is shown in Table IV. The overall incidence was 40 out of 1036 (3.9 per cent). Although there were more bleeds in diathermy patients than ligature patients, the difference fell far short of statistical significance (χ^2 test (2 D.F); $p = 0.86$). The relative risk of haemorrhage after diathermy is 1.34 (95 per cent confidence limits 0.71 to 2.54). The severity of the bleeds (ignoring 'false alarms', which occurred in one diathermy and two ligature patients) is shown in Table V. Again, no significant differences were found between the two groups.

Timing of the post-operative bleeds is shown in Figure 1 (primary) and Figure 2 (secondary). Although most (11 out of 13) of the primary bleeds that were severe enough to warrant reoperation occurred within eight hours of the initial procedure, two patients were returned to theatre after an interval of 16 hours. The only secondary bleed requiring further surgery occurred six days after tonsillectomy.

We noted with interest that only two out of 417 patient undergoing adenoidectomy suffered bleeds from the adenoid bed, giving an incidence of 0.5 per cent.

Successful outcome

If a successful outcome for either technique is defined as successful control of operative bleeding with no post-operative haemorrhage, then 31 out of 523 diathermy

TABLE IV
INCIDENCE OF POST-OPERATIVE HAEMORRHAGE

	Diathermy	Ligatures
No bleed	500	496
Primary bleed	15	10
Secondary bleed	8	5
Primary + secondary bleed	–	2

TABLE V
SEVERITY OF POST-OPERATIVE HAEMORRHAGE

	Diathermy	Ligatures
Minor	5	3
Moderate	11	9
Severe	7	7

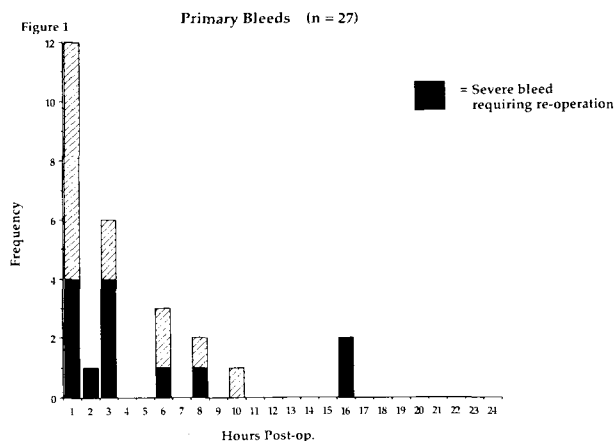


FIG. 1

Timing of primary post-operative haemorrhage.

patients and 35 out of 513 ligature patients would have had an unsuccessful outcome. (It will be noted that two patients had both failure to control operative bleeding and occurrence of post-operative haemorrhage). This gives a relative risk of unsuccessful outcome after the use of ligatures of 1.16 (95 per cent confidence limits 0.71 to 1.92); there is therefore little difference between the two techniques.

Discussion

This study has failed to demonstrate any significant difference in either frequency or severity of post-operative haemorrhage after tonsillectomy when comparing diathermy and ligature haemostasis. We feel that we have studied a sufficiently large group of patients to detect any clinically relevant differences between the two techniques and have found only that operation time is reduced when diathermy is used.

It is difficult to relate our post-operative haemorrhage rate (3.9 per cent) to that found in other studies, as many different criteria have been used to define post-operative bleeds (and in many publications no firm definition is stated). We used a very broad definition to ensure that no bleeds were missed and it is therefore unlikely that we have underestimated the true incidence.

Tonsillectomy is now routinely performed on a day-case basis in many North American hospitals. The reasons

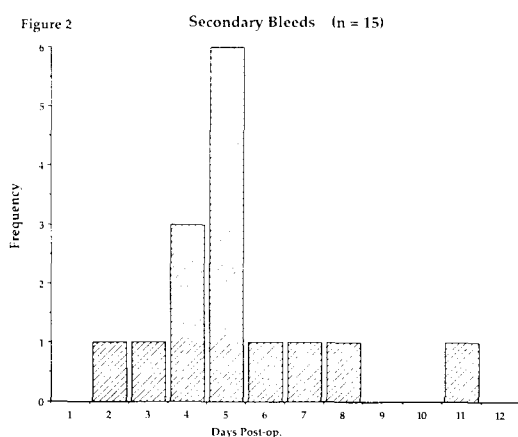


FIG. 2

Timing of secondary post-operative haemorrhage.

for this are mainly financial: the insurance companies will not pay for inpatient tonsillectomy. There is great interest in the potential for day-case tonsillectomy in the UK. Yardley (1992) has suggested in a retrospective study that primary haemorrhage following tonsillectomy is uncommon (0.49 per cent) and all significant bleeds occur within eight hours of surgery. He also suggested that bleeding after adenoidectomy was more common than after tonsillectomy. Our results show that serious haemorrhage certainly does occur more than eight hours after tonsillectomy and that the incidence of less severe but nonetheless significant bleeding is rather higher when examined in a careful prospective study. We also found that haemorrhage was much more likely after tonsillectomy than adenoidectomy. Our data would suggest that adenoidectomy would be a much safer day-case procedure than tonsillectomy.

Prior to this study, seven of the authors of this paper used only ligatures to achieve haemostasis after tonsillectomy: as a result of the study, they have now all converted to the routine use of diathermy. Those that previously used diathermy have not changed their practise.

Conclusion

Diathermy is no more likely to result in post-tonsillectomy haemorrhage than using ligatures. Diathermy is a significantly faster method of securing haemostasis and is therefore to be recommended in preference to ligatures. Junior surgical staff should still be taught to tie ligatures in the tonsillar fossa as situations will arise where there are necessary, such as a profusely bleeding large vessel or failure of diathermy equipment.

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References

- Carmody, D., Vamadevan, T., Cooper, S. M. (1982) Post-tonsillectomy haemorrhage. *Journal of Laryngology and Otology* **96**: 635–638.
- Cohen, L. (1909) Post-operative tonsillar bleeding. It's surgical control, with mention of cases. *Journal of the American Medical Association* **53**: 698–701.
- Haase, F. R., Noguera, J. T. (1962) Haemostasis in tonsillectomy by electrocautery. *Archives of Otolaryngology* **75**: 125–126.
- Johnson, F. (1962) Electrocautery in tonsil and adenoid surgery. *Archives of Otolaryngology* **75**: 127–129.
- Mackenzie, I. J., Johnson, A. P., Maran, A. G. D. (1983) Prospective study of pain and haemorrhage following tonsillectomy. *Clinical Otolaryngology* **8**: 366.
- Malik, M. K., Bhatia, B. P. R., Kumar, A. (1982) Control of haemorrhage in tonsillectomy. *Journal of the Indian Medical Association* **79**: 115–117.
- M'Auliffe-Curtin, J. (1987) The history of tonsil and adenoid surgery. *Otolaryngology Clinics of North America* **20**: 415–419.
- Murty, G. E., Watson, M. G. (1990) Diathermy haemostasis at tonsillectomy: current practice—a survey of UK otolaryngologists. *Journal of Laryngology and Otology* **104**: 549–552.
- Papangelou, L. (1972) Hemostasis in tonsillectomy. *Archives of Otolaryngology* **96**: 358–360.
- Phillips, J. J., Thornton, A. R. D. (1989) Tonsillectomy haemostasis: diathermy or ligation. *Clinical Otolaryngology* **14**: 419–424.
- Roberts, C., Jayaramachandran, S., Raine, C. H. (1992) A prospective study of the factors which may predispose to post-operative tonsillar fossa haemorrhage. *Clinical Otolaryngology* **17**: 13–17.
- Roy, A., De la Rosa, C., Vecchio, Y. A. (1976) Bleeding following

- tonsillectomy. A study of electrocoagulation and ligation techniques. *Archives of Otolaryngology* **102**: 9–10.
- Siodlak, M. Z., Gleeson, M. J., Wengraf, C. L. (1985) Post-tonsillectomy secondary haemorrhage. *Annals of the Royal College of Surgeons of England* **67**: 167–168.
- Waugh, G. E. (1909a) A simple operation for the removal of tonsils, with notes on 900 cases. *Lancet* **1**: 1314–1315.
- Waugh, G. E. (1909b) An operation for the total excision of tonsils (letter). *Lancet* **2**: 572.
- Whillis, S. S., Pybus, F. C. (1910) Enucleation of tonsils with the guillotine. *Lancet* **ii**: 875–878.
- Worthington, T. C. (1907) A simple method of excision of the faucial tonsil. *Journal of the American Medical Association* **48**: 1761–1762.
- Yardley, M. P. J. (1992) Tonsillectomy, adenoidectomy, and adenotonsillectomy: are they safe day case procedures? *Journal of Laryngology and Otology* **106**: 299–300.

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