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The influence of weather on the frequency of secondary post-tonsillectomy haemorrhage

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Abstract

The aim of this study was to determine whether certain weather variables influence the secondary post-tonsillectomy haemorrhage rate and to examine the influence of a change in these variables on secondary haemorrhage. This was a prospective study carried out in a tertiary referral institution. All patients undergoing bilateral tonsillectomy over a one-year period were included. Local weather data, including daily temperature (max/min), relative humidity and water vapour pressure, were acquired. All patients readmitted to our department with secondary post-tonsillectomy haemorrhage were recorded. Of 346 patients undergoing tonsillectomy, 32 developed secondary haemorrhage (9.2 per cent). A significant negative correlation was found between secondary haemorrhage rate and the average monthly temperature (max/min) and water vapour pressure (Pearson's correlation = –0.8) ($p \leqslant 0.002$). These results suggest that performing tonsillectomy in warmer weather when the water vapour pressure is higher may reduce the secondary haemorrhage rate.

Key words: Tonsillectomy; Haemorrhage; Post-operative Complications; Meteorological Factors; Weather; Climate; Temperature; Humidity

Introduction

Tonsillectomy is one of the most common operations performed by otolaryngologists.[1] Post-operative haemorrhage can be a severe and potentially life-threatening complication. In the United Kingdom, secondary post-tonsillectomy haemorrhage rates vary from 1 to 9 per cent.[2–4]

Secondary haemorrhage commonly occurs five to seven days post tonsillectomy. The belief that infection causes secondary haemorrhage has not been substantiated.[5] Furthermore, the level of experience of the surgeon has not been shown to affect the secondary haemorrhage rate.[3,4,6] Other factors that might predispose to secondary post-tonsillectomy haemorrhage include age, gender, and the use of non-steroidal anti-inflammatory drugs and diathermy for tonsillectomy. Children have a lower secondary haemorrhage rate[4,7] than adults.[6,8] Two studies have found young male adults to have a higher secondary post-tonsillectomy haemorrhage rate than females,[6,7] but other studies have found the opposite.[3,8,9] The use of non-steroidal anti-inflammatory drugs for analgesia after tonsillectomy is associated with a higher rate of secondary haemorrhage.[10–12] The use of bipolar diathermy for tonsillectomy has a significantly higher secondary haemorrhage rate than cold steel instrument dissection in adults.[4]

More recently, the effort to minimize the theoretical risk of acquiring Creutzfeld-Jakob disease from surgical instruments by introducing disposable instruments for tonsillectomy throughout the UK was thought to be associated with an increase in secondary post-tonsillectomy haemorrhage rates. Of three recent studies,[13–15] two failed to demonstrate that the introduction of disposable instruments was associated with a significant increase in secondary haemorrhage rate.[13,14]

Some studies have found there to be an increase in the secondary post-tonsillectomy haemorrhage rate in warmer months.[6,9] Other studies contradict these findings.[3,16] None of these studies analysed measured weather data variables in support of their findings.

The effect of weather variables, including temperature, vapour pressure and relative humidity, on acute laryngitis[17] and epistaxis[18] has been reported. These variables may have an effect on human physiology. However, their effect on post-tonsillectomy haemorrhage has not been studied.

This prospective study analysed the influence of the weather on the frequency of secondary post-tonsillectomy haemorrhage. The aims were to determine whether there was any correlation between secondary post-tonsillectomy haemorrhage

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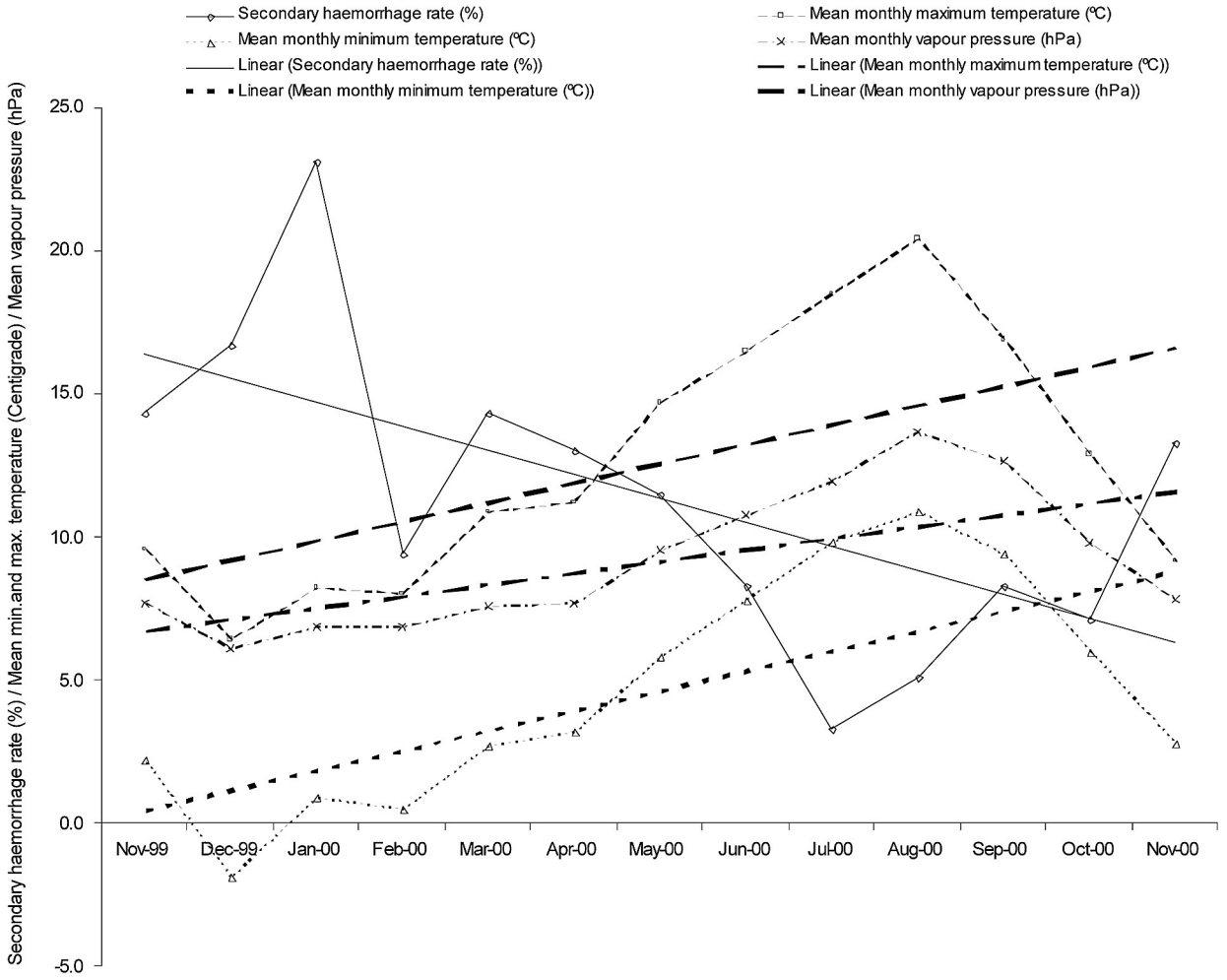

FIG. 1

Graph illustrating the negative correlation of secondary post-tonsillectomy haemorrhage rate to mean monthly maximum and minimum temperatures and vapour pressure.

rate and individual weather variables (daily minimum and maximum temperatures, mean water vapour pressure and mean relative humidity), and whether changes in any of these variables could be associated with secondary haemorrhage. Two hypotheses were formulated: (1) that there is no correlation between secondary post-tonsillectomy haemorrhage rate and individual weather variables; and (2) that the secondary post-tonsillectomy haemorrhage rate is not associated with changes in any of these variables. Secondary post-tonsillectomy haemorrhage quite often occurs five to seven days after surgery. We therefore chose to analyse the changes in the weather variables within five days of the onset of secondary haemorrhage.

Materials and methods

This was a one-year prospective study (8 November 1999 to 7 November 2000). All patients (adults and children) undergoing bilateral tonsillectomy were studied. All patients attending with secondary post-tonsillectomy haemorrhage were included. A proforma was used to prospectively collect data, including age, gender, date of surgery and date of secondary post-tonsillectomy haemorrhage. The local meteorological data for the duration of the study, including daily minimum and maximum temperatures, water vapour pressure and relative humidity, were obtained from the Scottish Crop Research Institute (SCRI), Invergowrie, Dundee, UK and the UK Meteorological Office based on recordings at the Leuchars weather station (altitude 10 m, latitude 56:38N, longitude 02:86W). The relationship between secondary post-tonsillectomy haemorrhage rate and these weather variables was studied.

The correlation of monthly secondary post-tonsillectomy haemorrhage rate to the mean monthly recordings of minimum and maximum temperature, vapour pressure and relative humidity was analysed using Pearson's correlation test. The daily minimum and maximum temperatures, mean vapour pressure and mean relative humidity on the dates when secondary post-tonsillectomy haemorrhage occurred were compared with the same weather variables recorded one, two and five days before the onset of haemorrhage. The changes in these variables that occurred between the day of haemorrhage and one day before it were compared to those occurring between the day of haemorrhage and two and five

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TABLE I

MONTHLY SECONDARY POST-TONSILLECTOMY RATE AND THE MEAN MONTHLY WEATHER VARIABLES

	Tonsillectomies (*n*)	Secondary haemorrhages *n* (%)	Mean maximum temperature (°C) (monthly)	Mean minimum temperature (°C) (monthly)	Mean vapour pressure (hPa) (monthly)	Mean relative humidity (%) (monthly)
Nov 1999	21	3 (14.3)	9.55	2.21	7.7	77.3
Dec 1999	24	4 (16.7)	6.4	-1.9	6.1	78.6
Jan 2000	13	3 (23.1)	8.2	0.9	6.9	77.9
Feb 2000	32	3 (9.4)	8.0	0.5	6.9	77.6
Mar 2000	28	4 (14.3)	10.9	2.7	7.6	73.8
April 2000	54	7 (13.0)	11.2	3.2	7.7	77.5
May 2000	26	3 (11.5)	14.7	5.8	9.5	79.3
June 2000	24	2 (8.3)	16.5	7.8	10.7	76.1
July 2000	30	1 (3.3)	18.5	9.8	12.0	76.7
Aug 2000	39	2 (5.1)	20.4	10.9	13.7	81.6
Sept 2000	12	1 (8.3)	16.9	9.4	12.6	85.2
Oct 2000	28	2 (7.1)	12.9	6.0	9.8	83.7
Nov 2000	15	2 (13.3)	9.16	2.77	7.8	82.2
	Total = 346	Total = 37				

days beforehand. Statistical analysis was undertaken using the paired *t*-test. A p value <0.05 was considered significant.

Secondary post-tonsillectomy haemorrhage was defined as bleeding occurring between day 1 and day 10 after the operation. It is our practice to readmit all patients who reattend with secondary post-tonsillectomy haemorrhage. Intravenous antibiotics, intravenous fluids, hydrogen peroxide gargles and appropriate analgesia are prescribed. A full blood count is taken. If the haemorrhage is severe or continuous despite medical treatment, the patient is returned to the operating theatre to arrest the haemorrhage under general anaesthesia.

Results

A total of 346 patients (133 male and 213 female) underwent bilateral tonsillectomy during the 12-month period. The mean age was 16.7 years (range 2–53 years). There were 192 patients (55.5 per cent) who underwent tonsillectomy using bipolar diathermy, 145 (41.9 per cent) who underwent tonsillectomy using cold steel instruments for dissection, and nine (2.6 per cent) who underwent tonsillectomy using a combination of both methods (seven patients had one tonsil removed by each method and two had tonsils removed using a combination of both methods).

Reactionary haemorrhage occurred in one patient (0.3 per cent). Secondary haemorrhage occurred in 32 patients (9.2 per cent) (nine male, 23 female, mean age 19.5 years, range 2–45 years). The incidence of secondary post-tonsillectomy haemorrhage among the patients who underwent tonsillectomy using bipolar diathermy, cold steel instruments for dissection and a combination of both methods was 23 (12 per cent), eight (5.5 per cent) and one (10 per cent), respectively.

Those patients who developed secondary post-tonsillectomy haemorrhage required a median in-patient stay of two days (range one to four days). Two patients needed blood transfusion and three required surgery to arrest the haemorrhage. Three patients were readmitted on more than one occasion (one patient was readmitted twice and the other two were readmitted three times) with secondary post-tonsillectomy haemorrhage. A total of 37 secondary haemorrhage episodes occurred during the study period.

The monthly secondary post-tonsillectomy haemorrhage rate, the mean monthly minimum and maximum temperatures, water vapour pressure and relative humidity are shown in Table I. A significant negative correlation was found between secondary haemorrhage rate and the mean monthly maximum and minimum temperatures and water vapour pressure (Pearson's correlation = -0.782, -0.792 and -0.784, respectively) (p = 0.002, 0.001 and 0.002, respectively) (Table II and Figure 1).

The mean maximum and minimum temperatures, water vapour pressure and relative humidity on the days when secondary post-tonsillectomy haemorrhage occurred were compared to their mean values one, two and five days previously. The paired *t*-test was used for analysis. There was no significant difference between mean maximum and minimum temperature, water vapour pressure or relative humidity on the day of haemorrhage and their mean values one, two and five days previously (p >0.09).

The magnitude of the changes in mean maximum and minimum temperature, water vapour pressure and relative humidity occurring between the day of haemorrhage and one day previously were compared to the changes occurring between the day of haemorrhage and two and five days before. No significant difference was found (p >0.2).

TABLE II

THE CORRELATION BETWEEN MONTHLY SECONDARY POST-TONSILLECTOMY HAEMORRHAGE RATE (%) AND THE MEAN MONTHLY WEATHER VARIABLES (* DENOTES STATISTICAL SIGNIFICANCE)

	Pearson's correlation	Significance (two-tailed)
Mean monthly maximum temperature (°C)	-0.782*	p = 0.002*
Mean monthly minimum temperature (°C)	-0.792*	p = 0.001*
Mean monthly vapour pressure (hPa)	-0.784*	p = 0.002*
Mean monthly relative humidity (%)	-0.274	p = 0.366

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Discussion

During the time of Hippocrates in ancient Greece it was thought that weather changes could influence human physiological processes. Human bio-meteorology was not formally acknowledged as a natural science, however, until significant progress was made in modern statistics, physics and physiology during the last century. Although the effect of meteorological factors on acute laryngitis[17] and on the frequency of epistaxis[18] has been studied, the influence of the weather on post-tonsillectomy bleeding has never been reported.

The weather data used in this analysis derive from two sources. The Scottish Crop Research Institute, Invergowrie, Dundee, UK, located no more than 2 miles from Ninewells Hospital and Medical School, provided temperature recordings for the duration of the study. The UK Meteorological Office supplied recordings of water vapour pressure, pressure at mean sea level and relative humidity over the same period. The recordings supplied were measured at their Leuchars weather station, no more than 15 miles from the hospital site. Throughout the study we have made the assumption that the weather data recorded at these two sites are representative of the climate in which our institution's catchment population, and hence the study group, lives.

In a study such as this the sample size is limited by the secondary post-tonsillectomy haemorrhage rate, which in the UK is usually less than 10 per cent.[2–4] A multicentre study would be inappropriate in assessing the relationship between secondary post-tonsillectomy haemorrhage and weather variables, owing to large geographical variations in the weather.

This study demonstrates that there is a statistically significant negative correlation between secondary haemorrhage rate and mean monthly maximum and minimum temperatures and water vapour pressure. From this we can extrapolate that there is a higher incidence of secondary post-tonsillectomy haemorrhage during colder weather in the geographical area of this study. We saw no clear pattern between post-tonsillectomy haemorrhage and relative humidity.

Viral infections of the upper respiratory tract are well known to be more prevalent during colder months. Patients who suffer from recurrent tonsillitis may also be more susceptible to recurrent viral upper respiratory tract infections. Theoretically, a concurrent viral pharyngitis could cause acute inflammation and hyperaemia in the healing tonsillar fossa, which may lead to secondary haemorrhage. If viral infection were indeed one of the precipitating factors, this would explain why no pathogens are isolated in bacterial cultures from the haemorrhagic tonsillar fossa.

The findings with respect to the influence of temperature and vapour pressure on post-tonsillectomy haemorrhage in this study mirror those of other studies examining the effect of meteorological parameters on acute laryngitis in adults[17] and the frequency of epistaxis.[18] Specifically, low temperature, low diurnal temperature range and low mean water vapour pressure were associated with an increased occurrence of acute laryngitis and epistaxis.

Conclusion

Although secondary post-tonsillectomy haemorrhage is likely to be multifactorial in aetiology, the results of this study indicate that the weather has a statistically significant influence. Specifically, temperature and water vapour pressure are the influential meteorological factors having a statistically significant negative correlation. Performing tonsillectomy in warmer weather with a higher water vapour pressure may reduce the secondary haemorrhage rate in our particular climate.

- **This prospective study analysed the influence of the weather on the frequency of secondary post-tonsillectomy haemorrhage**
- **A significant negative correlation was found between secondary post-tonsillectomy haemorrhage rate and the average monthly temperature and water vapour pressure**
- **These results suggest that performing tonsillectomy in warmer weather with a higher water vapour pressure may reduce the secondary haemorrhage rate**

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References

1 Blair RL, McKerrow WS, Carter NW, Fenton A. Audit Sub-Committee of the Scottish Otolaryngological Society. The Scottish tonsillectomy audit. *J Laryngol Otol* 1996;**110** (Suppl 20):1–25
2 Lloyd-Faulconbridge RV, Fowler S, Horrocks J, Topham JH. Comparative audit of tonsillectomy. *Clin Otolaryngol* 2000;**25**:110–17
3 Carmody D, Vamadevan T, Cooper SM. Post-tonsillectomy haemorrhage. *J Laryngol Otol* 1982;**96**:635–8
4 Lee MSW, Montague M-L, Hussain SSM. Post-tonsillectomy haemorrhage - cold versus hot dissection. *Otolaryngol Head Neck Surg* 2004;**131**:833–6
5 Kumar R. Secondary haemorrhage following tonsillectomy/adenoidectomy. *J Laryngol Otol* 1984;**98**:997–8
6 Roberts C, Jayaramachandran S, Raine CH. A prospective study of factors which may predispose to post-operative tonsillar fossa haemorrhage. *Clin Otolaryngol* 1992;**17**:13–17
7 Kristensen S, Tveteråas K. Post-tonsillectomy haemorrhage. A retrospective study of 1150 operations. *Clin Otolaryngol* 1984;**9**:347–50

https://doi.org/10.1258/002221505774783548 Published online by Cambridge University Press

8 Wei JL, Beatty CW, Gustafson RO. Evaluation of post-tonsillectomy hemorrhage and risk factors. *Otolaryngol Head Neck Surg* 2000;**123**:229–35
9 Collison PJ, Mettler B. Factors associated with post-tonsillectomy hemorrhage. *Ear Nose Throat J* 2000;**79**:640–2, 644, 646
10 Smith I, Wilde A. Secondary tonsillectomy haemorrhage and non-steroidal anti-inflammatory drugs. *J Laryngol Otol* 1999;**113**:28–30
11 Robinson PM, Ahmed I. Diclofenac and post-tonsillectomy haemorrhage. *Clin Otolaryngol* 1994;**19**:344–5
12 Stage J, Jensen JH, Bonding P. Post-tonsillectomy haemorrhage and analgesics. A comparative study of acetylsalicylic acid and paracetamol. *Clin Otolaryngol* 1988;**13**:201–4
13 Oluwasanmi AF. Post tonsillectomy morbidity: following the introduction of single-use instruments. *Auris Nasus Larynx* 2003;**30**:77–80
14 Montague ML, Lee MSW, Hussain SSM. Post-tonsillectomy haemorrhage – reusable and disposable instruments compared. *Eur Arch Oto-Rhino-Laryngol* 2004;**261**:225–8
15 Maini S, Waine E, Evans K. Increased post-tonsillectomy secondary haemorrhage with disposable instruments: an audit cycle. *Clin Otolaryngol* 2002;**27**:175–8
16 Williams RG. Haemorrhage following tonsillectomy and adenoidectomy. *J Laryngol Otol* 1967;**81**:805–8
17 Danielides V, Nousia CS, Patrikakos G, Bartzokas A, Lolis CJ, Milionis HJ, *et al.* Effect of meteorological parameters on acute laryngitis in adults. *Acta Otolaryngol* 2002;**122**:655–60
18 Danielides V, Kontogiannis N, Bartzokas A, Lolis CJ, Skevas A. The influence of meteorological factors on the frequency of epistaxis. *Clin Otolaryngol* 2002;**27**:84–8

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