Foreign Body Granuloma Associated With Dura-Cranioplasty After Resection of Convexity Meningioma With Extracranial Extension

—Case Report—

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Abstract

A 72-year-old man presented with a space-occupying lesion at the site of the prior craniotomy one year after removal of a convexity meningioma with an extracranial extension. The lesion had grown outside the duraplasty with extracranial extension through the degenerative cranioplasty, and was removed. The histological diagnosis was granulation. The original dura-cranioplasty had been performed using Goretex dura substitute, hydroxyapatite cement, and fibrin glue-bonded autologous bone dust. This rare case of foreign body granuloma occurring after craniotomy with dura-cranioplasty indicates that detailed preoperative evaluation of tissue destruction based on neuroimaging is essential for construction of a suitable cranioplasty.

Key words: foreign body granuloma, meningioma, dura-cranioplasty, hydroxyapatite cement, autologous bone dust

Introduction

Artificial materials are commonly used for the repair of craniotomy, and typically do not result in severe adverse tissue response.21,22 Any adverse effects of such materials are independently identified prior to clinical application, although the risk of combined use is rarely evaluated. Occasional cases of granulation after craniotomy have been associated with intracranial use of artificial materials,1,2,5 but none of symptomatic granulation associated with dura or cranioplasty. We present a unique case of granulation at the site of a previous craniotomy that used multiple artificial materials for dura-cranioplasty.

Case Report

A 72-year-old man initially presented with a history of increasing swelling over the right parietal region for 6 months. Neurological examination showed mild dementia and slight left hemiparesis. Computed tomography (CT) and magnetic resonance imaging revealed a well-enhanced neoplasm in the right parietal convex with extracranial extension (Fig. 1). The extracranial part of the tumor was first removed with the surrounding temporal muscle. Craniotomy with a sufficient margin was then performed, and the intracranial part attached to the dura was totally removed as a typical convexity meningioma resection. Goretex dura substitute (GD) was used for duraplasty. After drilling of suspicious bone invasions, the bone flap was replaced using hydroxyapatite cement (HC) for cranioplasty of the defect (Fig. 2A). Fibrin glue-bonded autologous bone dust (FBD) was coated onto the inside of the flap for reinforcement (Fig. 2B). Histological examination revealed atypical meningioma with extracranial invasion. Radiography showed no residual tumor and the
Fig. 2  A: Intraoperative photograph during the first operation showing the cranioplasty using bone cement. B: Schematic overview of dura-cranioplasty design. Fibrin glue-bonded autologous bone dust (FBD) coating the inside of the hydroxyapatite cement (HC) cranioplasty. Goretex dura substitute (GD) was used for duraplasty.

Fig. 3 Neuroimaging on second admission. Axial (A) and coronal (B) computed tomography scans showing a high-density extradural lesion with extracranial extension.

Fig. 4 Intraoperative photographs during the second operation showing the extradural space containing friable yellow tissue (A), which was mixed with and replaced the degenerative bone cement (B; inside view of bone flap).

Fig. 5 Photomicrographs of the extradural lesion showing foreign body reaction against bone grafts and some giant cells phagocytizing bone fragments (A), and the cerebral surface lesion showing vaguely lobular, sheet-like proliferation of meningothelial tumor cells with prominent nucleoli (B). Mitotic figures are occasionally noted, compatible with atypical meningioma in the first operation. Hematoxylin and eosin stain, original magnification A: ×200, B: ×400.

patient was followed up without postoperative therapy. One year after surgery he noticed recurrent swelling at the site of the previous lesion. Serum chemistry showed no remarkable findings except for slight elevations of white blood cell count and C-reactive protein (9700/μl and 0.36 mg/dl, respectively). CT showed a high density space-occupying lesion in the extradural space with extracranial extension (Fig. 3). A second operation was performed to remove this lesion. The extracranial part of the lesion was solid and had invaded the temporal muscle, so was initially resected separately with sufficient margin. The extradural part of the lesion appeared to consist of friable yellow tissue with degenerative cranioplasty (Fig. 4). The previous craniotomy was repeated to remove the lesion. During resection of the duraplasty to check for dural invasion, an independent small lesion on the parietal convexity was removed. This cerebral surface lesion was completely separated from the extracranial lesion by the intact duraplasty. No other remarkable abnormalities were found on the cerebral surface, so revision of the duraplasty was performed using a new GD, and a titanium mesh was used for cranioplasty instead of the bone flap to prevent recurrence. Histological examination revealed tumor recurrence only in the cerebral surface lesion. The entire extradural lesion consisted of granulation tissue with dense chronic inflammatory infiltration and prominent foreign body reaction against bone debris (Fig. 5). No dural invasion was detected. The postoperative course was uneventful and the patient has shown no signs of recurrence during follow up for 3 months.

Discussion

In the present case, FBD, HC, and GD were used for dura-cranioplasty. All these artificial materials are currently used in craniotomy with no severe adverse effects in in-

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dividual applications. Accordingly, we suggest that the combination of multiple artificial materials may have induced granulation in this case. GD did not seem to be important in the granulation as histological findings showed that the dura remained intact. Further, use of GD in the second operation has not resulted in another recurrence.

HC is mainly used for filling bone defects derived from craniotomy or for drilling of the skull base in neurosurgery. Previous studies of HC have shown that an osteoconductive response led to replacement of new bone ingrowth from host bone, without inducing unfavorable tissue responses. In contrast, bacterial contamination and larger cranial defects with HC use were associated with significant increased risk of complications. No bacterial infection was identified in the pathological specimens in our case, but the relatively larger size of the repaired defect may have been causative. The involvement of HC use in inducing granuloma in our case is unclear. Nevertheless, alternative materials such as methyl methacrylate, which leads to less inflammatory reaction, might have been more suitable.

FBD is another material to repair defects derived from craniotomy. This method is advantageous over the direct use of bone dust, and results in dispersion within the surrounding tissue at the time that reactive fluid transudation occurs. Reoperation after use of FBD resulted in inflammatory cell infiltration beginning at 14 days after operation, followed by absorption of the fibrin glue which was replaced by inflammatory cells, osteoblasts, and fibroblasts within 2 months. In contrast, our case showed marked bone debris, inducing foreign body reaction, at one year after the operation. FBD should have been applied as an alternative infill to HC, and the combined use of these two materials would not normally have been adopted. In our case, FBD was used to coat the inside of the HC for reinforcement. We also performed duraplasty inside the reinforcement, and so positioned the FBD in a dura-cranioplasty sandwich (a dead space consisting of artificial tissues). In this case, the FBD would have only contacted non-live tissues, and so would not have induced physiological reactions such as infiltration and replacement by inflammatory cells, osteoblasts, or fibroblasts. In normal use for filling bone gaps or burr holes, FBD maintains sufficient attachment to the host bone, allowing prompt integration through replacement by new bone ingrowth. In contrast, the FBD in our case remained attached to the host tissue. Such isolated non-live tissues could have led to the foreign body reaction. The present findings suggest that careful use of FBD for cranioplasty is required, especially in cases with large bone defects.

Individually, FBD, HC, and GD are widely accepted materials for reconstruction of craniotomy. However, in our case, the combination of all three had insufficient contact with the live tissue. In particular, the FBD was placed in a dead space. This design would account for the fragile tissue in the extradural space, and may have been important in the occurrence of granulation. Reconstruction of craniotomy for such cases needs to be designed to avoid the presence of non-live tissues in a dead space. We used FBD for reinforcement of the HC cranioplasty in the initial operation. Operations for tumors with extracranial extensions occasionally require complex designs with multiple materials for construction of the dural-cranioplasty. The bone defect in our case was relatively large, so use of more solid materials such as methyl methacrylate or titanium mesh might have been more suitable for the initial cranioplasty, and so would have avoided postoperative complications. Overall, these findings suggest that detailed preoperative evaluation of tissue destruction based on neuroimaging is essential for construction of a suitable cranioplasty reducing the risk of unanticipated complications.

References