Editorial

Bone flap cultures

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Infections have plagued surgeons for all recorded history and remain a significant problem today. Historical documents including the Edwin Smith papyrus (circa 1600 BC) and writings of Hippocrates (circa 450 BC) describe principles of wound management and antisepsis to prevent infection. Although Galen proposed the concept of *pus bonum et laudabile* (that is, that “good and commendable pus” was favorable in wound healing), modern surgeons remain flummoxed by the appearance of pus, despite all the measures undertaken to prevent surgical infection. Following on the work of Koch and Semmelweis, Lister developed the concept and practice of antisepsis, which persists to date in our rituals of gowns, gloves, masks, and site and instrument sterilization. However, only recently have many of these inviolable precepts of infection prevention been questioned on the basis of scientific evidence.

Chiang and colleagues addressed one of these rituals of uncertain significance in their present study. In the setting of severe brain swelling, craniotomy bone flaps are frequently removed, stored, and replaced at a later time when the edema has receded. The autologous bone provides an excellent cosmetic and cost-effective solution and, in comparison to intraoperative methacrylate or custom-fashioned synthetic cranioplasty, may be less susceptible to infection. It had been the practice at the authors’ institution to culture the craniotomy flaps at the time of removal and discard those flaps with evidence of contamination. This practice was discontinued, and the initial portion of this report describes a retrospective analysis, which was performed to determine potential factors related to positive craniotomy flap cultures. There was no distinct association between positive intraoperative cultures and surgical technique, emergency procedures, or operating room environment. Electrophoresis of the most common skin flora contaminant in these cultures, *Propionibacterium acnes*, showed multiple genotypes, suggesting that contamination emanated from the patient rather than a common exogenous source. On this basis, a prospective cohort study was designed to determine the relationship between surgical site infection (SSI) and various demographic and procedural factors, including intraoperative bone flap cultures. Among 372 bone flaps cultured, the majority (297) were reimplanted in the same procedures, whereas 24 of 80 procedures that involved delayed cranioplasty had autologous bone flaps reimplanted. A surprising 50% of intraoperative cultures were positive, mostly with skin flora and sparse cultures characterized by limited numbers of colonies in the culture. There was no association between positive intraoperative culture and SSI for either immediate or delayed implantation; only 2 patients had concordant organisms on intraoperative culture and subsequent SSI. Among multiple variables, only the prep solution (other than povidone-iodine), insufficient drying time for the prep solution, female sex, and Gliadel wafer implants were associated with an SSI.

The study makes an important point: although neurosurgical craniotomy flaps are frequently contaminated (presumably by patient skin flora), the contamination is likely not a factor in the development of a subsequent SSI. Discarding cryopreserved bone flaps with sparse positive cultures is not warranted, and SSI is equally frequent for both culture-negative and culture-positive bone flaps. The other findings are less certain, due in part to the study design and in part to the complexity of SSI pathogenesis. Confounding factors in the analysis of perioperative infection include systemic factors (for example, hyperglycemia, nutrition, renal function, nasal flora, obesity, smoking, age, and chemotherapy), surgical factors (mechanical wound closure, hematoma, antibiotics, radiation, procedure duration, foreign body presence, skin prep, and infection risk classification), and perioperative factors (ischemia, temperature, shock, and so on). To reliably assess the individual influence of all these confounding variables in a heterogeneous patient population, a much larger cohort than the present study (which included only 22 SSIs) would be required. For example, the authors noted a significant reduction in SSI for povidone-iodine skin prep, although the comparative prep was not stipulated and patients were not randomized. This finding is in contradiction to a recent randomized trial and meta-analysis of nonneurosurgical patients undergoing clean-contaminated surgical procedures, in which chlorhexidine-alcohol was superior to povidone-iodine for preventing incisional and deep incisional infections. Similarly, the finding in the current study of increased infections in patients receiving Gliadel wafers is also tenuous due to multiple associated risk factors in this cohort of patients with advanced CNS malignancy, concurrent radio- and chemotherapy, and likely advanced age.
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The authors should be commended for identifying a quality issue in their practice and designing a prospective study to determine optimal management. Culturing bone flaps in clean surgical procedures prior to cryopreservation appears to be counterproductive. The development of evidence-based protocols to reduce SSI remains an important challenge, especially as reimbursement for infection-related treatment is restricted. Eliminating useless rituals is also an imperative, yet surgeons and perioperative nurses maintain dogmatic adherence to long-standing, unproven practices. The Cochrane Collaboration database has recently shown insufficient evidence to justify the use of skin antiseptics, preoperative antiseptic bathing, hair removal by shaving, or perioperative normoglycemia. Although there has been substantial progress in the science of understanding causative factors and preventative strategies in the battle against SSI, in many ways the words of the French battlefield surgeon Paré remain applicable: “I dressed the wound; God healed it.”

References

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Response

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We appreciate Dr. Mayberg’s thoughtful editorial on our study and his historical perspective. We all concur on the strengths and weaknesses of our study. We are currently conducting a larger study to assess the role of patient- and procedure-related factors on the risk of SSI after craniotomy/craniectomy. We hope the new study will help us determine whether Gliadel wafers are a risk factor for SSI in this population or whether other factors are the true risk factors.

We would like to respond to Dr. Mayberg’s comment that culturing the stored flaps “appears to be counterproductive.” Although positive cultures were not associated with SSI, none of the bone flaps was grossly contaminated or contaminated with very pathogenic organisms, such as Staphylococcus aureus. We acknowledge that we do not have data to support this practice, but we feel more comfortable obtaining cultures from bone flaps that are banked to ensure that we do not implant flaps that are grossly contaminated or are contaminated with very pathogenic organisms.

Like Dr. Mayberg, we doubt that povidone-iodine skin preparation is better than chlorhexidine-alcohol. We think our results indicate that skin preparation that is done properly is better than one done improperly. In that vein, we believe our observation that allowing the skin prep material to dry was associated with a significantly lower rate of SSI is important and should be followed up with either a multicenter prospective randomized trial or a multicenter prospective cohort study. We suspect that most institutional review boards would frown on a randomized trial that involved using the skin prep solution improperly (that is, not allowing it to dry) in the control arm. Thus, a prospective observational cohort study might be the best way to address this question. We feel strongly that this issue deserves serious study given the pressure surgeons and operating room staff members are under to increase “through put” and given the seriousness of these infections—86.4% of the patients required a surgical procedure to treat their infections. The pus was indeed neither good nor commendable!

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