Anesthesia for Children Undergoing Craniospinal Radiotherapy

DENNIS T. GLAUBER, M.D.,* STEVE M. AUDENAERT M.D.†

Radiation therapy is frequently used in the treatment of cerebrospinal malignancy in children. Sedation is often inadequate in depth or too long in duration, and general anesthesia may be required. We describe our approach to such cases and a protocol which has proven highly satisfactory.

The radiotherapeutic requirements are for daily therapy over a 5–8-week period, averaging 30 treatments per child. Each session involves two to four exposures of 30–45-s duration. The children are generally outpatients and are usually treated in the prone position.

Anesthetic considerations include: 1) the technique must provide brief anesthesia of adequate depth to ensure immobility during high energy radiation; 2) prompt awakening and minimal recovery time are mandatory; 3) the patient is alone in the treatment room for periods of up to a minute, and monitoring must be from outside the radiation area; 4) anesthetic agents are needed that can be given repeatedly with safety; 5) it is desirable to avoid repeated invasive procedures, such as intravenous cannulation or tracheal intubation; and 6) provision must be made to maintain a patent airway in a variety of body positions.

Our protocol for dealing with these patients and the anesthetic considerations enumerated above has evolved to include: 1) utilization of a Hickman catheter for vascular access; 2) a sleep dose of iv thiopental for a stress-free induction; 3) inhaled anesthesia with halothane in oxygen via mask throughout the treatment; 4) securing the mask to the patient’s face with paper tape, tagged and placed for rapid removal should this become necessary; and 5) monitoring the patient with ECG, automated blood pressure cuff, a pulse oximeter, and a battery powered remote access stethoscope. The ECG, BP readings, and oximeter are observed via closed circuit television from just outside the treatment room.

* Assistant Professor of Anesthesiology.
† Resident in Anesthesiology.

Received from the Department of Anesthesiology, RN-10, University of Washington School of Medicine, 1959 N.E. Pacific, Seattle, Washington 98195. Accepted for publication May 14, 1987.

Address reprint requests to Dr. Glauber.

Key words: Anesthesia: pediatric. Surgery: radiotherapy.

Case Reports

Six patients have now completed their therapy, and several more are currently being treated. They range in age from 2–7 yr, and have presented a variety of special problems. The first, a 2-yr-old with recurrent posterior fossa teratoma, was referred because a variety of sedation regimens had proven unsatisfactory. Initial use of rectal barbiturate was also a failure. Stooling, poor sedation, long recovery, and development of proctitis and diarrhea were seen after only four such treatments. The second, a 61-yr-old, was an inpatient in the psychiatric unit, and was unmanageable without anesthetic assistance. All of our patients have had CNS tumors. None had increased intracranial pressure (none did have functioning VP shunts). One-third of our patients have presented with Hickman catheters already in place for chemotherapy. No gross airway abnormalities were present in this population, although one child was severely Cushingoid from steroid therapy. Two-thirds have required prone positioning for treatment.

Discussion

The use of long-term central venous catheters is common in modern pediatric practice. Complications include the morbidity attendant with insertion, which should be minimal, as well as potential complications of sepsis, site infection, air embolism, thrombosis, thromboembolic phenomena, and dislodgement or fracture of the catheter. The more serious of these complications are rare, and, with meticulous attention to technique, the incidence of all complications can be kept acceptably low. Repeated general anesthetics mandate venous access. Ease and efficiency of procedures are greatly aided by the use of long-term catheters, particularly in children. Patient trauma is reduced and family acceptance is enhanced.

The use of sleep doses of iv barbiturate is familiar to all anesthesiologists. While repeated use is common, as in anesthesia for electroconvulsive therapy, use of this technique on an almost daily basis for several weeks raised some concern that drug accumulation might occur. Serum thiopental levels were therefore assayed (liquid chromatography) on our first patient. Samples were obtained via the Hickman catheter on multiple occasions between the 8th and 23rd anesthetics. Rough pharmacokinetic data and lack of accumulation are reflected in figure 1.

Following the stress-free intravenous induction, anesthesia is deepened with halothane in oxygen. We side with others who use inhaled anesthetics in preference to rectal or intramuscular medication. The problems with
repeated rectal barbiturates, as in our first patient, have been described in mice by Hinkle et al. In addition, it has been noted by Harrison and Bennet that “chronic usage of thiopental per rectum appears to cause colitis and proctitis. . . . Accuracy of dosage becomes impossible after as few as five anesthetics.”

The most popular in anesthetic for radiotherapy in children has been ketamine. While the well-known responses of dysphoria and hallucinations are more common in adults, we were reluctant to use this anesthetic, especially in patients with central nervous system disease. Despite several series on the use of ketamine in radiotherapy, the incidence of purposeless movements and the reported depression of laryngeal reflexes also led us to prefer inhaled anesthetics. Several authors have insufflated inhaled anesthetics in patients with retinoblastoma, where prone positioning was not required. Davies did report a 6-yr-old child requiring prone positioning for cranial radiation therapy, but used im and iv ketamine in a technique which required daily restarting of an intravenous line.

Halothane, as well as ketamine, has been used safely and repeatedly in children. In a recent review, Stock and Strunin reaffirmed the extreme rarity of hepatic dysfunction following halothane in the pediatric age group. They suggest that perhaps children do not have the metabolic and/or immunologic mechanisms necessary for halothane to cause liver damage. Wark reviewed 165,400 computerized anesthetic records from The Hospital for Sick Children, Great Ormond Street, London, and described only two patients with otherwise inexplicable post-halothane hepatitis. Furthermore, 267 patients had received multiple halothane exposures within 28 days without hepatic problems. The two patients who developed hepatitis were not part of this subset.

Airway management with mask and tape worked very well, even in our Cushingoid patient (fig. 2), and prone positioning added little or no difficulty (fig. 3). Secretions would drain forward and the tongue would also tend to fall forward when the patient was prone. An oropharyngeal airway was necessary on only a few occasions.

The isolation of the child during irradiation required diligent monitoring from outside the treatment room. The visual field of the television camera included the
patient's head and torso, as well as the monitors in use. These monitors included automatic oscillotonometry (Dinamap®), oxygen analyzer, electrocardiograph, and, most importantly, a pulse oximeter. We also utilized a battery-powered remote access stethoscope (Life Sound®). This provided clearly audible breath and heart sounds during isolation, and suffered from minimal interference during actual irradiation.

Recovery times from the anesthetics outlined above were usually less than 10–15 min. Only the smallest child had a few reported episodes of nausea and vomiting at home. There was no emesis from any child in the recovery room. In fact, an acute thirst was a noteworthy feature. This was marked distinction from the sedation attempts which preceded the referral of our patients. These medications, in addition to poor conditions for therapy, often left the children drowsy and irritable for hours. Over a protracted course of daily radiotherapy, nutrition could suffer greatly. In contrast, general anesthesia provided the required immobility for a predictable time and with rapid recovery.

The rapport between anesthesiologist and radiotherapists on one side, and children and their families on the other, has contributed greatly to the success of this technique. One or both parents are in the room during anesthetic induction and recovery. Continuity of care by a few anesthesia personnel is maintained, and those individuals quickly learn the anesthetic characteristics and the psychology of each child.

In summary, we describe a protocol which has evolved over 160 anesthetics administered to six young children over a period of 9 months. The importance of modern monitoring techniques and of indwelling central venous access has been stressed.

Addendum

Since this clinical report was submitted, a review has appeared (Kenna JG, Neuberger J, Miele-Vergani G, Mowat AP, Williams R: Halothane hepatitis in children. Br Med J 294:1209–1211, 1987) suggesting the occurrence of halothane hepatitis in pediatric patients. In view of this, our current recommendation favors the use of isoflurane in preference to halothane.

REFERENCES

3. Wagman LD, Kirkemo A, Johnston MR: Venous access: A pro-

![Fig. 3. Face mask taped to patient in prone position.](http://anesthesiology.pubs.asahq.org/pdfaccess.ashx?url=/data/journals/jasa/931382/)