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Infectious Complications After Reimplantation of Bone Flaps in Patients Who Underwent Decompressive Craniectomy

To the Editor—As a neurosurgical procedure, decompressive craniectomy has been described as a therapeutic approach to intractable intracranial pressure—resulting from a traumatic brain injury or brain edema of other etiology—and malignant middle cerebral artery infarction, as outlined in a number of algorithms for therapy.[1] Some of the technical details of the procedure, including the storage of removed bone flaps, are mostly based on institutional experience, and the infectious complications associated with delayed cranioplastic repair have not been routinely monitored.

A survey consisting of the following 5 questions was e-mailed to a representative convenience sample of 100 large and small neurosurgical departments at university, teaching, and community hospitals in Germany: (1) How many decompressive craniectomies were performed between 2004 and 2006? (2) How many bone flaps were reimplanted between 2004 and 2006? (3) How many infections (ie, clinical diagnosis in a patient's record) associated with bone-flap reimplantation were observed between 2004 and 2006? (4) How are bone flaps stored at your institution? (5) Is there a maximal storage duration at your institution?

The medical insititutions from which the quality assurance data were collected and recorded remained anonymous; any identifiers of the institutions were destroyed after being entered into a spread sheet (Excel 2003; Microsoft Deutschland GmbH), in compliance with German federal data protection laws. Specific institutional review board authorization is not required by German law for this kind of research.

Only the data sets of 12 medical centers could be fully analyzed, because many institutions were not able to match decompressive craniectomies with their respective reimplantation procedures or to provide infection rates; these insitutions had to be excluded. Therefore, the planned multiple regression analysis using JMP, version 5.1 (SAS), had to be abandoned because of the small number of medical centers included in our study.

In the 12 medical centers included in the study, 682 decompressive craniectomies (range, 4–335 procedures per medical center) and 301 bone-flap reimplantation procedures (range, 2–137 procedures per medical center) had been performed. This represents a mean reimplantation rate of 44% (range, 37%–75%). Of the 301 bone-flap reimplantation procedures, 22 were reported to have infectious complications (mean infection rate, 7.3%; range, 0%–11.7%). There was a large variation in maximal storage times among the 12 medical centers: no restrictions, 1 month, 6 months, 12 months, 24 months, and up to 5 years. The 12 medical centers' practice patterns for storage were also highly variable, including frozen storage at −80°C ($n = 3$), −70°C ($n = 3$), −24°C ($n = 1$), and an unknown temperature ($n = 3$) and bone-flap implantation in the abdominal wall ($n = 2$). Bone flaps were pretreated with either Lavasept (BBraun AG) for 5 minutes ($n = 1$) or Jodobac (Bode Chemie) for 30 minutes ($n = 1$), or they were boiled in sterile normal saline for 20 minutes before freezing ($n = 1$). The infection rate in the medical center with a storage temperature of −24°C was the highest at 11.7%; however, no valid statistical analysis could be performed because of the small number of medical centers in our study.

Decompressive craniectomy is reported to be a lifesaving rescue procedure for selected patients, although its definite place in algorithms for therapy for intractable intracranial pressure still needs to be determined.[1] With the increased utilization of this neurosurgical procedure, the questions of how to handle, store, and reimplant bone flaps harvested at initial decompression and the infectious complications associated with delayed cranioplasty become an important issue for the long-term care of those often severely ill patients.

Our study was limited by the small number of complete data sets for analysis, which is one of the major drawbacks of surveys, and highlights the demand for prospective surveillance efforts. The infection rate that we calculated in our study is in accordance with the rates found in the literature (ie, 2.1%–7.8% in larger case series).[2,3] However, no common definitions for infectious complications after delayed cranioplasty are in place, which limits comparison. The storage procedures described in the literature also differ from one medical center to the next. For example, freezing techniques include freezing at −35°C or −84°C without pretreatment,[3] at −80°C after rinsing with neomycin,[4] at −16°C after immersion in amikacin sulphate,[5] and at −20°C in 100% ethanol solution and autoclaving before reimplantation.[6] Jho et al.[2] described a technique that uses gas sterilization with ethylene oxide for storing explanted skull bone at room temperature, and interest is growing in the intracorporeal storage of bone in the abdominal wall[7] or in a subgaleal pocket,[8] especially in regions of the world where extracorporeal storage is limited

because of problems with electricity and infrastructure. However, with regard to graft survival and the rate of infection after reimplantation of bone flaps, the differences between intracorporeal and extracorporeal storage modalities need to be determined before a final recommendation for the proper storage of bone flaps can be made. Also, the effects of the material used to fix the bone flap (eg, the use of a titanium clamp system [Craniofix; BBraun AG] and plates [Leibinger]) remain unclear.

In summary, our survey of 12 medical centers and our review of the literature reveal nonstandardized, highly variable protocols for the handling of bone flaps after decompressive craniectomy. With a mean infection rate of approximately 7%, a comprehensive approach to evaluating these practice patterns for the storage of bone flaps is warranted.

Ideally, a prospective, randomized trial would compare intracorporeal and extracorporeal storage techniques, but, given the large number of patients needed to reach sufficient power, this option seems unrealistic. Therefore, the development of standardized definitions of infections associated with delayed cranioplasty after decompressive craniectomy and the inclusion of these definitions as a marker in established surveillance systems (eg, the National Nosocomial Infections Surveillance system[9] and the Krankenhaus Infektions Surveillance System[10]) might be an alternative approach to evaluating current practice patterns and might improve a patient's outcome in the future.

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