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Tools and techniques

Preoperative lumbar drainage placement for surgical cranioplasty

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ABSTRACT

Objective: Intraoperative reduction of cerebrospinal fluid may be required in patients undergoing cranioplasty (CP) surgery, especially in the presence of bulging cranial defects. Direct cannulation of the frontal horn of the lateral ventricle is associated with risks such as intracerebral haemorrhage or postoperative leakage of cerebrospinal fluid. Here we report our initial experiences with preoperative lumbar drain (LD) placement for cranioplasty surgery in patients with bulging cranial defects.

Method: The medical records of patients who were treated with LD prior to CP surgery at our institution were retrospectively analysed. Pre-, intra- and postoperative modalities, complications and outcome parameters are described.

Results: A total of 14 patients (mean age 46 years) were included in this analysis. The majority of patients had received decompressive craniectomy due to space-occupying cerebral infarction (64.3%) and traumatic brain injury (14.3%). CP was performed unilaterally with autologous bone graft in 93% of cases. No complications occurred during lumbar drainage placement and the grafts were implanted without the need of dural opening and ventricle puncture. LDs were maintained for an average of 17 ± 15 h (range, 1–48 h). There were no LD related complications in the further course.

Conclusion: Our initial experiences demonstrate that preoperative LD placement facilitates CP in patients with bulging cranial defects requiring surgical cranioplasty. Intraoperative puncture of ventricles for reducing cerebrospinal fluid is avoided and therefore, the risk of intracerebral haemorrhage and brain damage is reduced. Further studies are needed to evaluate the advantages of this technique as an alternative to conventional methods of intraoperative CSF reduction.

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1. Introduction

Decompressive craniectomy (DC) is an effective option to decrease life-threatening intracranial hypertension in traumatic brain injury (TBI) and patients with haemorrhagic or ischemic stroke [1–4]. CP surgery with reinsertion of the autologous bone flap or implantation of alloplastic grafts is usually required in the further course of respective patients. The surgical procedure is associated with high rates of complications such as wound healing disorders, infections or osteolysis of the autologous bone [5,6]. This especially applies to patients with bulging cranial defects, as puncture of the ventricles to decrease the volume of intracranial cerebrospinal fluid for graft implantation may be necessary.

Herniation of the cranial defect can have various reasons. Cerebral edema may be present in the acute phase after TBI or stroke. Hydrocephalus (HC) may also lead to a bulging cranial defect which may require implantation of a CSF shunt system.

However, bulging defects may also occur without edema or HC. In these cases, the CP procedure can be difficult because the cranioplasty cannot be adapted into the desired position. Temporary CSF reduction may be necessary and this can be achieved through various methods. Usually, the frontal horn of the lateral ventricle is cannulated intraoperatively through insertion of an external ventricular drainage (EVD) or a Cushing cannula. However, this procedure is associated with the risk of misplacement or intracerebral haemorrhage (ICH) with subsequent postoperative neurological deterioration [7–10]. EVD-associated haemorrhagic complications occur in 7.0% of cases (95% confidence interval: 4.5%–9.4%) [7,8]. The use of preoperative lumbar drainage (LD) has been reported for the prevention of spinal cord ischemia in patients undergoing thoracic endovascular aortic repair [11]. Furthermore, LD's are frequently used in skull base surgery to prevent or treat postoperative CSF fistulas, especially for extended endoscopic endonasal approaches with large dura defects [12,13]. The technique of LD placement is similar to that of epidural anaesthesia which is routinely used, e.g. for caesarean section [14]. Therefore, the placement of the LD can also be performed by anaesthesiologists. To the best of our knowledge, its use for reduction of CSF prior to

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surgical CP has not yet been reported in the literature. The risk of peri-procedural intracerebral haemorrhage can be minimized and the craniotomy defect can be brought into the desired position by varying the CSF flow rate (pre- and intraoperatively).

2. Methods

In this retrospective study, the data of consecutive patients treated with preoperative lumbar drainage prior to CP surgery at our institution were analysed.

Patient demographic information, pathology, specific risk factors and details of the surgery and hospital course were analysed. Further analysis focused on time of CP and LD placement, duration of LD, peri- and postoperative complications and neurological outcome (assessed by modified Ranking Scale).

During the study period, the use of LD placements was not subject to a specific decision tree or paradigm but was left to the discretion of the attending neurosurgeon. In general, patients were considered for this procedure when a bulging cranial defect was present without signs of cerebral edema or HC (Fig. 1). Patients who experienced only intraoperative bulging defect, received a conventional cannulation of the frontal horn of the lateral ventricle through insertion of an EVD or a Cushing cannula.

All lumbar drains (Epidural Minipack System 4, Protex/Smiths Medical, Grasbrunn, Germany) were placed by a neurosurgeon. Drainage of spinal fluid was typically maintained at 10 cc per hour (volume led) depending on the shape of the cranial defect (Fig. 2). The drain was removed immediately after the operation.

The data were retrospectively collected from the clinical database and inserted into an Excel analysis. For the descriptive

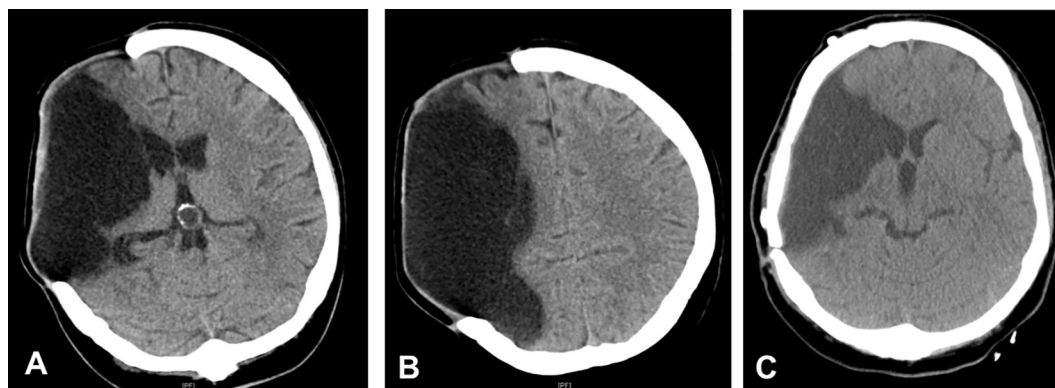


Fig. 1. A + B: CT-scan of a female patient five month after an MCA-stroke and right-sided decompressive craniectomy. The cranial defect is raised over the bone margins and CP without drainage of CSF is not possible. C: CT-scan of the same patient one day after successful CP using the LD for CSF reduction.

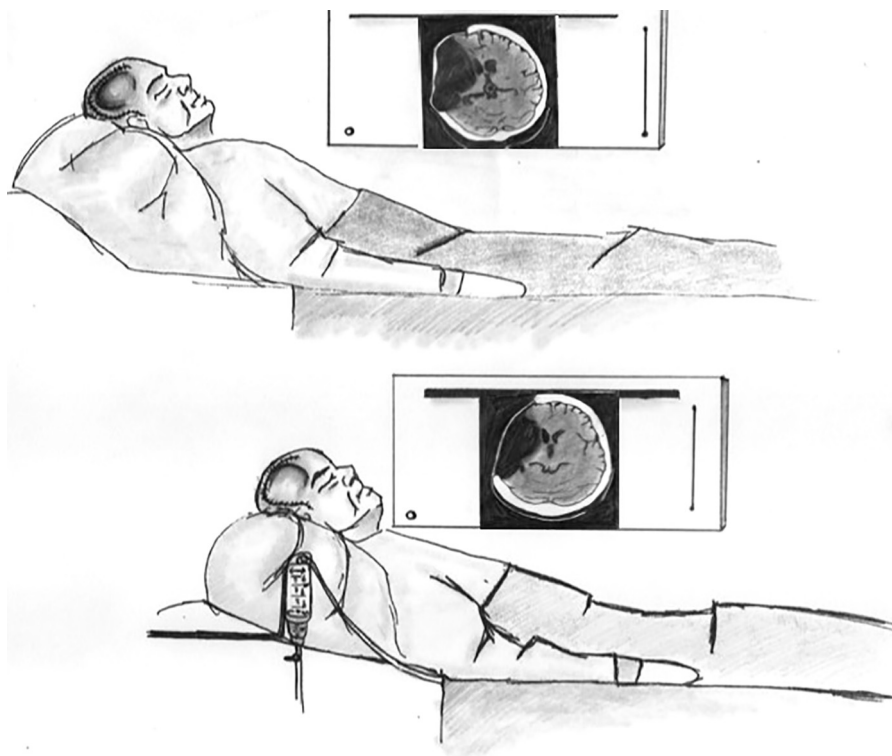


Fig. 2. Example of an LD placement. A patient with bulging cranial defect received an LD. Due to the continuous CSF drainage the bulging defect decreased to a normal head shape and CP can be performed.

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