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REVIEW

Transurethral Resection of the Prostate (TURP) Syndrome: A Review of Perioperative Management

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ABSTRACT

Transurethral resection of the prostate (TURP) syndrome is a systemic complication caused by excessive absorption of electrolyte-free irrigation fluids during transurethral resection of prostate or bladder tumors. TURP syndrome can begin as early as 15 minutes after resection begins and can last up to 24 hours after surgery. The factors affecting the development of TURP syndrome are divided into two categories: patient-related factors (age, comorbid diseases, and prostate size) and surgery-related factors (type of irrigation fluid, duration, height of the fluid bag, absorption rate of irrigation fluid, and surgeon's experience). Signs and symptoms are due to hypervolemia, hyponatremia, and toxicity of substances in the irrigation fluid. Diagnosis is difficult because many signs and symptoms are variable and nonspecific. The clinical spectrum can range from asymptomatic hyponatremia and headache to nausea, vomiting, convulsions, visual disturbances, pulmonary edema, coma, cardiovascular collapse, and death. Since it may occur in the early perioperative period and causes central nervous system symptoms and signs, spinal anesthesia may be helpful for early diagnosis. When the diagnosis is made, informing the surgical team and ending the surgery is critical. Control of seizures, ensuring airway safety with endotracheal intubation, and treating hypervolemia, hyponatremia, and other electrolyte irregularities should be implemented immediately.

Keywords: Hypervolemia, hyponatremia, hyposmolarity, TURP syndrome

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INTRODUCTION

Benign prostatic hyperplasia (BPH) is a pathological condition that increases with age in men and causes bladder outlet obstruction. Surgical treatment options are applied to patients who do not respond to medical treatment for BPH. Although there are alternative surgical methods, transurethral resection of the prostate (TURP) is the most commonly applied surgical treatment method.[1,2] In TURP surgeries, irrigation solutions transmit electrical current and irrigate the bladder. Rare but life-threatening TURP syndrome may occur in patients who undergo this procedure. Transurethral resection of the prostate (TURP) syndrome is a systemic complication caused by excessive absorption of electrolyte-free irrigation fluids during transurethral resection of prostate or bladder tumors.[3] Although this syndrome is typically seen after transurethral resection of the prostate, it can also be seen after diagnostic cystoscopy,[4] percutaneous nephrolithotomy,[5] and various endoscopic gynecological procedures.[6,7] The literature reports an incidence of TURP syndrome between 0.78% and 1.4%.[8] Although mortality rates of 0.2–0.8% are reported in TURP syndrome, mortality rates of up to 25% can be observed in severe TURP syndromes[9] It has been stated that TURP syndrome may begin 15 minutes after the resection begins and may last up to 24 hours postoperatively.[10]

PATHOPHYSIOLOGY and PREDISPOSING FACTORS

Four basic mechanisms play a role in the pathophysiology of TURP syndrome:

- Circulatory overload caused by rapid and excessive absorption of irrigation fluid
- Metabolic effects due to glycine in the irrigation solution,
- Dilution of protein and electrolyte concentration in body fluids
- Renal dysfunction.

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Factors affecting TURP syndrome can be considered as patient factors and factors related to the surgical process. Patient factors include age, comorbid diseases, and prostate size. Surgical factors affecting the development of TURP syndrome are the type of irrigation fluid, the duration of irrigation fluid, the height of the fluid bag, the position of the patient, the rate of fluid absorption, and the surgeon's experience.

Type, Amount and Duration of Irrigation Fluids

Different irrigation fluids are used in TURP surgeries. These fluids inflate the bladder and clean the surgical area. Approximately 5–10% of irrigation fluids are absorbed from the circulation. The fluid absorbed into the circulation may cause hypervolemia, postoperative kidney damage, brain edema, and hyponatremia.[9] An ideal irrigation fluid should be non-hemolytic, non-toxic, transparent, and inexpensive. However, there is no such irrigation fluid.

Glycine is a non-essential amino acid metabolized to ammonia in the liver. Irrigation fluids contain 1.2% and 1.5% glycine, which is generally used at a concentration of 1.5%. Glycine is not hemolytic and provides a transparent appearance but is hypotonic. Because of its effect on the myocardium, it may lead to T-wave changes in electrocardiography and acute myocardial infarction in the postoperative period. [10,11] Glycine functions as an inhibitory neurotransmitter in the retina. Large amounts absorbed from irrigation fluids and passed into the systemic circulation may cause visual impairment and temporary blindness. Glycine also has harmful effects on the kidneys. Additionally, glycine can convert to ammonia in the liver, leading to hyperammonemia encephalopathy. Irrigation fluids containing glycine are used less frequently today due to their side effects.

Mannitol solutions at 3% and 5% concentrations can be used as irrigation fluid in TURP operations. The mannitol solution removes water from cells and expands intravascular volume without causing glycine toxicity. In patients with renal dysfunction, the excretion of mannitol solution through the kidney is less. Absorption of mannitol solutions may cause symptoms of hyponatremia.

Cytatic solution (Cytal) combines 2.7% sorbitol and 0.54% mannitol. Sorbitol is absorbed into the circulation as fructose. In patients with hypersensitivity to fructose, it may cause a reaction during surgery.

Physiological saline (0.09% isotonic solution) cannot be used in standard monopolar TURP surgeries. Due to its ionic structure, it blocks electrical current and does not cause coagulation. However, it is used as an irrigation solution in bipolar TURP.

The fluid absorbed from the prostatic venous channels is 20 ml/min. Approximately 6–8 liters of fluid can be absorbed into the circulatory system during a two-hour TURP surgery. Ingesting 1 L of fluid in one hour can decrease serum sodium concentration by 5–8 mmol/L. Absorption of 2 L or more of bladder irrigation fluids may cause TURP syndrome.[12]

Fluid Bag Height

The height of the irrigation bag affects the solution's hydrostatic pressure. In TURP operations, the height of the irrigation bag above the surgery area is recommended to be an average of 60 cm. If the irrigation bag is over 100 cm, it increases the possibility of TURP syndrome.[13]

Prostate Size and Surgery Experience

Large prostate volume increases the amount of tissue that needs to be resected. Prolonged surgery duration increases the amount of bleeding and, therefore, the absorption of irrigation fluid from the venous system. More surgical experience, shorter surgery time, and less irrigation fluid use result in fewer prostate perforations. Thus, fewer prostatic venous sinuses open, leading to less fluid absorption.[12,14]

Age and Comorbid Diseases

Due to the decrease in renal functions with aging, it becomes difficult for the kidneys to establish sodium and water balance. Thus, the possibility of TURP syndrome increases in geriatric patients. Patients' comorbidities may impact the hemodynamic responses that occur during TURP syndrome. In cases of left ventricular dysfunction, excessive fluid absorption into the circulation may cause pulmonary edema.[15]

SIGN AND SYMPTOMS

Symptoms of TURP syndrome are due to hypervolemia, hyponatremia, and toxicity of substances in the irrigation fluid. The fact that signs and symptoms are generally nonspecific makes diagnosis difficult. The clinical spectrum can vary from asymptomatic hyponatremia to electrocardiographic changes, headache, nausea, vomiting, convulsions, visual impairments, pulmonary edema, coma, cardiovascular collapse, and death[16,17] (Table 1). The patient may be restless and anxious and complain of headaches. The most consistent findings are bradycardia and arterial hypotension, which the anesthesiologist in the perioperative period can detect. Abdominal bloating may also occur in patients due to absorption of irrigation fluid through perforations in the prostate capsule.[18] Changes in consciousness that may lead to coma have been attributed to hyponatremia, hyperglycemia, or hyperammonemia.

Table 1. Signs and symptoms of transurethral resection of the prostate syndrome

Central nervous system	Cardiopulmonary system	Metabolic and Renal
Nausea / Vomiting	Hypertension	Hyponatremia
Headache	Hypotension	Hypoosmality
Restlessness	Bradycardia	Hemolysis
Vision disorders / Blindness	Arrhythmia	Anemia
Seizures	Respiratory distress	Hyperglycinemia
Confusion	Pulmonary edema	Hyperammonemia
Coma	Shock	Acute renal failure

Hyponatremia can occur when any irrigation fluid is used, but hyperglycemia and hyperammonemia occur only with glycine.[19] Visual impairments can range from decreased visual acuity to temporary blindness.[20]

Hypervolemia

Small amounts of irrigation fluid are absorbed through the prostatic sinuses in almost every TURP operation. Circulating 1 L of irrigation within 1 hour results in an acute decrease in serum sodium concentration of 5 to 8 mmol/L and may indicate an increased risk of TURP syndrome.[18] Both hypertension and hypotension can be observed in TURP syndrome. Hypertension and reflex tachycardia are explained by rapid volume expansion reaching 200 mL/min. Patients with poor left ventricular function may also develop pulmonary edema due to acute circulatory overload. Hypothermia may develop due to excessive amounts of irrigation solution.[21]

Hyponatremia

Symptoms of hyponatremia are related to both the severity and rate of plasma sodium concentration. A decrease in serum sodium concentration to <120 mmol/L means TURP syndrome will have a severe course.[22] This condition can lead to cerebral edema, increased intracranial pressure, and neurological symptoms. Seizures, coma, permanent brain damage, respiratory arrest, brainstem hernia, and death may occur due to hyponatremia.[21,22]

Hypoosmolarity

The primary physiological determinant of central nervous system findings is acute hypoosmolality, not hyponatremia. This is an expected situation because the blood-brain barrier is not permeable to sodium but to water. The brain responds to hypoosmotic stress by decreasing intracellular sodium, potassium, and chloride. Thus, intracellular osmolarity decreases, and brain edema occurs. Cerebral edema is a severe problem and can lead to cerebral herniation and death.

TREATMENT AND PERIOPERATIVE MANAGEMENT

Treatment of TURP syndrome depends on early recognition, and treatment should be based on the severity of symptoms. When TURP syndrome is detected intraoperatively, the surgery should be terminated as soon as possible. Absorbed water must be eliminated, and hypoxemia and hypoperfusion must be treated. The patient may need to be supported with oxygen support. In patients with altered consciousness, endotracheal intubation may be required to administer anticonvulsants and anesthetics. Mildly symptomatic patients with nausea, vomiting, and stable hemodynamic parameters should be observed closely. Supportive treatment is generally sufficient in patients with mild symptoms; hypotension should be treated with fluid resuscitation and vasopressor agents.[23]

Severe hyponatremia (serum sodium<120 mmol/L) can be treated with 3% hypertonic saline (approximately 1000 mL/12 hours) after careful evaluation. It reduces brain edema by expanding plasma volume. Neurological damage or death may occur in patients who are not administered hypertonic saline or are administered late. It should be noted that a serum sodium concentration <100 mmol/L is incompatible with life. However, central pontine myelinolysis may develop due to rapid correction of hyponatremia. It is considered safe to increase the serum sodium concentration by one mmol/L per hour.[24]

Hyperglycinemia stimulates N-methyl-D-aspartic acid (NMDA) receptors associated with encephalopathy. NMDA receptor antagonists or glycine antagonists can be used to control the patient's seizures. Additionally, serum magnesium levels may decrease due to decreased serum osmolarity. Magnesium replacement may control seizure activity.

Both furosemide and mannitol have been used as diuretics in acute pulmonary edema cases. Furosemide relieves pulmonary edema by providing more sodium diuresis than

mannitol, a sodium-sparing diuretic. However, furosemide is not recommended in patients with hemodynamic instability because it will deepen hypotension. Glycinin has a short half-life (85 minutes). Therefore, visual disturbances due to hyperglycemia usually resolve spontaneously within 24 hours and do not require intervention.[23]

ANESTHESIA

It is widely accepted that spinal anesthesia is the preferred anesthesia technique for TURP. It has been reported that spinal anesthesia is usually performed in reported TURP syndromes. Sedation should be avoided as the patient's consciousness allows early detection of mental status. It has also been reported that spinal anesthesia reduces pulmonary edema and blood loss.[3,25–28] However, spinal anesthesia reduces central venous pressure, potentially resulting in more excellent absorption of irrigation fluid compared to general anesthesia. Diagnosis of TURP syndrome under general anesthesia can be difficult because it masks the patient's complaints. In this case, anesthesiologists must rely on electrocardiographic changes, blood pressure, and pulse changes. Caution should be exercised in fluid resuscitation to reduce hypotension caused by spinal anesthesia.

CONCLUSION

In conclusion, rare but fatal TURP syndrome may occur due to the absorption of large amounts of irrigation fluid during therapeutic urological and gynecological endoscopic procedures. Since it can occur intraoperatively or in the early postoperative period and causes central nervous system symptoms and signs, spinal anesthesia is generally accepted for early diagnosis. Since clinical suspicion is essential in diagnosis, TURP syndrome should be considered. Symptoms may progress from mild headache and nausea/vomiting to pulmonary edema and cardiovascular collapse. When the diagnosis is made, informing the surgical team and ending the surgery is critical. Treatment of seizures with anticonvulsant and anesthetic drugs, endotracheal intubation to ensure airway safety, treatment of hypervolemia, hyponatremia, and other electrolyte irregularities, and symptomatic treatment should be applied immediately.

Disclosures

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