Neuroradiology (1990) 32: 151–153

Neuro radiology

The diagnosis of infections associated with acrylic cranioplasties

E. C. Benzel[1], K. Thammavaram[2], and L. Kesterson[1]

[1] University of New Mexico, School of Medicine, Division of Neurosurgery, Albuquerque, New Mexico, USA
[2] Department of Surgery, Louisiana State University Medical Center, Shreveport, Louisiana, USA

Received: 25 July 1989

Summary. Fifty-two methylmethacrylate cranioplasties were performed on forty-seven patients over a five year period. Two cranioplasties became infected and required removal. The overall infection rate for methylmethacrylate cranioplasty was thus 2/52 or 3.8%. Both of these patients had bifrontal cranioplasties involving both orbital rims and the frontal sinus. The infection rate for those cranioplasties involving the frontal sinus was 2 of 9 or 22%. None of the 43 cranioplasties not involving the frontal sinus became infected.

Ten patients in this series had postoperative CT scans. Gas within the non-infected methylmethacrylate could simulate infection, making it difficult to diagnose cranioplasty infections by CT. Although certain CT changes, such as epidural air and soft tissue swelling, may be observed only with infected cranioplasties, the clinical picture is the only truly reliable indicator of infection.

Key words: Infection – Cranioplasty – Methylmethacrylate – Acrylic

There rarely is need to evaluate a patient for the possibility of an infected cranioplasty. Experience is therefore limited. The authors review their experience over 5 years to assess the value of CT scanning and clinical findings in this situation.

Methods

Fifty-two acrylic (methylmethacrylate) cranioplasties were performed on 47 patients over the five year period ending March 1988 by the neurosurgery service at the Louisiana State University Medical Center and at the Veterans Administration Hospital in Shreveport, Louisiana. All cranioplasties were performed by utilizing equal volumes of methylmethacrylate monomer and vehicle in a manner similar to that described by Capanna [1].

The average age of the patients in this series was 29 years. The average time between craniectomy and the cranioplasty was 10 months (range 0 to 7 years). There were 39 male patients and 8 female patients. Twenty five were black and 22 were white.

Nine patients had their original operation for tumor, 32 for trauma, 5 for infection and 1 for an aneurysm. The 32 trauma patients included 17 compound depressed skull fractures, 9 gunshot wounds to the head, and 6 subdural hematomas. Nine of the 52 patients (17%) had calvarial defects involving the frontal sinus.

Results

Two cranioplasties became infected and were removed:

1. The first of these was a 26-year-old male who had a self inflicted shotgun wound to the face, requiring a craniectomy and excessive debridement of the frontal and ethmoid sinus region. This patient subsequently underwent multiple reconstructive procedures. One year later, he was found to have a frontal sinus abscess. This was drained and the frontal sinus obliterated. The patient underwent a frontal cranioplasty with reconstruction of both orbital rims and the nasal bone 7 months later. This cranioplasty became infected and was removed 10 months later.

2. At the age of 13 years, the second patient had a frontal sinusitis that progressed with the formation of a subgaleal abscess, infratemporal abscess with necrosis of the temporalis muscle, an epidural abscess, a subdural empyema over both frontal lobes, and osteomyelitis of the frontoparietal skull bilaterally. This required a frontal sinus abla-

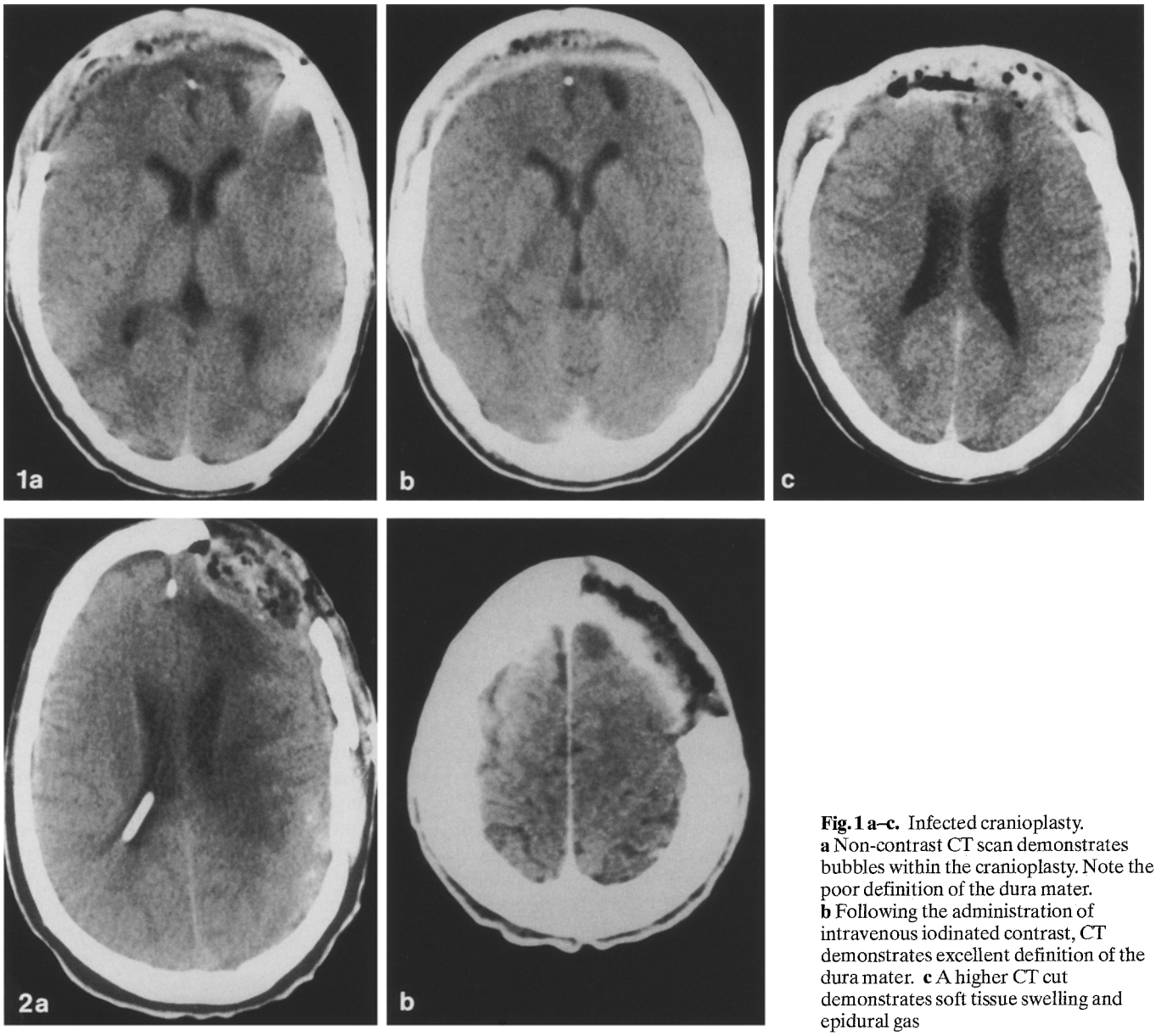

Fig. 1 a–c. Infected cranioplasty. **a** Non-contrast CT scan demonstrates bubbles within the cranioplasty. Note the poor definition of the dura mater. **b** Following the administration of intravenous iodinated contrast, CT demonstrates excellent definition of the dura mater. **c** A higher CT cut demonstrates soft tissue swelling and epidural gas

Fig. 2 a, b. 2 non-infected cranioplasties. **a** Many gas bubbles are visualized within this non-infected cranioplasty. This patient had a significant amount of frontal encephalomalacia; hence, a central dural stay suture was brought through the cranioplasty to prevent epidural hematoma formation. **b** Intravenous contrast enhancement of another patient's non-infected cranioplasty demonstrates significant dural definition. Note that there is no soft tissue swelling. A comparison of this CT scan and Fig. 1 b illustrates the great similarity of the CT findings of infected and non-infected cranioplasties. Only the observation of epidural gas and soft tissue swelling on CT scan helped to define the presence of an infection. Dural enhancement is not an indicator of pathology. It is merely a manifestation of normal dural enhancement which, in the presence of a skull defect is not masked by the radiodense overlying calvarium.

tion and a bifrontal craniectomy with the drainage of his abscesses and empyemas. He subsequently underwent repeated re-explorations and drainages of the subgaleal and subdural abscesses with resection and debridement of necrotic dura mater and bone. He ultimately defervesced clinically, requiring no further surgery for the acute infectious process. A frontal fascia lata duraplasty was performed. One month following presentation to the hospital, the patient had a left parieto-occipital craniectomy for evacuation of an asymptomatic subdural empyema. Eight months later, he underwent a bifrontal acrylic cranioplasty, including a bilateral orbital rim and nasal bone reconstruction and a separate left parietal cranioplasty. Thirty-two months later, the patient presented with progressive frontal soft tissue swelling, periocular edema, a cutaneous fistula, and a CT scan demonstrating epidural gas and soft tissue swelling (Fig. 1). The frontal cranioplasty was removed and the cutaneous fistula closed.

The infection rate for those patients whose cranioplasty involved the frontal sinus was 22%. None of the remaining 43 cranioplasties (not involving the frontal sinus) became infected. Overall, 2 of 52 craniplasties, or 3.8% became infected. Ten patients in this series had postoperative CT scans. All had gas bubbles within the acrylic.

Only soft tissue swelling and epidural air, however, correlated with the occurrence of infection (Fig. 2).

Discussion

Beynon et al. published a case report of a 53 year old female who had undergone an L5-S1 laminectomy with the placement of a methylmethacrylate "fusion" [2]. A postoperative CT scan revealed a low density area and a honeycomb gas appearance consistent with an abscess. The patient subsequently underwent surgery. No infection or abscess was found. They concluded that the treating physician should be aware that methylmethacrylate contains gas bubbles and that the consequent CT appearance should not be confused with that of abscess formation. Mason subsequently reported similar CT findings with gas bubbles simulating an abscess after methylmethacrylate cranioplasty [3]. These patients demonstrated no clinical evidence of infection over an extended period. Mason felt that the bubbles were formed by the mixing and hardening of the acrylic during the polymerization process [3].

The difference between the CT scan appearance of the infected (Fig. 1) and noninfected (Fig. 2) cranioplasties in the series presented here was imperceptible, unless epidural gas or soft tissue swelling was present (Fig. 1 c). The latter phenomenon is best evaluated by clinical examination. Enhancement of the dura mater with intravenous iodinated contrast material did not appear to offer assistance with respect to the definition of an infectious process (Fig. 2 b). Dural enhancement was noted in both infected and non-infected cranioplasties.

In summary, methylmethacrylate may falsely simulate an abscess on computerized tomography. The clinical picture is the only reliable indicator of infection. Extra caution should be exercised when applying acrylic to calvarial defects related to the frontal sinus. The 22% infection rate with cranioplasties performed in this region should be taken into account. Elsewhere on the calvarium, the incidence of infection is nil.

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E. C. Benzel, M. D.
Division of Neurosurgery
University of New Mexico
School of Medicine
2211 Lomas Boulevard
Albuquerque, New Mexico 87131
USA