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Technical Note

Selection of cranial site for shunting debilitated patients

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Summary

Background-objective. The optimum cranial site for ventricular catheter insertion in CSF shunts is still under debate and there has been no general consensus as far as surgical technicalities are concerned. Furthermore, there have been no reports dealing with appropriate cranial site selection in debilitated patients. The aim of this report is to stress the need to utilize a frontal approach when dealing with patients who are likely to remain bed-bound for long periods and to emphasize the well-known prerequisites such as meticulous surgical technique and perioperative general and local care.

Method. A retrospective analysis of all shunt operations and revisions performed in our department during the last 6 years.

Findings. This analysis revealed 8 long-term recumbent patients with late valve extrusion (N1 = 5) or primary wound breakdown (N2 = 3), all through the occipital area. Extended periods of bed rest due to neurological disease combined with poor nursing and dietary intake had led to either chronic valve extrusion or wound breakdown. Shunt revision was performed successfully by a frontal approach in 5 whereas 2 tolerated shunt removal and one died of meningitis.

Conclusion. In debilitated patients or those who are likely to remain bed-bound for long periods, a frontal approach for proximal catheter insertion may help prevent immediate postoperative wound breakdown or late valve extrusion.

Keywords: CSF shunt; frontal approach; hydrocephalus; valve extrusion.

Introduction

Even though shunt surgery is viewed as simple, it has the highest failure rate of any neurosurgical procedure. In fact, there are important technical considerations to be taken into account on virtually every step of the operation. Among them is the optimum site for ventricular approach, a long-standing controversy still under dispute [7, 8]. Choices for catheter placement include the frontal, occipital and posterior temporal approach (Keene's point), with the first 2 preferred by 85% of neurosurgeons [6].

Despite the fact that debilitated patients represent a significant population among those requiring hydrocephalus surgery, shunting techniques and ventricular approach in them have never been reported. These patients lie in the supine position for prolonged periods and compression of the skin over the valve may lead to breakdown, extrusion and sometimes infection.

We present 8 bedridden patients who were treated for hydrocephalus by the occipital approach and suffered primary wound breakdown or late valve extrusion. We stress the importance of the frontal approach in those patients who are likely to remain in bed for long periods, a technique that may help prevent complications such as wound breakdown and valve extrusion.

Material and results

During the last 6 years 365 shunts or revisions were performed in our department, either via an occipital (group A = 310) or a frontal route (group B = 55). Forty patients from group A (group A1) and 35 from group B (group B1), had long periods of bed rest preoperatively and postoperatively. Eight patients, all from group A1 presented with either late valve extrusion (N1 = 5) or primary wound breakdown (N2 = 3) (Table 1). Five of them were originally treated in our department. None of group B1 developed such a complication.

Table 1 summarizes the patients' demographic and clinical parameters. Two patient groups were identified. The first group (5 patients) developed late valve extrusion between 1–3 months, with the exception of one patient who had an extruded but surgically occluded valve for 9 years. Although all exposed valves were considered colonized by skin flora no active local, CNS or valve infection was identified clinically or

Table 1. *Demographic data and clinical characteristics of the 8 patients presented with extruded valves or skin breakdown*

Sex	Age	Etiology	Status	Postoperative breakdown	Exposure duration	Local infection	CSF infection	Shunt replaced
F	77	NPH	B	1 mo	3 mo	no	no	yes
F	51	P-t	B	3 mo	1 mo	no	no	yes
M	64	P-t	B	1 mo	9 yrs**	no	no	yes
M	64	P-h	B	2 mo	2 mo	no	no	no
F	45	O	B	3 mo	2 we	no	no	yes
M	20	O	B	1 we*	N/A	no	no	yes
M	39	O	B	1 we*	N/A	no	yes	died
F	21	P-h	B	1 we*	N/A	no	no	no

NPH Normal Pressure Hydrocephalus, *P-t* Post-traumatic, *P-h* Post-haemorrhagic, *O* Obstructive, *B* Bed-bound, *mo* month, *we* week.
* Surgical wound breakdown only with no valve extrusion, ** in situ but surgically occluded non-functioning valve.

by laboratory investigations. The second group (3 patients) developed wound breakdown within one week post-surgery. From the latter group, one patient developed CSF infection and died. Finally, 5 patients underwent shunt replacement via the frontal approach, whereas two tolerated shunt removal.

Discussion

Strategies for the treatment of hydrocephalus vary significantly among neurosurgeons. One of the parameters leading to this is the site of burr-hole placement. The choice between frontal or an occipital burr holes remains mainly a matter of the surgeon's or the institution's preference [8]. Li *et al.* [6], in 1999, asked 149 neurosurgeons concerning hydrocephalus treatment, with 40% favouring an occipital approach, 30% a frontal one, 14% a posterior temporal approach and 16% stating that they would select the route allowing easiest ventricle cannulation.

Available data concerning long-term performance and infection rates of the 2 main ventricular approaches are contradictory. In 1988 Albright *et al.* [1], retrospectively analysed 114 shunt operations and concluded that frontal shunts had a 5-year function rate of 70%, as opposed to 40% of parietal shunts. Two years later, Bierbrauer *et al.* [3] performed a prospective randomised trial in 121 patients and reported that 70% of posteriorly placed shunts did not require further surgery during the 27-month study period vs. 59% of anteriorly placed shunts. They concluded that frontal shunts are not superior in terms of infection or malfunction. Since available data have failed to show any advantage of one approach over the other, the choice is left to the surgeon's convictions.

Head trauma or spontaneous haemorrhage, old age, intracranial procedures, tumours or infection, all represent causes of hydrocephalus and long-term bed rest. Shunting techniques in bed-bound patients have not been addressed systematically, neither in classical neurosurgical textbooks, nor in international literature. A shunt procedure in these patients is usually performed with the same technique as in an ambulatory patient, taking only precautions to avoid tracheostomy or gastrostomy incisions.

Our experience with the 8 reported cases, has led us to the conclusion that the occipital approach represents a high-risk choice when dealing with bed-bound patients. Occiput is a skin area commonly involved in the development of bedsores. Inserting a valve in this area stretches the skin further thus increasing the possibility of erosion. Furthermore, the classic curvilinear incision often used, might compromise the skin flap vascularization. This, along with impaired healing due to poor nutrition, steroid intake or poor local hygiene, predispose to immediate postoperative wound breakdown or late skin erosion.

In the case of valve extrusion, an infection is likely to occur since the occipital scalp area in bedridden patients due to poor local hygiene, is colonized by a high microbial burden often resistant to antibiotics, acquired during a prolonged hospital stay. This was not the case in the majority of our patients. In the 5 patients with long-term valve extrusion, no CNS infection was diagnosed. Valve cultures revealed *Staphylococcus Epidermidis* in 2 cases, considered as skin flora colonizing the shunt without causing infection (local or CNS), since the patients had no symptoms or signs supporting such a diagnosis. The exact mechanism that prevented infection is not clear and it is in contrast with previously reported similar cases [4] in whom CNS infection developed after a short period. From the group of patients with immediate skin breakdown, 2 were treated accordingly with good results while one developed meningitis and died.

If despite the high risk, a surgeon selects the occipital approach, certain operative principles may help prevent valve extrusion. A well-nourished patient is at lower risk

for both infection and wound breakdown. A small size valve made by less ''aggressive'' material with no sharp edges will help avoid further pressure on the surgical wound [8]. The valve reservoir should not be placed directly underneath the incision and if a bulky device is to be used, it should be placed at the neck or the prethoracic area [8]. Furthermore, a shunt device with a slit valve at the peritoneal end may be appropriate, thus obviating the need for a ''high profile'' valve device under the scalp. Dural openings should be large enough to allow penetration of the proximal catheter, but small enough to provide a tight seal around it, avoiding a CSF leak which may lead to wound contamination and breakdown [5]. Knots from connector ties should be placed in the subcutaneous tissues beneath the tubing rather than directly over it and beneath the skin [9]. Skin should be closed in 2 layers with careful apposition of skin edges.

In the postoperative period, it is important to avoid any form of pressure over the wound with good nursing and wound care. Nutrition and maintenance of skin hygiene are important preventive measures. Patients should be turned frequently and the wound examined often for signs of tenderness or redness. Finally, water-filled mattresses, rubber pillows, alternating pressure mattresses and thick foam pads are useful. It is a fact that not all shunts placed by an occipital approach in debilitated patients will extrude. Attention to these details is most definitely among the reasons for that.

Conclusions

Our experience with the above 8 patients lead us to the conclusion that ventricular catheter insertion in debilitated patients or those that will remain bed-bound for some time after a shunting procedure, should be performed by the frontal approach. An occipital approach may lead to immediate postoperative wound breakdown or late valve extrusion. If a surgeon selects an occipital approach in debilitated patients, an operation plan with attention to detail, a skilled and expeditious surgical technique and meticulous care are imperative for the avoidance of serious complications.

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Comment

This short paper discusses a rather trivial technical point. Namely; debilitated old patients should preferably have their shunt valves at scalp areas not exposed to chronic pressure. Frontal entry is better then occipital!

Technically speaking, in infants and children, we did not observe similar problems when shunts were inserted in an occipital trajectory. Bed-ridden adults are a different and important population.

Despite the triviality of this point, they present some data showing a reduced rate of shunt skin problems when implanted frontally.

Because in ''shuntology'', data is so rare, and hand-waiving is so common, I think this, and similar, papers should be published.

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