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Pressure exerted by head bandages used in otological surgery

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Abstract

The pressure exerted by head bandages at the operation site following ear surgery was measured using a balloon catheter and pressure transducer. The initial pressures achieved, their diminution with time and the relationship of pressure to the induction of headache in the patient were studied.

The principal findings were that the standard otological head bandage is rarely tight enough to prevent haematoma formation, bandages have lost their efficacy after the first hour and headaches are associated with a significantly higher initial bandage pressure.

Key words: Otology, surgery; Bandages; Headache

Introduction

The head bandage has become a routine part of post-operative otolaryngological practice since the technique of harvesting temporalis fascia became widespread. It is assumed that these bandages provide gentle support for the operation site and help prevent haematoma formation (Ludman, 1988). However, the pressure exerted by the bandages is not usually known, nor whether it is sufficient to prevent a haematoma.

We therefore aimed to measure the pressure exerted by these head bandages at the operation site and to establish how that pressure changed with time. We also wished to determine how much variation there was in bandage pressure when applied by different members of staff and whether bandage pressure was related to the induction of headaches in the patients.

Materials and methods

The pressure exerted by bandages was measured using balloon catheters originally designed for measuring rectal pressures during urodynamic studies. The sterile balloon was placed over the wound at the site from which the temporalis fascia was harvested but separated from the wound by a single piece of absorbent dressing ('Melolin': Smith and Nephew). The bandages were then applied in the conventional circumferential fashion. Two crepe bandages ('Parema 10 cm × 4 m') were used, secured with zinc oxide adhesive tape. The large size of the balloon (55 × 25 × 5 mm) allowed partial inflation with only about 5 ml of air. As a result the balloon was almost flat when in place: a prominent balloon would artificially concentrate the compressive effect of the bandage at the operative site. Pressure measurements were made using a conventional blood pressure transducer (Elcomatic EM751). The transducer was connected to a strain gauge amplifier with digital display calibrated in mmHg. Before incorporation into the bandage, the pressure in the balloon was set to zero on the meter.

In Studies 1 and 2 the subjects are patients undergoing middle ear surgery requiring harvesting of temporalis fascia *via* an endaural incision. The bandages were applied by the theatre nursing staff as is our usual practice. For Study 3 the subject was a volunteer member of the hospital staff.

Results

Study 1

The first group of ten patients had pressures measured in the operating theatre, on return to the ward, and hourly for the subsequent 18 hours. The means of these values together with their standard deviation are shown in Figure 1.

There was a rapid decrease in pressure in the first hour followed by a slower but steady decline over the period monitored. The mean pressure was more than 38 mmHg only when the bandage had been first applied in the theatre. By the time the patients had returned to the ward the mean was below this level.

Study 2

A second group of ten patients also had pressures measured in the theatre, on return to the ward, and 18 hours later. This group and the ten patients used in Study 1 were asked *via* a questionnaire whether they had a headache on the evening of the operation, and/or on the morning after the operation.

By the morning following the operation nine patients had developed a headache and 11 had not. The mean pressures are shown in Figure 2. The mean pressure in those

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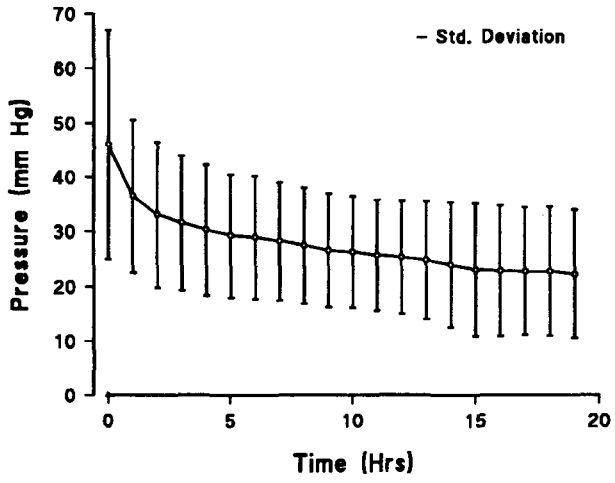

FIG. 1

The variation of the mean pressure under a head bandage with time after its application.

with headache was significantly higher than in those without headache, both when in the theatre and on return to the ward (Student's t-test; $P<0.001$). There was no significant difference in the pressures measured 18 hours post-operatively.

Study 3

In this study nine experienced members of the theatre nursing staff who routinely applied head bandages were asked to apply bandages to a volunteer. They were asked to apply them at normal tightness, too tight, too loose and again at medium tightness. There was a large variation in readings for the normal tightness level (range 18 to 83 mmHg). Even when asked to apply the bandage too tightly the mean pressure was only 45 mmHg (Figure 3). This pressure is close to the mean level recorded for patients in the theatre in Study 1.

Discussion

The obvious question is: how tight does the bandage over the operation site have to be to prevent the formation of a wound haematoma? It is our impression from experience in clinical practice that haematomas are associated with arteriolar if not arterial bleeding and not with capillary ooze. The hydrostatic pressure in large and medium sized arteries such as the superficial temporal is high and not greatly different from the systolic pressure measured in the brachial artery (120 mmHg). However the resistance to flow increases rapidly as vessel diameter decreases so that the hydrostatic pressure at the end of the smallest arterioles just prior to the start of the capillary circulation is 38 mmHg (Ganong, 1977). This is therefore the theoretical minimum pressure required to prevent haematoma formation. In our studies this level was only achieved when the bandage was first applied (mean 46 mmHg) and the pressure had fallen to below this level (mean 37 mmHg) by the time the patient had returned to the ward. This rapid drop in pressure with time is similar to that found in studies of pressure under bandages used in varicose vein surgery (Raj *et al.*, 1980) and in the treatment of venous stasis ulceration (Dale *et al.*, 1983). It therefore seems that if the head bandage has a compressive effect it is only within the first hour after surgery.

The relationship of haematoma production to bandage pressure following varicose vein stripping has been studied by Hardy *et al.* (1980). The two situations are not directly analogous as haematoma after vein surgery are assumed to be predominantly venous in origin. Hardy *et al.* (1980) were unable to demonstrate that the compressive bandaging limited haematoma formation. Rowe-Jones and Leighton (1993) have recently demonstrated an equal incidence of haematoma rates following ear surgery in two groups, one with head bandages the other without. Similar results were obtained by Powell (1989) in a study of dressings following pinnaplasty surgery. In neither study was the pressure exerted by the head bandage measured.

Those patients who suffered a headache on the following morning had higher initial bandage pressures. Although there was some overlap in the two groups it seems that to achieve a bandage pressure high enough to prevent a haematoma, the bandage has to be tight enough to induce a headache.

The large variation in pressure achieved between the appliers of bandages was expected, as similar variations have been demonstrated between surgeons applying bandaging after varicose vein surgery (Fentem *et al.*, 1976). We used several appliers rather than a single person so as

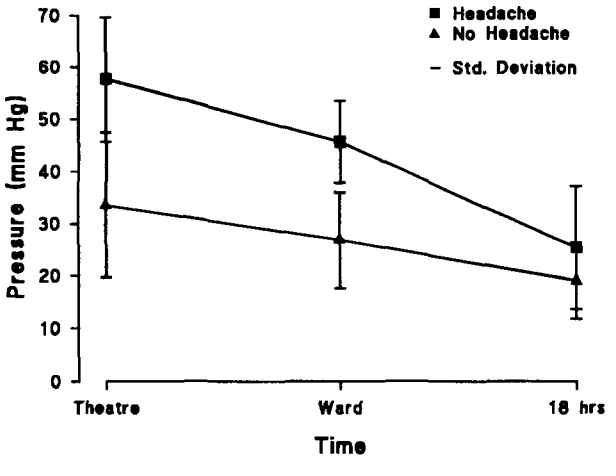

FIG. 2

The mean pressures under a head bandage in patients with and without headaches, measured in the theatre immediately after application, on return to the ward, and 18 hours later.

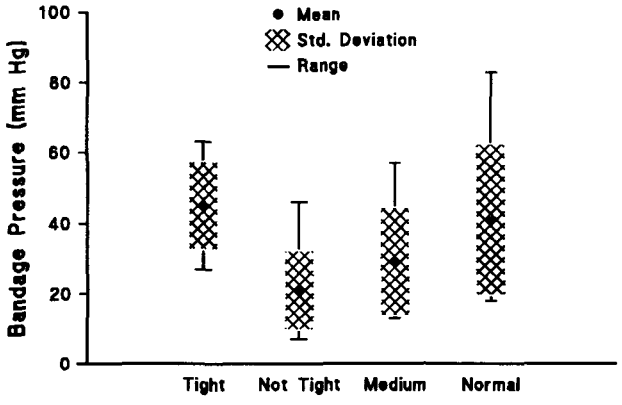

FIG. 3

The variation in bandage pressure obtained by a group of staff members following four different instructions.

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to reflect the spread of pressures likely to be encountered in clinical practice. During Studies 1 and 2 the staff applying bandages were obviously aware that their performance was being measured and despite our request to apply the bandages as normally as possible, we suspect that there was a tendency to put them on tighter than normal. This suspicion was confirmed in Study 3 where the mean pressure measured in the theatre in Study 1 (46 mmHg) was similar to the mean pressure when the appliers were asked to bandage the volunteer tighter than normal (45 mmHg). The pressures achieved in Studies 1 and 2 are therefore probably higher than would have been achieved in routine practice.

The traditional head bandage may have a role in otology in providing gentle support, for keeping dressings in place or for keeping inquisitive fingers out. Our study suggests that if a bandage is to have a compressive effect, then it should be tight enough to induce a headache. Even then it will have lost its efficacy after the first hour.

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