Severe intraoperative hyponatremia in a patient scheduled for elective hysteroscopy: A case report

CDR Colleen M. Estes, CRNA, MS, NC, USN
LCDR John P. Maye, CRNA, PhD, NC, USN
San Diego, California

Hysteroscopy is a minimally invasive procedure that may result in potentially disastrous complications. A hysteroscopy requires the insertion of a hysteroscope into the uterine cavity and the installation of a suitable distention medium for visualization of the endometrium. Potential risks include fluid volume overload, uterine perforation, hemorrhage, infection, and the need for immediate hysterectomy. Solutions most commonly used for distention of the uterine cavity are 1.5% glycine and sorbitol. Hypotonic, electrolyte-free distention media have the potential to be absorbed in volumes large enough to cause hyponatremia and hypervolemia, complications initially described as transurethral resection of the prostate (TURP) syndrome. Hyponatremia and hypervolemia have been associated with hysteroscopic surgical procedures. The following is a case report detailing the perioperative events of a 40-year-old woman in whom severe hyponatremia developed during an elective hysteroscopy.

Key words: **Hyponatremia, hysteroscopy, TURP [transurethral resection of the prostate] syndrome.**

Hysteroscopy is a procedure that may appear to be minimally invasive but may result in potentially disastrous complications. A hysteroscopy requires the insertion of a hysteroscope into the uterine cavity and the installation of a suitable distention medium for the visualization of the endometrium. Although a minimally invasive procedure, it carries the risk of fluid volume overload, uterine perforation, hemorrhage, infection, and potential need for an emergency hysterectomy.[1] Outcomes can be affected dramatically by the vigilance and communication of the entire operating room team. Solutions most commonly used today are 1.5% glycine and sorbitol. Many variations of solutions exist; however, none meet the criteria for the ideal medium. Ideal properties for media include the following: isotonic, electrically inert, nontoxic, transparent, and easy to sterilize. In an attempt to preserve transparency and augment the visual field for the surgeons, solutions used today are moderately hypotonic.[2] Hypotonic, electrolyte-free distention media have the potential to be absorbed in volumes large enough to cause hyponatremia and hypervolemia.

Transurethral resection of the prostate performed in men is associated with a complication referred to as *TURP syndrome*. TURP syndrome is a surgical complication caused by the absorption of large volumes of the distention medium, resulting in hyponatremia and water intoxication.[2] This condition, if unrecognized, can progress to pulmonary edema and often can be fatal.[3] Complications associated with surgical hysteroscopy can be identified with what is seen clinically in TURP syndrome. The dilutional pathophysiology of the hyponatremia associated with hysteroscopy is similar and, as a result, has been labeled the "female TURP syndrome."[4]

Case summary

A 40-year-old woman, ASA physical status II, was undergoing treatment because of a history of menorrhagia. The medical history was positive for smoking. The patient was not taking any prescribed or over-the-counter medications. Surgical history revealed 2 previous hysteroscopies for myoma resection, both of which were discontinued because of excessive bleeding. Preoperative laboratory results included a complete blood cell count, which showed normal values, and a 12-lead electrocardiogram showing sinus tachycardia. Preoperative medications were administered intravenously in the preoperative holding area and consisted of 2 mg of midazolam hydrochloride and 1 g of cefazolin sodium.

Upon arrival to the operating room, standard monitors were placed. The induction was performed with 180 mg of propofol, 120 mg of lidocaine, a remifentanil infusion starting at 1 µg/kg per minute, and 50 mg of rocuronium. The patient was intubated orally with a 7.5 mm endotracheal tube, and an upper extremity warming blanket was placed on the upper torso. The patient then was placed in lithotomy position with a slight Trendelenburg position used to aid the surgeon's visual field. Before surgical incision, a propofol infusion was titrated from 125 µg/kg per minute to 150 μm/kg per minute, and the remifentanil infusion was titrated from 0.5 μg to 0.7 μg/kg per minute for the remainder of the surgical procedure. The patient remained in hemodynamically stable condition throughout the anesthetic. Glycine 1.5% was delivered through the hysteroscope using gravity pressure. Approximately 1.5 hours into the procedure, the circulating nurse informed the surgeon that the fluid volume given to the patient was 4,700 mL, and the output measured in the collection devices was 2,300 mL, a deficit of 2,400 mL. The systolic blood pressure ranged from 102 to 108 mm Hg and the diastolic blood pressure from 42 to 50 mm Hg; the heart rate was 60 to 70 beats per minute; and the oxygen saturation was 100%. A venous blood sample was obtained from the patient, and electrolytes were reported using a portable blood-gas analyzing device. Results were as follows: Na^+, 122 mEq/L; glucose, 81 mg/dL; K^+, 3.6 mEq/L; and ionized Ca^+, 1.1 mg/dL.

The surgeon was notified of the serum sodium level, and the procedure was terminated. Vital signs at this time were as follows: blood pressure, 100/50 mm Hg; heart rate, 70 beats per minute; and oxygen saturation, 99%. A total of 10 mg of furosemide was given intravenously, and an indwelling urinary catheter was inserted before the patient's emergence from anesthesia. The patient was extubated in the operating room without difficulty and responded appropriately to verbal stimuli. The patient was transported to the postanesthesia care unit (PACU). Vital signs on admission to the PACU were as follows: blood pressure, 150/83 mm Hg; heart rate, 99 beats per minute; and oxygen saturation, 99%. Upon arrival into the PACU, an 800-mL bolus of lactated Ringer's solution was administered as replacement to maintain fluid balance after the administration of furosemide. The patient received a total of 1,000 mL of lactated Ringer's solution during the case, with a total urine output of 800 mL. A 12-lead electrocardiogram obtained in the PACU revealed normal sinus rhythm. A repeat set of electrolytes was obtained immediately after the patient was settled into the PACU, serum Na^+ level now measured 129 mEq/L. A sample was not obtained for serum osmolarity determination. Recovery was uneventful, and the patient was discharged to home later that evening.

Discussion

Resecting a myoma through a hysteroscope prevents the need for a laparotomy, uterine incision, and a postoperative hospital stay.[5] Hysteroscopy offers some advantages for the patient, but is not without risk. Distention of the uterine cavity requires inflow pressures of 80 to 100 mm Hg.[1] Excessive hydrostatic pressure created by the fluid causes an increase in intrauterine pressure. When the intrauterine pressure exceeds mean arterial pressure, there is potential for increased absorption of the hypotonic solution.[3,6] Excessive absorption of the irrigating medium occurs when open venous channels are exposed to high inflow pressures.[6] The desirable properties that make the amino acid glycine a suitable medium for surgical hysteroscopy are the same that can cause excessive systemic absorption of the medium resulting in hyponatremia, hypokalemia, hypocalemia, and hyposmolarity.[1]

Intracellular absorption and metabolism of glycine lead to excessive extracellular free water and result in hypo-osmolar hyponatremia if not eliminated. As a rule, for every liter of hypotonic fluid absorbed, the serum sodium level will decrease by 10 mmol/L (10 mEq/L).[7,8] The additional secretion of antidiuretic hormone as a result of the stress response to surgery reduces the elimination of excessive water, worsening the situation. As water moves along osmotic and hydrostatic gradients, hypertension and bradycardia occur. In some patients, pulmonary edema and hypotension develop as a result.[1,2] Water also may move across the blood-brain barrier, resulting in cerebral edema and increased intracranial pressure. Ammonia, a major metabolite of glycine, also can contribute to the central nervous system symptoms associated with excessive absorption.[1,2,7]

Complications related to the absorption of fluid are dependent on the amount and type of fluid absorbed. Media that can be used are 1.5% glycine, sorbitol, mannitol, and dextran. Hypotonic solutions such as sorbitol and mannitol also carry the risk of hyponatremia. In addition, sorbitol can be metabolized to fructose and glucose and may result in hyperglycemia. Dextran, which is immiscible with blood and has a low index of refraction, is a viscous fluid that possesses superior clarity, contributing to the overall excellent optical properties of the solution. Complications with the use of dextran have included acute anaphylactic shock, cross-reactivity, and coagulopaties.[1] Glycine 1.5% was the distention medium used during this elective hysteroscopy. What makes 1.5% glycine an optimal medium for hysteroscopies is that it is a nonconductive, nonhemolytic, transparent fluid that provides good optical properties that enhance the visual field for the surgeon.[2]

Two basic principles determine the amount of fluid absorbed: (1) the height of the container determines the hydrostatic driving pressure of the fluid, and (2) the length of the procedure in relation to the amount absorbed. As much as 10 to 30 mL of fluid can be absorbed during every minute of resection.[2] Surgeons have a vital role in controlling intrauterine pressures, the most important variable that can alter fluid absorption. Keeping the intrauterine pressure below the mean arterial pressure can minimize absorption.[7,9] Fluid placed 36 to 52 inches above the patient can generate a pressure between 70 and 100 mm Hg.[7] A key aspect to the prevention of excessive absorption is the precise measurement of the fluid infused and the fluid recovered. These calculations should be performed every 15 minutes by the surgical team to determine the fluid deficit.[9] As noted in the case described herein, it was the operating room nurse who informed the surgeon of the fluid deficit. Fluid deficits are determined by measuring the amount of fluid instilled into the uterus by the surgeon and the amount of fluid returned to the collection containers; the difference becomes the deficit, which is the amount absorbed by the patient.[9] It is recommended that the case be terminated when the fluid deficit is between 1,000 and 2,000 mL.[7]

A high index of clinical suspicion associated with long resection or documented substantial fluid deficit can lead to early recognition and treatment. There is some controversy about the treatment modalities for the reduction of the fluid overload and the correction of an abnormal serum sodium level. In symptomatic patients, the recommendations are to replace sodium and eliminate excessive water. If both osmolarity and the serum sodium level are low (< 230 mOsm/L and 115 mEq/L, respectively), hypertonic saline can be infused; however, excessive speed of correction can cause central pontine demyelination.[1,2] Some patients may be asymptomatic despite a low serum sodium level, as in the case described herein. It is recommended that hypertonic saline be avoided in these instances because of its association with central pontine demyelination. Close observation and supportive care are appropriate in mild cases. Fluid restriction, saline replacement, and diuresis also can be used.[1] In our case, the patient was treated with furosemide, replacement of fluid losses, and careful postoperative observation.

Most of the complications associated with hysteroscopy, although rare, are avoidable. In this case, the excessive absorption of irrigating solution may have been related to the resection time (1 hour and 35 minutes), since neither excessive height of solution nor high intrauterine pressure was noted. Absorption of fluid is proportional to the length of the resection procedure.[2] On average, 10 to 30 mL of fluid is absorbed per minute of resection time in patients undergoing a TURP.[2] Operative hysteroscopies that last for more than 1 hour—and those that require large amounts of tissue resection—are more likely to lead to fluid volume overload.[3] This patient already had undergone 2 hysteroscopies for resection of the same myoma; in both cases, the procedures were terminated because of excessive bleeding. As the resection time increases, more uterine veins open, ultimately increasing the amount of hypotonic solution absorbed. The longer and more extensive the procedure, the more time and surface available for absorption of the solution.[4] Vigilance and continuous communication among the surgeons, anesthesia providers, and nursing staff assist in the early recognition and rapid treatment of this complication and are vital for a successful patient outcome.

REFERENCES

1. Murdoch JA, Tong JG. Anesthesia for hysteroscopy. *Anesthesiol Clin North Am.* 2001;19:125-140.
2. Malhotra V. Transurethral resection of the prostate. *Anesthesiol Clin North Am.* 2000;18:883-897.
3. Cooper JM, Brady RM. Intraoperative and early postoperative complications of operative stereoscopy. *Obstet Gynecol Clin North Am.* 2000;27:347-366.
4. Agraharkar M, Agraharkar A. Posthysteroscopic hyponatremia: evidence for a multifactorial cause. *Am J Kidney Dis.* 1997;30:717-719.
5. Schenk LM, Coddington CC. Laparoscopy and hysteroscopy. *Obstet Gynecol Clin North Am.* 1999;26:1-22.
6. Scott SM. Pulmonary edema and hyponatremia during hysteroscopic resection of uterine fibroids: case report. *CRNA.* 1998; 9:113-117.
7. Isaacson KB. Complications of hysteroscopy. *Obstet Gynecol Clin North Am.* 1999;26:39-51.
8. Prost AM, Liberman RF, Harlow BL, Ginsburg ES. Complication of hysteroscopic surgery: predicting patients at risk. *Obstet Gynecol.* 2000;96:517-520.
9. Morrison DM. Management of hysteroscopic surgery complications. *AORN J.* 1999;69:194-215.

AUTHOR

CDR Colleen M. Estes, CRNA, MS, NC, USN, is a staff nurse anesthetist at Naval Hospital Camp Pendleton, Oceanside, Calif.

LCDR John P. Maye, CRNA, PhD, NC, USN, is a clinical research coordinator, Naval School of Health Sciences, San Diego, Calif.

DISCLAIMER

The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the United States Government.