Late pseudotumoral brain necrosis following irradiation of a scalp neoplasm

Case report

Luciano de S. Queiroz, M.D., and Joaquim N. da Cruz Neto, M.D.
Department of Pathology, State University of Campinas, School of Medicine, Campinas, Brazil; and The Limeira Neurological and Neurosurgical Institute, Limeira, Brazil

The authors report the case of a 70-year-old man who developed intracranial hypertension and left-arm paresis 2 years after irradiation for a right preauricular basal cell epithelioma. Angiography disclosed a right temporal lobe mass and the histopathological diagnosis was late postirradiation necrosis of the brain. Postoperatively, dexamethasone was given in increasing doses up to 60 mg/day for control of cerebral edema. The patient died of gastrointestinal bleeding on the 60th postoperative day.

Key Words • radiation injuries • steroid therapy • brain edema

Late brain necrosis consequent to irradiation of scalp neoplasms is rare, and only 17 cases are presently on record. Corticosteroids may reduce brain edema related to these lesions but experience in this respect is, to our knowledge, still limited to one report. The following report is of a patient who developed cerebral radionecrosis unassociated with a brain tumor; steroid treatment was attempted in addition to surgical removal of the necrotic tissue.

Case Report

This 70-year-old man was admitted on April 9, 1975, for evaluation of intense diffuse headache, progressive loss of interest and initiative, and clumsiness of the left hand, starting 1 month previously. In February, 1973, he had received one course of x-ray therapy for an ulcerated basal cell epithelioma that measured 5 × 3 cm in the right preauricular region. Approximately 6800 rads were delivered to the tumor, fractionated in 20 doses of 340 rads, given over a period of 4 weeks (140 kV, 15 mA, skin-focus distance 23 cm). In November, 1973, a painful ulcerated lesion developed in the right tragus, and a biopsy yielded the diagnosis of radio-dermatitis. The irradiated tumor had disappeared completely by this time, leaving an atrophic scar.

Examination. The patient was lethargic. Muscle strength was impaired in the left hand but deep tendon reflexes were normal. Pathological reflexes were absent, and sensibility tests could not be performed. Cranial nerves were normal and optic fundi showed normal papillae but absence of venous pulse. Routine laboratory tests were noncontributory. Carotid angiography disclosed a right temporal lobe mass (Fig. 1).
Operation. A right temporal osteoplastic craniotomy was performed on April 12, 1975. On opening the dura, an intense bulging of the brain due to massive edema was observed. The cerebral cortex was edematous, but otherwise looked normal. The subcortical white matter was found to be firm, with an appearance suggestive of Grade I astrocytoma. Total removal of the tumor mass was attempted, and the whole temporal lobe was excised, reaching down to the inferior horn of the right lateral ventricle. Intravenous 20% mannitol instituted during surgery had little effect on the cerebral edema.

Pathological Examination. The surgical specimen consisted of many irregular white fragments, measuring 0.5 to 1.0 cm in diameter, some of which were tougher than normal brain tissue. On microscopic examination, the cerebral cortex was normal in some areas; most nerve cells in other areas showed ischemic change. The white matter showed coagulation necrosis (Fig. 2); in neighboring areas, diffuse demyelination and prominent fibrillary gliosis with a few gemistocytic astrocytes were found. Some of these had large, rarely hyperchromatic nuclei. Gitter cells were absent. Vascular changes were conspicuous and widespread, and consisted of fibrinoid necrosis of blood vessel walls (Fig. 3 upper), sometimes accompanied by thrombosis (Fig. 3 lower) or small hemorrhages into the brain parenchyma. Adventitial fibrosis was also seen, with a perivascular infiltrate of lymphocytes and plasma cells (Fig. 4); endothelial cell nuclei were often large and hyperchromatic, but endothelial proliferation up to lumen occlusion was not found. Congo red and methyl violet stains for amyloid were negative. The diagnosis was late radionecrosis of the brain.

Postoperative Course. Dexamethasone, 20 mg/day, was given in the immediate postoperative period. A slight accentuation of the left-arm paresis was noticed on the first day, but the patient recovered consciousness on the second day. On the fourth day, reduction of the steroid dose to 16 mg/day was
Radiation necrosis of brain

FIG. 3. H & E, × 400. Upper: Photomicrograph showing fibrinoid necrosis of a small blood vessel in the white matter. Lower: Photomicrograph showing lymphocytic infiltrate in the adventitia of small cerebral blood vessels. Note endothelial cell with a large nucleus.

FIG. 4. Photomicrograph showing organizing thrombosis of a blood vessel in the white matter. H & E, × 250.

tried, but resulted in rapid deterioration of consciousness and aggravation of left-arm paresis. Dexamethasone was then increased to 30 mg/day and the patient's neurological condition again improved. Over the next 60 days, several attempts at reducing the dosage proved unsuccessful. Prolonged maintenance on a fixed dose was followed by somnolence progressing to stupor. Steroid doses of up to 60 mg/day became necessary to keep the patient conscious and in a good neurological condition. He died on June 16, 1975, of sudden uncontrollable gastrointestinal hemorrhage. An autopsy could not be performed.

Discussion

The hazard of developing delayed radionecrosis may be minimized if the total radiation dose is appropriate and the course of treatment spreads over an adequate period of time. The average total dose that a normal brain will tolerate is 6500 to 7000 rads, in 6½ to 8 weeks, delivered by five 200-rad fractions per week. The depth dose for 2 cm in the present case was calculated as 70% or 4760 rads, which is below the recommended range. However, according to the criteria of Kramer, the overall treatment time of 4 weeks was too short, and the individual dose of 340 rads too high.

The clinical and radiological features of our case were those of an expanding intracranial mass, and thus agree with the experience of others. Intracranial hypertension was present in seven of 15 cases of delayed cerebral radionecrosis reviewed by Cambier, et al. The 2-year latency interval is well within the expected period, which ranges from 9 months to 9 years and peaks between 1 and 3 years. Histopathological findings were typical of delayed radionecrosis of the brain. Although amyloid has been demonstrated in the cerebral lesions of some cases, it was absent in others and in ours. The presence of cerebral coagulation necrosis and prominent vascular changes ruled out the diagnostic possibility of a Grade I astrocytoma.
Late pseudotumoral brain necrosis following irradiation of extracranial neoplasms occurs much less often than necrosis due to irradiation of brain or pituitary tumors. The first group includes cases treated for scalp neoplasms and cases treated for deep head and neck tumors. When irradiation is directed toward a deep head or neck tumor (such as ethmoidal, pharyngeal) or the pituitary region, radionecrosis is likely to affect the diencephalon, brain stem, or the cervical cord, and death ensues. However, for patients who develop brain necrosis after irradiation of scalp epitheliomas surgical prognosis is very good. In 12 operated cases, only one died of the cerebral lesions. In this regard, the fatal course of our case as a consequence of progressive brain edema is unusual. Edema was probably caused by the massive vascular lesions that acted as a source of excess extracellular fluid.

It is of interest that steroid therapy in cerebral radionecrosis is not mentioned by Kramér or Cambier, et al. The case of Eyster, et al. is possibly the first reported instance of this complication in which corticosteroid treatment was attempted. In their case, dexamethasone was given for 3 months, beginning immediately after operation, with good remission of cerebral edema; the patient’s condition deteriorated when the drug was stopped but improved promptly on reinstitution of therapy. In our patient, the steroid had to be administered at progressively increasing doses for proper control of edema. These observations may be related to the phenomenon of steroid dependency. Further experience with steroids in delayed cerebral radionecrosis is required for a better assessment of their usefulness in this rare condition.

References


Address reprint requests to: Luciano de S. Queiroz, M.D., Department of Pathology, State University of Campinas, School of Medicine, Caixa Postal 1170, Campinas, Brazil.