



Multiple Intratumoral Hemorrhage at Sites Remote from the Craniotomy Site

Da-Li Wu, Cheng-Fu Chang, and Yung-Hsiao Chiang*

*Department of Neurological Surgery, Tri-Service General Hospital, National Defense Medical Center,
Taipei, Taiwan, Republic of China*

We report a case of multiple intratumoral bleeding at sites remote from the craniotomy site, complicating the postoperative course of a patient who underwent surgical removal of a metastatic brain tumor in the left parietal lobe. To the best of our knowledge, such a complication is rare. Possible mechanisms underlying the complication are discussed, including drainage of cerebrospinal fluid during the operation, perioperative hemodynamic status, and the function of hemostasis in patients with brain metastasis.

Key words: remote intracranial hemorrhage, craniotomy

INTRODUCTION

The occurrence of immediate multiple intratumoral hemorrhages at sites remote from a craniotomy site are very rare. In a review of the literature, we were not able to identify an example of this situation. Our patient had hepatocellular carcinoma with multiple brain metastases, underwent craniotomy to remove a major tumor, and then had multiple intratumoral hemorrhages at sites remote from the craniotomy site. We present the clinical course of this patient and discuss the possible pathogenesis of this unusual complication.

CASE REPORT

A 42-year-old male was found to have hepatocellular carcinoma one year ago. He received surgery, which involved resection of the primary hepatocellular carcinoma, followed by chemotherapy. Progressive weakness of the right limbs was noted one week before admission to the oncology ward. A magnetic resonance image (MRI) of the brain revealed multiple metastases. The largest tumor was in the left parietal lobe and caused a prominent mass effect and clinical symptoms (Fig. 1). After meeting with oncologists, neurosurgeons, the patient's family members,

and the patient, it was decided that surgical removal of the largest tumor would be carried out.

The patient underwent a left parietal craniotomy in the supine position with the head stabilized by a Mayfield three-point head holder. The patient was maintained in a state of general anesthesia. The monitoring system consisted of direct arterial pressure measurement and electrocardiogram measurement of the heart. Massive bleeding during removal of the tumor was noted and the patient was transfused with four units of whole blood and four units of packed red blood cells (RBCs). A review of the anesthesia record indicated that the procedure lasted approximately 4 h and that there was no evidence of any intraoperative hypo- or hypertension. The highest intraoperative blood pressure was 120/70 mm Hg and the lowest was 90/50 mm Hg.

Two hours after transfer to the Neurosciences Intensive Care Unit (Neuro-ICU) the patient developed dilated pupils with no reaction to light stimulation. His score for the Glasgow Coma Scale at that moment was 2T. An emergent computed tomography (CT) scan of the brain revealed multiple intratumoral hemorrhages with severe brain edema (Fig. 1). The family refused any further intensive treatment. Six days later, the patient expired because of cerebrovascular failure. The pathology of the brain tumor was metastatic hepatocellular carcinoma.

DISCUSSION

Postoperative hemorrhage is a life-threatening complication in neurosurgery that usually occurs at the site of surgery. This complication is usually attributed to inadequate intraoperative hemostasis^{4,8}. Postcraniotomy hemorrhages that are remote from the surgical site have occa-

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*Corresponding author: Yung-Hsiao Chiang, Department of Neurological Surgery, Tri-Service General Hospital, No. 325, Sec. 2, Cheng-Gong Road, Taipei, Taiwan, Republic of China. Tel: +886-2-8792-7177; Fax: +886-2-8792-7178; E-mail: tsghns01@ndmctsgh.edu.tw

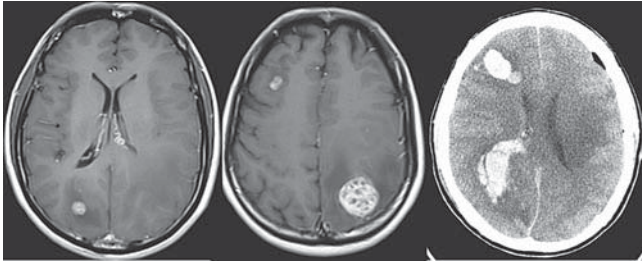


Fig. 1 Pre-op and post-op imaging studies. Contrast T_1 -weighted MR images demonstrating multiple metastasis (left and middle). Post-op CT scan revealed tumor hemorrhage remote from the site of craniotomy (right).

sionally been reported, and the locations have been epidural⁸, subdural⁹, or intracerebral^{5,15}. Recently, Brisman et al.² reviewed 37 cases of postoperative intracerebral hemorrhage that occurred at locations remote from the craniotomy site. Such hemorrhages are likely to develop during or soon after surgery and tend to occur preferentially in certain locations; for example, infratentorial hemorrhages involve the cerebellum, and supratentorial hemorrhages occur in superficial and lobar sites. Furthermore, these intracerebral hemorrhages seem to be related to the craniotomy site, operative positioning, and nonspecific mechanical factors. Multiple and single intracerebral hemorrhages have also been described after spinal anesthesia, lumbar myelography, and surgical treatment of extracerebral fluid collection^{11,12}.

It is interesting that all the hemorrhages that occurred at locations remote from the craniotomy site in our patient occurred in other tumor sites. To the best of our knowledge, there are no other reported cases of this situation. There are two reports of intratumoral hemorrhage occurring in patients with brain tumors after insertion of external ventricular drainage or a ventriculoperitoneal shunt^{13,14}. These authors suggested that ventricular decompression may result in rapid motion and distortion of the intracranial structures and a sudden imbalance between intracranial and intratumoral pressures, leading to vascular insufficiency, congestion, and then hemorrhage within the tumor. König et al.¹⁰ have suggested that removal of a supratentorial space-occupying mass may induce a reduction in intracranial pressure with a critical increase in the transmural pressure of veins or venules, which might account for hemorrhage occurring at locations remote from the craniotomy site. Both these effects could have contributed to the occurrence of hemorrhages at sites remote from the craniotomy site in our patient. However, these effects do not explain why the hemorrhages occurred

in every single metastatic tumor that was visible in the MRI scan.

Hypertension is considered the leading cause of nontraumatic intracerebral hemorrhage¹. Our patient had no history of hypertension, and there were no abnormal intra- and postoperative blood pressure recordings. Blood pressure was monitored; however, it was not recorded at some critical time points, such as during the time of intubation, extubation, and transportation of the patient to the Neuro-ICU. However, no abnormal pressure was recalled by anesthesiologists or nurses.

There are reports that the level of D-dimer is elevated from baseline in patients with metastasis, indicating a hemostatic hyperactivity that is usually seen in cancer patients^{3,6,7}. This means that the storage of coagulation factors in patients with cancer is diminished. Our patient had hepatocellular carcinoma and received a liver resection operation. It is reasonable to suggest that he may have lacked a good storage of coagulation factors, although routine preoperative profiles of coagulation function in our patient were within normal ranges. However, our patient underwent a large amount of bleeding during the operation that would have consumed a substantial amount of coagulation factors. We also noted that intraoperative blood loss was replenished mostly with solutions such as normal saline and packed RBCs, which are free of hemostatic components.

It is very difficult to determine the possible mechanisms underlying the complication. We believe that it may have been caused by multiple factors, including a change of intracranial pressure, intratumoral hemodynamic changes, the tendency of the hepatocellular carcinoma to bleed, a preexisting hypercoagulable status that is common in cancer patients and may have consumed a lot of coagulation factors, and the status of the patient after the liver resection, which may have decreased his capacity to produce coagulation factors.

Patients who have hepatocellular carcinoma with brain metastasis should be monitored very carefully. Transfusion of large quantities of coagulation factors, fresh frozen plasma, or vitamin C and K during perioperative periods is very important to prevent intracerebral hemorrhage. If intracerebral hemorrhage does occur after the surgery, hemostasis profiles should be checked immediately and abnormalities corrected. Surgical treatment of intracerebral hemorrhage should be performed if the hemorrhage has a mass effect and the patient can tolerate the operation. Stereotactic radiosurgery without craniotomy may be an alternative for treating those patients who have such brain metastases.

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