EPI DURAL GRANULOMATA IN THE PRESENCE OF TANTALUM PLATES*

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Since its introduction into neurosurgery,2,8 tantalum has been widely used for the repair of cranial defects. The large number of penetrating wounds of the brain during the recent emergency has afforded an excellent opportunity to employ tantalum in a wide variety of instances. There have been a number of thorough reports in the literature, indicating the efficacy of tantalum. While the enthusiasm with which this apparently non-cytotoxic and fairly malleable metal has been received is no doubt well justified, there seems to be a need for emphasis on the complications which can readily be encountered in the use of tantalum plates for cranial repair. Bradford and Livingston† have enumerated these complications and have demonstrated failure in cranial repair with tantalum in 8 cases. These authors have already clearly stated the prerequisites for successful cranioplasty with tantalum.

It is the purpose of this communication to report an additional 11 cases in which removal of a tantalum plate was necessitated by the formation around the foreign body of a large infected epidural granuloma. Knowledge of this particular complication, which often does not manifest itself clinically for a long time after cranioplasty, seems particularly important in view of recent repeated advocation of the use of tantalum in the presence of infection.4,9

CASE REPORTS

Two of the following patients (Cases 1 and 2) were seen and operated on by one of us (AMM) at time of the original injury. Both these patients as well as the other 9 received a cranioplasty elsewhere and were not seen by us until the symptomatology of an epidural granuloma manifested itself.

Case 1. R. D. received a through-and-through bifrontal gunshot wound in June 1945, which resulted in severe cerebritis and meningitis. The destruction of both frontal sinuses exposed the patient to repeated secondary infections. A solid tantalum plate was used for cranioplasty, which was performed elsewhere 1 year after the injury. The presence of a continuous low-grade infection beneath the plate manifested itself by repeated attacks of conjunctivitis and one acute attack of iritis.

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of the left eye resulting in blindness. Removal of the tantalum plate and resection of
an extensive epidural granuloma resulted in cure.

Case 2. F. K. received a compound, comminuted, depressed skull fracture by
blunt injury in July 1945. Successive insertion of 3 tantalum plates elsewhere within
3, 7 and 10 months after injury was performed in the presence of a persistent chronic
extradural infection. Permanent removal of the tantalum plate and total resection
of the extradural granuloma, which appeared irregular in shape, consistency and
color, resulted in cure. There were hemorrhages spread through the granuloma, one
of them measuring 3 cm. in diameter. Some areas within the granuloma appeared
necrotic, others were grayish-white and bluish in color. This granuloma represented
the severest of all foreign body reactions that we have seen in the presence of tan-
talum and was comparable only to the pathology seen experimentally in the pre-
3, 4. Follow-up studies of this patient have been carried out
over a period of 30 months. He has remained asymptomatic.

Case 3. C. H. was struck by an automobile tire in his left frontal region in June
1948 and received a compound, comminuted, depressed fracture of the frontal bone.
Four weeks later a CSF fistula developed which closed spontaneously in 10 days.
A solid plate was inserted into a potentially infected wound 2½ months after injury.
Conservative therapy with antibiotics did not alter the course of events which led
to cure only following removal of the tantalum plate, epidural granuloma, and super-
imposed abscess.

Case 4. C. B. sustained a shrapnel wound of the brain in April 1945. According
to his statement, shrapnel penetrated the left occipital bone and lodged in the right
parieto-occipital region, necessitating bilateral craniotomy. Two months after in-
jury, a tantalum cranioplasty was performed. In July 1948 the patient first noticed
swelling and tenderness over the site of cranioplasty. This was accompanied by
several episodes of chills and fever. On admission here an encapsulated abscess
was found overlying the tantalum plate. The abscess was evacuated and the entire
capsule was dissected out. Beneath this abscess was a solid tantalum plate, measur-
ing not more than 3×2 cm. Between tantalum plate and dura a thin but grossly
infected epidural granuloma was found and totally resected. The patient made an
uneventful recovery. It is particularly of note that the bony defect in this instance
was so small that it did not necessitate cranioplasty.

Case 5. T. G. sustained a gunshot wound of the right frontal area in February
1945. Because of recurrent drainage of pus from the original site of injury, he was
operated on 4 times during a period of 5 months. The 4th operation included craniop-
plasty with a solid tantalum plate. There was a direct connection with the frontal
sinus. The patient was asymptomatic for a year, then was treated by intermittent
incision and drainage until August 1947 when he was admitted to Kennedy. Re-
mova of the tantalum plate revealed grossly infected granulomatous tissue covering
the outer surface of the tantalum plate. The patient made an uneventful recovery.
Again, it is particularly noted that the bony defect measured only 2.5×1.5 cm., and
actually did not necessitate cranioplasty.

Case 6. T. H. sustained a shrapnel wound of the right parieto-occipital region in
June, 1944. The first solid tantalum plate was inserted 3 weeks after the injury.
From the available records it appears that debridement was performed at the same
time. Only 4 months later this plate had to be removed because of an underlying abscess. Simultaneously, a solid tantalum plate was reinserted. After 2 years, clinical symptoms, indicating the presence of an epidural granuloma, manifested themselves leading to admission to Kennedy. A freely movable solid tantalum plate and extensive infected epidural granuloma were removed, closure was performed, and the patient made an uneventful recovery.

Case 7. K. F. sustained a shrapnel wound of the right frontal area in September 1944. A period of 5 months elapsed between injury and cranioplasty. Seventeen months elapsed between cranioplasty and onset of symptoms indicating the presence of an epidural granuloma with overlying abscess. Removal of the plate and resection of the granuloma resulted in cure.

Case 8. E. J. sustained a shrapnel wound of the right frontal area in January 1945 with extension of the depressed fracture into the frontal sinus. A solid tantalum plate was inserted into a potentially infected area within 6 months after injury. Subsequent to cranioplasty the patient had intermittent attacks of conjunctivitis and swelling of the right upper lid. One of these attacks led to admission to Kennedy Hospital in January 1948. A typical epidural granuloma was found beneath the plate. Operative removal of the plate and granuloma resulted in cure. The size of the bony defect was approximately 2×3 cm., actually not necessitating cranioplasty.

Case 9. H. B. received a compound, depressed fracture of the right frontal bone in an automobile accident in September 1943. Cranioplasty was performed 15 months after the injury. Symptoms indicating the presence of an epidural granuloma first occurred 7 months after the plating. At that time, a purulent fistula developed which was treated by the local physician with intramuscular penicillin and wet packs for a period of 2 years. On admission to Kennedy in September 1947 the tantalum plate could be recognized in the depths of a draining sinus. Removal of the plate with resection of an extensive epidural granuloma and subsequent primary closure resulted in cure.

Case 10. W. S. received a compound injury in the right temporoparietal region in July 1944. A solid tantalum plate was inserted 6 months after the injury in spite of a persistent infection. Clinical signs to indicate the presence of an epidural granuloma did not manifest themselves until 2 years later when the patient was admitted to Kennedy. On operation here a smooth, brownish-green, dull membrane was found to cover the plate. The inner surface of the membrane showed a deep, brownish discoloration with interspersed roughened areas. The tantalum plate was noted to be elevated (Fig. 1) and the entire defect underneath the plate was filled with a thick, mucus-like mass. Parts of this mass were black and others were red, yellow, and gray. It measured 3 cm. in thickness and had the typical appearance of an epidural granuloma (Figs. 2 and 3). Primary closure following removal of the plate and resection of the granuloma resulted in cure.

Case 11. E. B. received a shrapnel wound of the right parietal bone in November 1944. Four months following the injury, a solid tantalum plate was inserted elsewhere. Three years intervened between the time of cranioplasty and onset of clinical signs and symptoms indicating the presence of an infected granuloma. Removal of the tantalum plate and resection of the granuloma in January 1948 at Kennedy resulted in cure.
Fig. 1. Anteroposterior view of skull showing elevation of the tantalum plate on the right side (Case 10).

Fig. 2. Epidural granuloma (Case 10).

Fig. 3. Photomicrograph showing fibrous granulation tissue with small acute focus at right center (Case 10).
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HISTOPATHOLOGY

The basic histopathologic changes are similar in each of the cases previously described. Chronic granulation is present directly in contact with the tantalum plate. This tissue is quite vascular, the vessels are of small calibre and many show some thickening of the vessel wall. There is an inflammatory cell infiltration composed chiefly of lymphocytes and plasma cells. Fibroblasts are prominent and these fade into a dense hyaline fibrous scar tissue in the outer portions of the sections. Vessels in these latter areas show sclerotic changes, chiefly marked intimal thickening. Lymphocytic perivascular infiltration extends from the areas of granulation into the scarred areas. Macrophages containing blood pigment are present in all cases both in the granulation and fibrosed tissue. This picture of chronic granulation and scarring shows a superimposed acute and subacute inflammatory reaction in some areas. There is a neutrophilic infiltration which varies in degree in the individual cases studied and which has progressed to necrosis of tissue in some instances. Bordering the acute reaction there is an infiltration by eosinophils and usually macrophages. There is marked congestion of capillary vessels and fresh hemorrhage is commonly present in the more acute areas. In the cases in which there is a draining sinus, the granulation tissue lining the tract shows both acute and chronic inflammation. These are the findings of a non-specific low-grade inflammation with attempted repair by scar tissue and with superimposed acute inflammatory reaction (Fig. 3).

STATISTICAL ANALYSIS

All 11 patients had suffered compound head injuries. Six of these injuries involved the frontal area, 1 the parietal, 1 the frontoparietal, 1 the parietotemporal, and 2 had penetrated the parieto-occipital lobes. In 4 patients, the penetrating wound of the brain communicated directly with the frontal sinus.

Shrapnel was the cause of injury in 5 cases; 2 patients suffered gunshot wounds. The remaining 4 were struck by blunt objects.

With the possible exception of Case 6, cranioplasty was not performed in any of these patients at the time of primary debridement. The time interval between injury and insertion of plate ranged from 3 weeks to 15 months. Nine cranioplasties were performed less than 6 months after the original injury. Two of the removed tantalum plates were found to have perforations; the remaining 9 were solid plates.

Onset of signs and symptoms indicating the development of an epidural granuloma subsequent to cranioplasty, ranged from 1 week to 33 months. In 8 of the 11 cases, symptoms developed 12 months after cranioplasty and later.

At time of admission to Kennedy Hospital, the skin had broken down over the plate in 8 patients. Purulent discharge with positive culture was found in all 8 patients. The remaining 3 patients presented themselves with fluctuant swelling, redness, and tenderness over the site of the plate.
At the time of removal of the plate, an infected granuloma (Figs. 2 and 3) was found in 10 of the 11 cases. In Case 5 an epidural abscess without fully developed granuloma, but with granulomatous tissue surrounding the plate, was encountered. In 4 cases the granuloma was covered by a frank abscess.

DISCUSSION

The most striking feature which applies to this entire group of cases is the fact that cranioplasty had been performed in the presence of actual or potential infection. The time interval between primary debridement and cranioplasty, although relatively short in the majority of instances, varied considerably in our cases. Rather than generalizing and setting a definite optimum time for cranioplasty there seems to be a need for return to the application of basic surgical principles in the indications for cranioplasty. Even though a metal may be non-cytotoxic, it is still a foreign body which is often poorly tolerated by tissues harboring infectious organisms. The cases reported by Bradford and Livingston, Lane and Webster, Lewin et al., as well as the cases reported in this communication, certainly suggest the inadvisability of repairing cranial defects with metallic foreign bodies in the presence of actual or potential infection.

In full agreement with Holbrook, who has observed granuloma formation with acrylic plates in the presence of infection, we do not believe that the granulomata that we have described are specifically related to tantalum. It rather seems that these granulomata represent a general foreign body reaction of infected tissue.

The need for large perforations in tantalum plates is suggested by the fact that in 9 of the 11 cases the plates were solid. Granuloma formation does not seem to occur as readily in the presence of perforated plates and can certainly be recognized more easily.

The delay of clinical manifestations indicating the presence of a chronic epidural granuloma is particularly striking in the presence of solid plates.

It seems then that the indications for cranioplasty with tantalum should be guided by basic surgical principles. In the presence of actual infection cranioplasty is contraindicated. In the presence of potential infection, approximately 12 asymptomatic months should elapse before tantalum repair is attempted. Only large defects endangering the underlying structures should be plated.

In the presence of defects that communicate with the frontal sinus, only that part of the defect that does not cover the sinus should be plated. At no time should the tantalum be used to close an open sinus. The plastic rebuilding of orbital ridges and similar structures is dangerous and not warranted (Case 3). Light, perforated plates should be used. Cosmetic effects should give way to sound surgical principles and safety for the patient.

As soon as clinical manifestations of an epidural granuloma present themselves, surgical intervention, as advocated by Bradford and Livingston, is mandatory. Removal of the plate and total excision of the granuloma, if
preceded by administration of antibiotics and chemotherapy, will prevent the threatening extension of the infectious process, and will usually result in cure.

**SUMMARY**

1. Eleven cases have been reported in which granuloma formation with or without overlying abscess necessitated removal of a tantalum plate.

2. The pathology, which is considered a general foreign body reaction of infected tissue rather than a specific response to tantalum, has been described.

3. In an attempt to prevent the dangerous complication of granuloma formation, the indications and contraindications for tantalum cranioplasty have been discussed.

4. The repair of cranial defects with tantalum plates in the presence of actual or potential infection is considered to be contraindicated.

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**REFERENCES**


5. Holbrook, T. J. Personal communication.


