

A Difficult Therapeutic Problem with a Nuclear Medicine Solution: A Case Report

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In this report, we describe the preparation of sterile ^{32}P chromic phosphate for injection into a small cystic brain tumor. The tumor, a recurrent cystic craniopharyngioma, was situated in the pituitary fossa and extended near the optic chiasm into the midbrain of the patient. A 10-cm needle was placed into the cyst through a tiny burr hole in the patient's skull and the ^{32}P was injected through the burr hole. The patient was discharged 36 hr later to return to his normal routine.

Key Words: ^{32}P chromic phosphate; radionuclide therapy; craniopharyngioma

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Craniopharyngiomas represent approximately 3% of brain tumors. They generally occur in children with approximately 50% occurring before the age of 20 yr. Most of these tumors are located in the suprasellar subarachnoid space or within the sella. Their usual size is 2-10 cm in diameter. Histologically, these tumors are benign; however, they are effectively malignant because of their location and ability to surround and penetrate vital structures. The tumor usually contains both solid and cystic portions. Cystic areas are filled with brownish, muddy fluid containing cholesterol crystals. Symptoms usually develop insidiously as the tumor slowly enlarges. A relatively high morbidity and mortality is associated with the tumor.

The treatment of craniopharyngiomas is controversial because of the relatively high rate of immediate postoperative sequelae such as diabetes insipidus and visual deterioration. Limited surgery, irradiation and intracystic instillation of radiocolloids or chemotherapeutic agents have been used to treat craniopharyngiomas. The advantage of intracystic radiotherapy is that it allows administration of very large doses of radiation to the entire cyst wall with little exposure to the brain.

CASE STUDY

A 14-year old male patient presented with symptoms related to a recurrent cystic craniopharyngioma. The attending neurosurgeon determined that the tumor could not be completely removed surgically and a radiation oncologist considered it inaccessible because of its proximity to the optic chiasm. A therapeutic option was the injection of ^{32}P into the cystic tumor. This choice required sterile preparation of the correct amount of ^{32}P in a small volume.

The most direct entry into the cyst was determined to be through its smaller superior portion. Before the procedure began, a stereotatic halo was placed around the patient's head and he was taken to the magnetic resonance (MR) unit. MR images (Fig. 1.) were obtained and were used to direct the accurate placement of the needle into the tumor deep within the brain. The cystic tumor was lobulated with a 4.0-ml intrasellar portion and a 2.5-ml suprasellar extension near the optic chiasm. The volume of the cyst was determined by MR to be 6.5 ml.

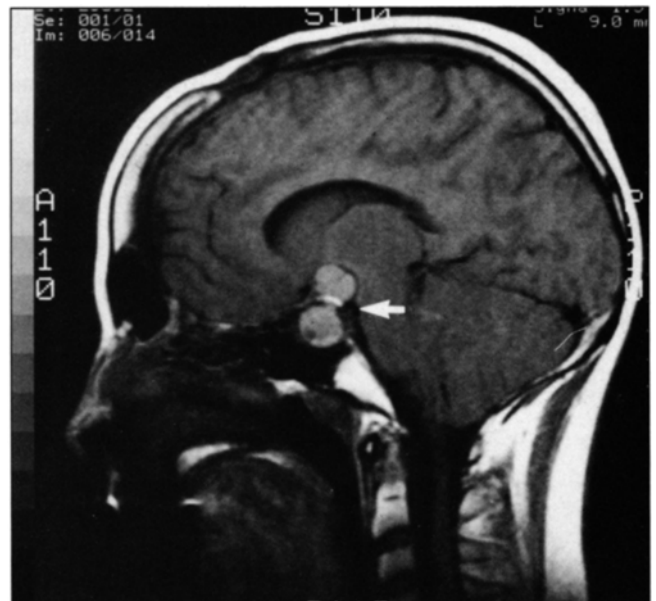


FIGURE 1. Sagittal magnetic resonance image at the midline showing dumbbell-shaped cystic tumor (arrow).

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The desired radiation dose to the cyst wall was 20,000 cGy. According to the work of Harbert (1), the calculated therapeutic activity was 394 μ Ci (14.6 MBq). The nuclear pharmacist performed test trials with a syringe and a special needle that were used to determine the effect of the dead space in the needle and the residual 32 P chromic phosphate that would remain in the syringe. The amount of 32 P chromic phosphate that would remain in the needle and syringe was determined to be 5% of the activity. We, therefore, prepared a dose of 32 P chromic phosphate that was 5% more than the calculated therapeutic activity.

All dose preparation was done in a Class II Type A/B3 vertical laminar flow hood. All surfaces were disinfected and the work surface was covered with sterile paper towels. A small acrylic beta radiation shield was placed close to the front of the working surface to minimize air turbulence. A 1-ml sterile tuberculin syringe, sterile syringe caps, a sterile outer cover for a 60-ml syringe, a vial of sodium chloride 0.9% for injection and the vial containing 15 mCi (555 MBq) of 32 P chromic phosphate in 5 ml of 30% dextrose were placed on the sterile work surface. The nuclear pharmacist scrubbed his hands thoroughly and put on three pairs of sterile gloves using sterile technique. One pair of gloves was discarded after all nonsterile outer wraps were removed.

Following dilution with sodium chloride 0.9% for injection, 394 μ Ci of 32 P in 0.2 ml were drawn. A sterile syringe cap was applied. The syringe was placed in a sterile wrap, which was placed in the plastic outer wrap of a 60-ml irrigation syringe. The plastic outer container of the irrigation syringe provides beta radiation protection and a clean transport vessel. The dose-syringe assembly was placed in a lead-lined syringe carrying box and delivered to the operating room (OR). Once in the OR, the nuclear medicine physician opened the lead box, opened the plastic dose syringe assembly and delivered the sterile syringe to a sterile OR work surface.

In the OR, a 10-cm needle was placed into the cyst through a tiny burr hole in the skull. To verify free flow of the fluid in both parts of the cyst, 0.3 ml of cyst fluid were removed and 0.3 ml of iohexol (Omnipaque 240, 240 mg iodine/ml) were injected under fluoroscopic control. Mixing of the contrast and fluid in both cyst compartments was observed. Then 0.3 ml of the cyst fluid were removed and 0.2 ml of 32 P chromic phosphate injected. A small quantity of the 32 P and cyst fluid

mixture was withdrawn into the syringe and reinjected two times for mixing of the isotope. The needle was withdrawn and the residual 32 P chromic phosphate in the needle and syringe was measured.

DISCUSSION

Phosphorus-32 is a pure beta emitter with a half-life of 14.3 days. The maximum beta particle energy is 1.7 MeV with an average beta energy of 0.69 MeV, which gives maximum and average ranges in tissue of 8 mm and 3 mm, respectively. After injection into the cystic tumor, the isotope becomes fixed by macrophages lining the wall of the cystic cavity. The radiation emitted causes fibrosis of the mesothelium lining the cyst and small blood vessels, resulting in reduced fluid production (2).

CONCLUSIONS

This patient's tumor was considered inoperable and not amenable to external irradiation. Because the major portion of the tumor was cystic, it was decided that intracystic instillation of 32 P chromic phosphate was the best method of treatment.

The nuclear pharmacist performed critical functions in the care of this patient. In departments without the services of a nuclear pharmacist, these duties would be performed by a nuclear medicine technologist. These duties included: the procurement and receipt of the 32 P chromic phosphate; the sterile preparation of the correct amount of activity in the proper volume; record keeping and the control of the 32 P chromic phosphate not used in the treatment; and quality control of the radiopharmaceutical and instruments.

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REFERENCES

1. Harbert, JC. *Nuclear medicine therapy*, New York, NY: Thieme Medical Publishers, Inc.; 1987.
2. Hazra TA and Howell SR. Uses of beta emitters for intracavity therapy. In: Spencer, RP, ed. *Therapy in nuclear medicine*. New York, NY: Grune and Stratton; 1978:307-312.