Anesthesiology
50:355–356, 1979

Water Intoxication after 15 Minutes of Transurethral Resection of the Prostate

BARBARA J. HURLBERT, M.D.,* AND DANIEL W. WINGARD, M.D.†

Water intoxication from intravascular absorption of non-electrolyte irrigating fluid is a well-known and often serious complication of transurethral resection of the prostate (TURP). The amount of fluid absorbed is related to the time elapsed and number of venous sinuses open during resection.[1] It is commonly accepted that a resection time of an hour is relatively safe for the prevention of this syndrome.[2,3] To our knowledge, acute water intoxication with grand mal seizures secondary to severe iatrogenic hyponatremia following only 15 minutes of resection has not been reported. Because of this, we feel the following case is of interest.

REPORT OF A CASE

A relatively healthy, 77-year-old, 59-kg white man, ASA II, had a history of chronic alcoholism. Past medical history, review of systems, and family history were essentially unremarkable. Two weeks prior to admission, the patient had complained of urinary retention and occasional urinary incontinence. Results of routine preoperative physical examination were normal except for an enlarged prostate with 820 ml residual volume after voiding. TURP was scheduled. Liver function studies, clotting studies, complete blood count, and renal screening studies disclosed no abnormality. Routine determination of serum electrolytes the night before the operation revealed CO_2 content, 30 mEq/l, pH 7.38, Cl^- 100mEq/l, Na^+ 140 mEq/l, K^+ 4.8 mEq/l, Ca^{++} 9.3 mg/dl.

The patient was brought to the operating room unmedicated. An epidural catheter was placed at the L3–L4 interspace and advanced approximately 2 cm into the epidural space. A 3-ml test dose of 3 per cent chloroprocaine was given at 7:50 A.M. Five minutes later 10 ml 3 per cent chloroprocaine were injected, followed 10 min later by an additional 10 ml, for a total dose of 23 ml. Satisfactory analgesia was established to a level of T8. Cystoscopic examination progressed uneventfully. At 8:30 A.M. 10 ml 3 per cent chloroprocaine were injected, without change in vital signs. TURP began at 8:34 A.M. with continuous irrigation of the bladder with 1.5 per cent glycine. At 8:46 A.M. the patient began complaining of "dizziness," a "tight feeling" in his throat, and "inability to breathe"; administration of 100 per cent O_2 by mask was begun. Heart rate remained 80/min and blood pressure was 120/80 torr. Within 2 min the patient lost consciousness and had a tonic-clonic seizure above the block. The seizure abated in 2 min leaving the patient mottled and somnolent. Serum electrolytes were determined and a 3 per cent saline drip was instituted. A second seizure occurred 5 min later, and 50 ml 50 per cent glucose were given iv to rule out hypoglycemia as the cause of the seizures. Vital signs remained unchanged. A total of 1,200 ml of 5 per cent dextrose in lactated Ringer's solution had been given by this time. A systemic toxic reaction to chloroprocaine was discounted when the results of serum electrolyte determinations became available: CO_2 content 21 mEq/l, pH 7.20, Cl^- 81 mEq/l, Na^+ 104 mEq/l, K^+ 4.2 mEq/l, Ca^{++} 6.3 mg/dl. Over the next 15–20 min, 300 ml 3 per cent saline solution were given, and the procedure was completed. One unit of packed erythrocytes was given to replace an estimated 600-ml blood loss. In the recovery room 45 min later, repeated electrolyte determinations and revealed CO_2 21 mEq/l, pH 7.23, Cl^- 90 mEq/l, Na^+ 114 mEq/l, K^+ 5.0 mEq/l, Ca^{++} 6.6 mg/dl; hemoglobin was 10.4 mg/dl. Transfusion of a second unit of packed erythrocytes was begun, and 200 ml 3 per cent saline solution were given iv because the patient was still restless, nauseated and vomiting. During this period values obtained for central venous pressure ranged from 9 to 11 cm H_2O. At 2:00 P.M., repeated electrolyte determinations revealed Na^+ 129 mEq/l and K^+ 3.5 mEq/l. The patient felt better. A total of 256 mEq Na^+ had been given. The following day the serum electrolytes had returned to normal ranges, with CO_2 25 mEq/l, pH 7.37, Na^+ 139 mEq/l, Cl^- 114 mEq/l, K^+ 3.6 mEq/l. The remainder of the postoperative course was uneventful.

DISCUSSION

Arterial hypertension, slowing of the pulse rate, widened pulse pressures, mental agitation, headache, confusion, nausea, dyspnea, cyanosis, progressive obtundation, convulsions, pulmonary edema, and cardiovascular collapse are seen in the classic picture of water intoxication following the use of distilled water for irrigation in TURP.[4,5] The patient's reaction depends upon the osmolarity of the fluid used, the amount of fluid absorbed, and the anesthesia administered.[5] The amount of absorption is governed mainly by three factors: 1) the hydrostatic pressure of the irrigating solution, 2) the number and sizes of the venous sinuses opened, and 3) the duration of exposure.[3,6] The osmolarity of the irrigating fluid is generally dependent on the surgeon's preference, although the solution must be transparent, non-electrolytic and nontoxic. Isotonic solutions are considered safer than hypotonic solutions.

In our case an isotonic solution was utilized. Although it was not measured, the hydrostatic pressure probably exceeded the 70 cm H_2O Taylor advocates.[7] Taylor

* Assistant Professor.
† Professor and Chairman.

Received from the Anesthesiology Department, University of Nebraska Medical Center, Omaha, Nebraska. Accepted for publication July 26, 1978.

Address reprint requests to Dr. Hurlbert: Department of Anesthesiology, the University of Nebraska Medical Center, 42nd and Dewey Ave., Omaha, Nebraska 68105.

points out that often the resectionist is not a good judge of fluid accumulation, and the amount of tissue removed does not correlate with the extent of fluid uptake.[7] As would be expected, fluid absorption is more closely correlated to the progress and extent of the operative procedure than to time *per se*. Our case points out there are exceptions to the classically taught "safe one hour" resection time advocated by Fillman *et al.*[3] Time is only a relative guide for each specific surgeon. Some surgeons reach the capsule and venous sinus plexus very early, while others never reach the capsule after 2–4 hours of resection time. Numerous reports cite one hour as a relative safe time with use of distilled water as the irrigating solution. Still and Modell[8] point out many feel a much longer time is safe when isotonic solutions are used. They were surprised that their patient developed this syndrome after only 75 min of resection time. Our case points out the need for constant vigilance during the entire procedure, as water intoxication may occur at any time.

In this case serum Na^+ fell precipitously in 15 min to 104 mEq/l, resulting in grand mal seizures. Seizures are most likely to occur when serum Na^+ drops below 120 mEq/l. However, Maluf found that the more rapid the decrease in serum Na^+, the more likely were seizures to develop; a 20–30 mEq/l reduction in serum Na^+ was an ominous sign, and indicated that large amounts of fluid had been absorbed.[6] Fluid may enter the intracellular space rapidly, and serum Na^+ may not accurately reflect the true dilution that has occurred. One cannot necessarily correlate serum Na^+ level with the total amount absorbed.[4,6,7] In our case the volume absorbed appeared to be greater than the 20 ml/min that Hagstrom suggests as an average.[1]

Often the anesthetist relies on changes in vital signs to diagnose water intoxication prior to the outset of seizures, pulmonary edema and cardiovascular collapse. In this case, there was no significant change in vital signs prior to the grand mal seizures. Had general anesthesia been used, we probably would not have determined serum electrolytes so early. Pulse and blood pressure often do not reflect the true clinical picture[9]; for this reason, conduction anesthesia is preferred for the early detection of the syndrome.

Grand mal seizures as a result of water intoxication following short transurethral resection times can occur. The classic signs of water intoxication, widened pulse pressures, slowing heart rate, and hypertension, may not occur prior to central nervous system alterations. An alert anesthetist, ever aware of the possibility of early occurrence along with conduction anesthesia, allows for early detection and treatment of this syndrome.

References

1. Hagstrom RS: Studies on fluid absorption during transurethral prostatic resections. J Urol 73:852–859, 1955
2. Harrison RH, Boren JS, Robison JR: Dilutional hyponatremic shock: Another concept of the transurethral prostatic resection reaction. J Urol 75:95–110, 1956
3. Fillman EM, Hanson OL, Gilbert LO: Radioisotopic study of effects of irrigating fluid in transurethral prostatectomy. JAMA 171:1488–1492, 1959
4. Marx GF, Orkin LR: Complications associated with transurethral surgery. ANESTHESIOLOGY 23:802–813, 1962
5. Marx GF, Koenig JW, Orkin LR: Dilutional hypervolemia during transurethral resection of the prostate. JAMA 174:1834–1837, 1960
6. Maluf NSR, Boren JS, Brandes GE: Absorption of irrigating solution and associated changes upon transurethral electroresection of the prostate. J Urol 75:824–835, 1956
7. Taylor RO, Maxson ES, Carter FH, et al: Volumetric, gravimetric and radioisotopic determination of fluid transfer in transurethral prostatectomy. J Urol 79:490–499, 1958
8. Still JA, Modell JH: Acute water intoxication during transurethral resection of the prostate, using a glycine solution for irrigation. ANESTHESIOLOGY 38:98–99, 1973
9. Mebust W, Brady TW, Valk WL: Observations on cardiac output, blood volume, central venous pressure, fluid and electrolyte changes in patients undergoing transurethral prostatectomy. J Urol 103:632–636, 1970

Anesthesiology
50:356–359, 1979

An Anesthesia Circuit Monitor

ROBERT FOREST, M.D.,* AND YVES LAMARCHE, M.D.†

Most new ventilators incorporate a low-pressure alarm as standard equipment. There are also available several commercial versions of high- and low-pressure alarms as separate units.[1,2] There is no question that some sort of disconnection-warning device is desirable. We describe below a multiple-function anesthesia circuit monitor. The model described adds three useful features to the basic concept of a high- and low-pressure alarm.

There is general agreement that exhaust gases should be removed.[3,5] Two problems are associated

* Chief resident.
† Professor and Chairman.
Received from the Department of Anesthesiology, Sherbrooke University Medical Center, Sherbrooke, Quebec, Canada J1H 5N4. Accepted for publication August 17, 1978.
Address reprint requests to Dr. Forest at his new address: VA Hospital, Long Beach, Cal. 90801.