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Clinical Articles

The Effect of Hair on Infection after Cranial Surgery

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Summary

Objective. Reports of large series of patients who had undergone successful cranial neurosurgery without hair removal led part of our team to abandon the practice of shaving patients' heads preoperatively. The aim of this study was to assess whether this change in routine, which was implemented in 1992, has affected the rate of postoperative infection in our cranial surgery patients.

Methods. A group of patients whose heads were shaved preoperatively was compared to a group whose hair was not shaved prior to cranial surgery. The latter patients had their hair washed with shampoo and 4% chlorhexidine within 24 hours of their operation. In the operating room, the surgical site was scrubbed for 8–10 minutes with 4% chlorhexidine diluted with water, and then cleansed with 10% povidone-iodine solution. Prophylactic antibiotics were administered for 3 days.

Results. We performed 1.038 cranial procedures without hair removal. The procedures included craniotomy for tumour, trauma, aneurysm, other vascular lesions and intracerebral haemorrhage ($n = 847$), stereotactic biopsy ($n = 90$), stereotactic craniotomy ($n = 34$), ventriculoperitoneal shunt placement ($n = 27$), surgical treatment of infection with aspiration of brain abscess or resection of infected tissue ($n = 14$), microvascular decompression for trigeminal neuralgia or hemifacial spasm ($n = 11$), and other miscellaneous procedures ($n = 15$). We observed 13 postoperative wound infections (1.25%), including 9 deep (0.87%) and 4 superficial infections (0.39%). There was no significant difference between the rate of infection in patients whose heads were shaven (12/980) and the rate in those whose hair was spared (13/1038) ($p > 0.05$). In addition, there were no other problems related to the surgical preparation technique in the latter group.

Conclusion. Cranial surgery without hair removal is safe and does not increase the risk of surgical wound infection. Patients naturally prefer to keep their full head of hair. We believe that preoperative hair removal is not necessary in preparation for any type of cranial neurosurgery.

Keywords: Hair; neurosurgical wound infections; shaving.

Introduction

The idea that the presence of hair in surgical sites increases the risk of infection has long been accepted, not only by neurosurgeons, but also by virtually all surgeons [1, 3, 6, 7, 12, 21]. However, research has shown that shaving the head changes the normal flora in the wound area, removes the natural protective effects that hair offers in fighting bacteria, and results in minor trauma to the scalp, all of which increase the risk of infection [12, 17, 20].

In 1992, Winston published results from the first large series of patients who underwent cranial neurosurgery without hair removal [28]. On the basis of these findings, one of our senior surgeon (EK) decided to abandon head shaving in all his cranial procedures that same year. We designed a study that would compare his infection results with those of other surgeons' operations which included shaving as part of the preparation routine. Our aim in this investigation was to present our extensive experience with cranial operations which involved no hair removal, and thus expand the knowledge on infection in this patient group. We also discuss the methods we have used for neurosurgical site preparation in our cranial operations.

Patients and Methods

Our prospective investigation was conducted in the Department of Neurosurgery at Uludağ University Medical School. The study involved 1,038 patients who underwent cranial surgery without hair removal between June 1992 and August 1999, and 980 individuals whose heads were shaved prior to cranial surgery during the same time period. Patient characteristics for the unshaven and shaven groups are listed in Tables 1 and 2, respectively. Patients who died within 1 month of their surgery were excluded from the study.

In the unshaven group, all patients had a full-body bath preoperatively, as described by Byrne *et al.*, and the intended surgical site was prepared according to the CDC guidelines for clean wounds [5, 9, 10]. In the initial cases, patients were instructed to wash their entire bodies with 4% chlorhexidine shampoo (Klorheksol, Merkez Lab, İlaç San, İstanbul) within 24 hours of surgery. In the operating room, immediately prior to the operation, the surgeon or an assistant

Table 1. *Characteristics of the Patients Whose Heads were not Shaven*

Procedures	Number of patients
Craniotomy (Tumour, trauma, aneurysm, intracerebral haemorrhage, other vascular lesions)	847
Stereotactic craniotomy	34
Stereotactic biopsy	90
Ventriculoperitoneal shunt	27
Microvascular decompression	11
Aspiration and resection of abscess tissue	14
Other procedures	15
Total	1038

Table 2. *Characteristics of the Patients Whose Heads were Shaved*

Procedures	Number of patients
Craniotomy (Tumour, trauma, aneurysm, intracerebral haemorrhage, other vascular lesions)	902
Ventriculoperitoneal shunt	22
Microvascular decompression	12
Aspiration and resection of abscess tissue	24
Other procedures	20
Total	980

scrubbed the hair at the surgery site and any other hair that was long enough to reach the site. A soft brush was used, and the area was scrubbed for 8–10 minutes using a cleansing solution of 10% povidone-iodine diluted 50 : 50 with water. The eyes were protected with sticky drape material, and a cotton ball was placed in the external auditory canal when the head was positioned lest that the solution drain into the ear. After drying with a sterile towel, the area was washed a second time with 10% povidone-iodine solution (Isosol, Merkez Lab, İlaç San, İstanbul). In early 1994, we discontinued the 10% povidone-iodine scrubs and began using a shampoo of 4% chlorhexidine diluted 50 : 50 with water for all the cleansing steps.

After scrubbing, we exposed the incision site by parting the hair with a sterile clamp. Initially, we used disposable covers and shirts in these operations, but in later operations we used autoclavable materials. In all cases, the operative field was covered with sterile drapes before the incision was made. Then we made the incision and secured the edges of the scalp with scalp clips in such a way that hair could not fall into the surgical site. At the end of the operation, care was taken to ensure that no hair was trapped in the suture knots during skin closure. Regarding foreign materials, titanium plates were used to reconstruct bone defects in 211 cases, and methylmethacrylate was used in 2 patients.

In the earlier cases, the operation site was closed using an interrupted pattern of nonabsorbable sutures in the galea aponeurotica and a continuous pattern of 3-0 silk or nylon in the skin. Later, we switched to using interrupted absorbable sutures in the galea aponeurotica and continuous nylon sutures, and most recently staples, for skin closure.

Prophylactic antibiotics were administered in all cases. Initially, all but the shunt patients received 2 g/day intravenous ceftriaxone for 3 days, with the first dose given 1 hour before surgery. Patients undergoing shunt surgery received 1 g/day intravenous vancomycin for 3 days. At the suggestion of the hospital's Infection Control Committee, we later changed the antibiotic regimen to 2 g/day intravenous cephalosporin for 3 days. The first dose was given 1 hour before the operation, and the second dose was administered 12 hours after surgery. In all but the stereotactic biopsy and shunt patients, a vacuum drainage device was inserted beneath the scalp and fixed in place with suture material. We removed the drainage system approximately 24 hours after surgery.

Wound dressing involved the use of head netting, with sterile sponges loosely placed between the netting and the incision. No plaster was used. Approximately 24 hours after the surgery, the wound site was exposed to air and the patient's hair was shampooed and combed into the style they had worn before the operation. The sutures were left in place for 7 days. All patients were followed up at three or four weekly intervals after the surgery to monitor wound healing.

Consistent with other studies in the literature, we defined the presence of infection on the basis of specific criteria, including pus at the operative site, a positive culture from a swab of the incision, development of postoperative bacterial meningitis, and/or inflammation in the area of the wound [6, 18, 20, 24]. For analysis, we used the Mann-Whitney test to statistically compare the infection rate in the shaven group to that in the non-shaven group.

Results

There were 13 (1.25%) postoperative wound infections in the patients who had no hair removed (Table 3). Four of these individuals (0.39%) had superficial cruet reactions to suture material, and 9 (0.87%) developed deep wound infections. Seven patients had methicillin-resistant *Staphylococcus aureus* (MRSA) infections, one patient was infected with both *Enterobacter cloacae* and MRSA, one patient with *E. cloacae* alone, one patient with *Acinetobacter baumanii*, and three patients contracted *S. epidermidis* infections. There were 12 (1.22%) wound infections in the patients whose heads were shaven preoperatively (Table 3). Five of these cases (0.51%) were superficial and 7 (0.71%) were deep infections.

There was no statistical difference between the in-

Table 3. *Rate of Infection in the two Patient Groups*

	Total number infection (n)	Infection rate (%)	Deep infection (n)	%	Superficial Infection (n)	%
Patient with hair	13	1.25	9	0.87	4	0.39
Patient whose heads were shaved	12	1.22	7	0.71	5	0.51

* $p > 0{,}05$.

fection rates in the two groups ($p > 0.05$). In addition, we observed no other serious problems related to the new surgical preparation technique. There was a temporary hairless zone over the incision line in some patients whose wounds had been closed with non-absorbable suture; however, once we changed to closing the galea aponeurotica with absorbable suture and using staples to close the skin, this was no longer a problem.

Discussion

In 1980, Cruse and Foord published a prospective study which reported on 62,339 surgical wounds. They found clean wound infection rates of 2.5% when the operative site was shaved with a manual razor, 1.4% when shaving was done with an electric razor, and 0.9% when no shaving was done [6]. Specific to craniotomy cases, Zenther *et al.* found that 5.5% of 237 patients who had a standard wet head-shave, 3.2% of 93 patients who had a dry shave, and 2.8% of 145 patients who had their hair removed with clippers developed a surgical infection [30]. Winston reported a wound infection rate of 0.3% in 312 cranial procedures in which the hair was left untouched [28]. Sheinberg and Ross reported no wound infections in a large series of diverse cranial procedures which were performed without hair removal [25]. In their analysis of 172 paediatric procedures, Piatt and Steinbok reported a 0.6% rate of infection [22]. Braun and Richter described a small series of cranial procedures done without hair removal in which there were no cases of wound infection [3]. Also, a preliminary version of our present study was published in 1994, and at that stage we reported no infection in the first 142 patients whose heads were not shaven [15].

Research has shown that re-operation of tumour cases and procedures to reposition shunts increase the frequency of infection [12, 14, 22, 23, 28, 29]. Of the 13 cases in our unshaven group, 7 patients developed infection after their first operation, and 6 became infected after their second operation. Three of these six cases were shunt-associated infections.

The literature describes the use of various routes and different forms of antibiotics in cranial surgery cases [1, 2, 4, 8, 11, 13, 24, 26]. As mentioned, we initially used 2 g/day intravenous ceftriaxone in all our operations, and the first dose of this drug should ideally be given before surgery, as in our protocol. However, at the suggestion of our hospital's Infection Control Committee, in August 1995 we switched agents and began to administer 2 g/day cephalosporin.

Randomised trials have shown that pre-operative shampooing with chlorhexidine is superior to povidone-iodine for reducing the scalp bacterial count, and that multiple pre-operative scrubs enhance this effect [14, 16]. Our routine involved a full-body chlorhexidine bath and two pre-operative scrubs of the incision site, initially with povidone-iodine but with chlorhexidine alone after 1994. Although we used povidone-iodine scrubs in many of the procedures, we encountered only 13 infectious complications in total, and one of these cases was an emergency operation. Numerous reports in the literature have documented severe ocular toxicity related to chlorhexidine [19, 27], and this is why we paid special attention to protecting the patients' eyes. Our experience, although preliminary, indicates that omitting the pre-operative shampoo and using povidone-iodine rather than chlorhexidine can produce results that are equal to those in cases where the accepted routine is used. The findings of our study are in line with the observations of Sheinberg and Ross [25].

As mentioned above, we noted a hairless area along the incision line in cases in whom the galea aponeurotica and skin were closed with silk and nylon suture. For this reason, we altered our protocol to substitute absorbable sutures for galea aponeurotica closure, and used the skin stapler for skin closure. Once these changes were implemented, we saw no more skin complications in our patients.

There were 18 shunt procedures in our preliminary series, and another 27 in the latest series of patients in this study. Two cases involved methylmethacrylate cranioplasty, and titanium plates were used in 211 patients. There was no indication that implanting foreign material precludes hair sparing, and this finding concurs with those in the series reported by Winston, and Sheinberg and Ross [25, 28].

Overall we found no difference in the rates of infection in the shaven and unshaven patient groups. Various published reports have claimed there is no correlation between shaving hair from surgery sites and reduced incidence of infection that shaving the hair from surgery sites does not reduce the incidence of infection. In fact, it has been demonstrated that shaving actually increases the risk of infection. Studies have shown that the shaving process exposes the scalp to microscopic trauma and changes the natural bacterial flora to a pathological mix [12, 17, 20, 28]. Initially, we

were hesitant to implement the new protocol, and some colleagues questioned it due to fears about potential infection. However, in addition to the comparable infection results in the shaven patients and in those whose hair was left untouched, the latter group was very pleased to have kept their full head of hair. Furthermore, hospitalisation time was shorter in this group and the patients' morale was comparatively higher. They quickly returned to normal daily activities, including those outside the home. In particular, patients with occupations in which personal appearance is important indicated that they would not have been able to return to work with an obvious surgical scar for fear of potential negative reactions from employers, co-workers and customers. Further, patients who have undergone previous operations in which their head was shaved have been very enthusiastic about this new method.

In summary, this report demonstrates our success with leaving patients' heads unshaven during surgical preparation, a method that can be used for all types of cranial neurosurgery. The infection rate in these patients was almost identical to the rate in patients whose heads were shaved before surgery. A prospective randomised trial is needed to confirm that this technique carries no more risk than preparation methods that involve shaving. Clearly, patients would much rather keep their hair, and they have reacted positively to the new routine. We suggest that this protocol be used for all cranial neurosurgical operations.

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Comment

Although several studies have addressed this problem and have shown that a non-shaving policy does not increase the infection hazards of intracranial surgery, hair shaving remains common practise in neurosurgery. Why is that? Maybe it is because surgeons tend to be conservative and, to some extent, this is good as the improvement in surgical techniques has been the fruit of a long-standing tradition. Maybe the issue is not only infection, but also, for example, the careful designing and planning of the boneflap which may be more difficult with the hair in situ.

This is not a randomised study, as the authors have pointed out themselves and, therefore, the results should be interpreted with caution. The main bias, in this respect, is that the non-shaven group was operated on by one surgeon only, i.e. a senior surgeon, whereas the shaven patients were operated on by many surgeons. Furthermore, it is difficult to say whether the two patient groups were comparable as only information on the pathology is given.

Nevertheless, I consider this a well conducted study and many details are provided on the care given to the skin preparation. I assume that the results of this study will make surgeons reconsider their shaving policy.

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