

Impact of timing of cranioplasty on hydrocephalus after decompressive hemicraniectomy in malignant middle cerebral artery infarction

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ABSTRACT

Objective: Patients with malignant middle cerebral artery infarction frequently develop hydrocephalus after decompressive hemicraniectomy. Hydrocephalus itself and known shunt related complications after ventriculo-peritoneal shunt implantation may negatively impact patients' outcome. Here, we aimed to identify factors associated with the development of hydrocephalus after decompressive hemicraniectomy in malignant middle cerebral artery infarction.

Patients and methods: A total of 99 consecutive patients with the diagnosis of large hemispheric infarctions and the indication for decompressive hemicraniectomy were included. We retrospectively evaluated patient characteristics (gender, age and selected preoperative risk factors), stroke characteristics (side, stroke volume and existing mass effect) and surgical characteristics (size of the bone flap, initial complication rate, time to cranioplasty, complication rate following cranioplasty, type of implant, number of revision surgeries and mortality).

Results: Frequency of hydrocephalus development was 10% in our cohort. Patients who developed a hydrocephalus had an earlier time point of bone flap reimplantation compared to the control group (no hydrocephalus = 164 ± 104 days, hydrocephalus = 108 ± 52 days, $p < 0.05$). Additionally, numbers of revision surgeries after cranioplasty was associated with hydrocephalus with a trend towards significance ($p = 0.08$).

Conclusion: Communicating hydrocephalus is frequent in patients with malignant middle cerebral artery infarction after decompressive hemicraniectomy. A later time point of cranioplasty might lead to a lower incidence of required shunting procedures in general as we could show in our patient cohort.

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1. Introduction

Over last years the treatment of patients with space occupying middle cerebral artery infarctions has fundamentally changed. More and more early surgical decompressive hemicraniectomies are performed to prevent increased intracranial pressure due to developing cerebral edema. This change of paradigm was necessary due to the poor outcome of conservative treatment in these patients with mortality rates of up to 78%. Several large prospective randomized trials have clearly demonstrated a significant reduction of

mortality and improvement of patient outcome after hemicraniectomy [1–4]. In particular patients between 18 and 60 years, an infarct volume exceeding 145 cm^3 , an initial NIHSS score of >15 taken to surgery within the first 48 h after symptom onset benefit from a decompressive hemicraniectomy. An absolute risk reduction of 50% concerning mortality and 42% concerning a modified Ranking Score ≥ 4 after 12 months can be achieved [3]. The benefit of the initial surgical treatment can still be found 3 years after hemicraniectomy [5]. However, despite these promising results, some patients develop complications that are solely related to the hemicraniectomy. The influence of those surgical complications on the long term outcome is insufficiently recognized and discussed.

Besides the classical surgical complications (wound infections, meningitis, cerebral abscess formation, hematomas, cerebrospinal fluid (CSF) fistulas etc.) there is a certain spectrum of complica-

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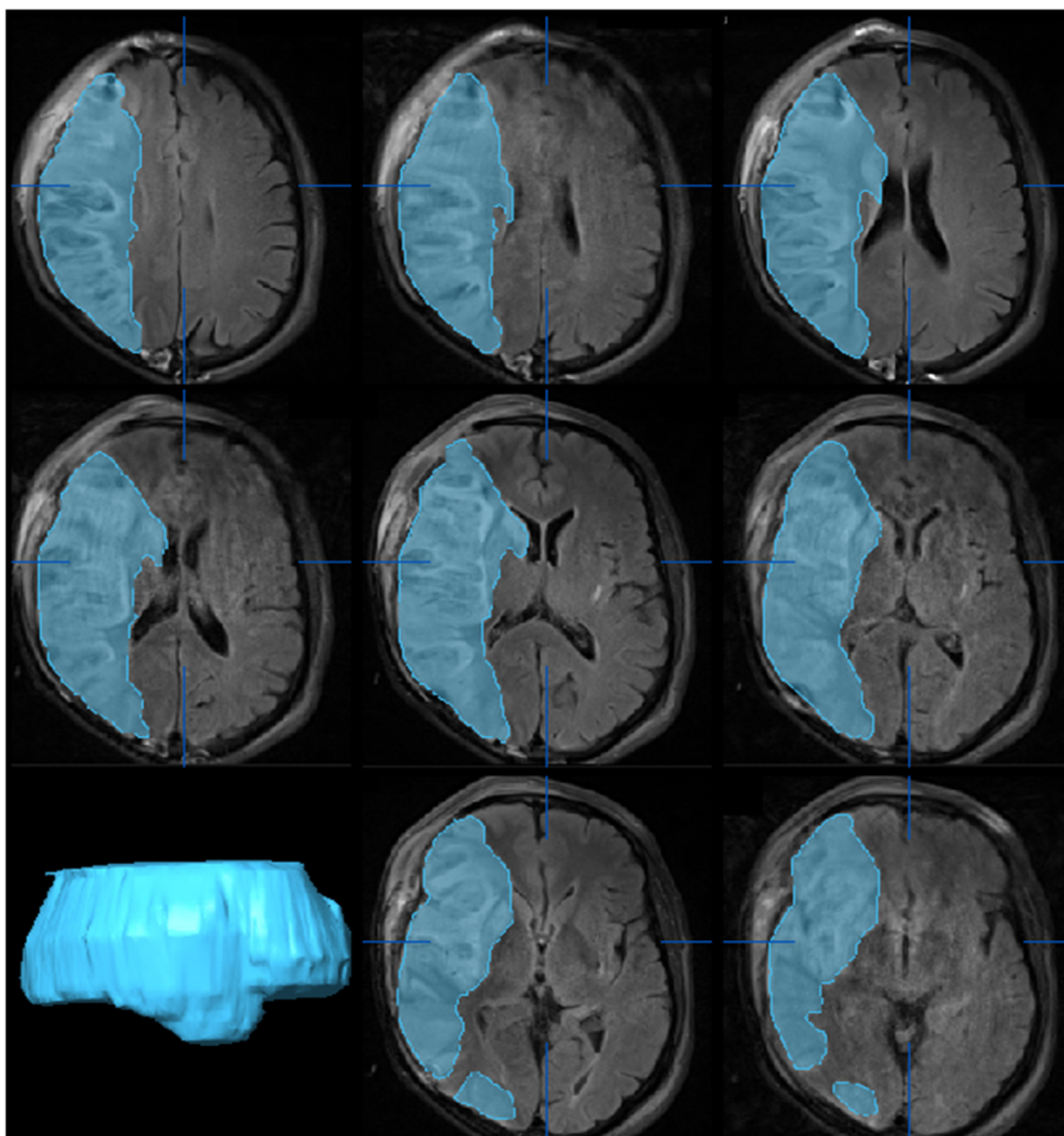


Fig. 1. Preoperative MRI scan showing a large right sided malignant middle cerebral artery infarction (grey).

tions that can be attributed to a wrong allocation of CSF, impaired CSF circulation and malabsorption of CSF following decompressive hemicraniectomy. Development of hydrocephalus and subsequent increase of intracranial pressure (ICP) is probably one of the more frequent complications in this spectrum. Numbers up to 47,8% have been reported [6–9]. There seems to be evidence that the development of hydrocephalus after decompressive hemicraniectomy may have a negative influence on the neurological outcome [10]. On the other hand, reports of the sinking skin flap syndrome describe paradoxical herniation as a possible result of a reduced intracranial pressure [11,12]. In a small prospective patient cohort 26% of the patients developed a sinking skin flap syndrome radiographically, only 11% had relevant clinical symptoms [13]. Further the development of extra-axial fluid collections is yet another CSF related complication that has been reported with an incidence of 18% in these patients [14,15] while its clinical relevance is insufficiently understood. Ropper et al. could show that all the extra-axial fluid collections in patients after decompressive hemicraniectomy

because of a malignant middle cerebral artery infarction resolved spontaneously [15].

Beyond decompressive craniectomy for treatment of malignant middle cerebral artery infarction of course decompressive surgery as well is performed following severe traumatic brain injury [16,17]. As shown in a review by Stiver et al. development of post-cranioplasty hydrocephalus is a common complication [18]. A recent retrospective study reviewing the data of all patients at their institution who underwent cranioplasty following craniectomy for stroke, subarachnoid haemorrhage, epidural hematoma, subdural hematoma, and trauma reported an incidence of 13,5% for post-cranioplasty hydrocephalus [19]. In contrast, only 1% of patients with head injury and without craniectomy develop hydrocephalus, while up to 30% develop hydrocephalus following aneurysmal SAH [20,21]. Hydrocephalus itself is associated with a poorer neurological outcome following traumatic brain injury [22,23].

In this retrospective study, we aimed to elucidate the incidence of the development of hydrocephalus after decompressive hem-

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