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TUR syndrome - pathophysiology, symptoms, diagnosis and treatment.

Zespół poresekcyjny (TUR syndrom) - patofizjologia, objawy, diagnostyka i leczenie

Summary
Transurethral resection syndrome (TUR syndrome) is a rare but serious complication of endoscopic procedures. The underlying cause of its occurrence is unpredictable absorption into the bloodstream of the patient irrigating liquid, which is used to ensure good visibility of the operating field. The main symptoms are connected with cardiovascular disorders (hypo-and hyperkinetics) as well as respiratory system and central nervous system disorders. Fully symptomatic resection syndrome is life-threatening.
The development of endoscopic techniques in urology, gynecology, orthopedics using irrigation fluids has led to greater attention to the problem of resection syndrome. As has been shown that the greatest risk of this complication are loaded with transurethral resection of bladder tumors (TURT-Trans Urethral Resection Tumoris) and prostate (TURP Trans Urethral Resection Prostate), described as transurethral resection (TUR syndrome)and as the effect it has become a multidisciplinary problem. Causal and symptomatic treatment is conducted by a surgical physician specialist in close cooperation with the anesthesia. Knowing the exact etiopathogenesis particular emphasis should be put on minimizing the risk of its occurrence. The use of laser techniques, bipolar electrical systems, osmotic lavage fluid and continuous improvement of surgical techniques should be used to lower the risk.

Key words: resection syndrome, water intoxication, irrigation fluids

Streszczenie.
Zespół resekcji przezcewkowej (TUR syndrom) stanowi rzadkie, ale bardzo poważne powikłanie zabiegów endoskopowych z wykorzystaniem płynów płuczących. Podłożem jego wystąpienia jest niekontrolowane wchłanianie płynu płuczącego, służącego zapewnieniu dobrej widoczności pola operacyjnego. Główne objawy dotyczą układu sercowo-naczyniowego (hipo- i hiperkinetyka), układu oddechowego oraz centralnego układu nerwowego. Pełnoobjawowy zespół poresekcyjny stanowi zagrożenie dla życia pacjenta.
Rozwój technik endoskopowych w urologii, ginekologii, ortopedii z użyciem irygacji, doprowadził do zwrócenia większej uwagi na problem zespołu poresekcyjnego. Ponieważ wykazano, że największym ryzykiem wystąpienia tego powikłania obciążone są zabiegi resekcji przezcewkowej nowotworów pęcherza(TURT- Trans Urethral Resection Tumoris) i prostaty(TURP-Trans Urethral Resection Prostate), określono go nazwą zespołu resekcji

przezcewkowej(TUR syndrom). Stał się on problemem multidyscyplinarnym. Leczenie zespołu jest przyczynowe i objawowe, a prowadzone jest przez lekarza specjalności zabiegowej w ścisłej współpracy z zespołem anestezjologicznym. Znając dokładnie etiopatogenezę zespołu należ położyć szczególnie nacisk na działania minimalizujące ryzyko jego wystąpienia. Temu ma służyć wykorzystanie technik laserowych, bipolarnych obwodów elektrycznych, osmotycznych płynów płuczących oraz ciągłe doskonalenie technik zabiegowych.

Słowa kluczowe: zespół poresekcyjny, zatrucie wodne, płyn płuczący

Introduction

TUR (transurethral resection) is a very important urological endoscopic diagnostic and therapeutic procedure. The urologist performs surgery with a resectoscope under visual control and visibility, which during surgery is provided thanks to a constant flow of irrigating liquid. The phenomenon of electroresection mono-and bipolar (the effect of cutting and coagulation) is used. A serious complication of TUR syndrome is associated with the absorption of irrigating liquid through the open vessel during operations, such as reported by the patient's discomfort, chest pain, blurred vision (visual acuity impairment, vision in blue), hypotension, nausea, vomiting, oliguria, loss consciousness. These are the so-called symptoms of water intoxication defined as a resection syndrome. The term water intoxication was first used by Wier in 1922. It involved a group of symptoms caused by systemic fluid overload and hyponatremia occurring during endoscopic procedures using liquid irrigants. Today, this problem affects patients undergoing transurethral resection of bladder tumors, prostate, diagnostic cystoscopy, percutaneous nefrolitotomii, cystolitotrypsji, arthroscopic and endoscopic gynecological surgery using irrigation (transcervical resection of the endometrium-TCRE), endoscopic operations of. rectal tumors. Research the last 20 years indicate that TUR syndrome concerns 1-8% of patients undergoing TURP (transurethral resection of the prostate). Mortality rate is at a level of from 0.2% to 0.8%.

A threat of TUR syndrome occurs after 15 minutes from the start of resection of the prostate and lasts up to 24 hours after surgery. This long period forces medical staff to focus on the patient during the intraoperative and postoperative phase not to overlook any of the symptoms. Quick diagnosis and initiation of treatment increases the patient's chances for recovery. The absorption of small amounts of fluid (1-2 liters) can easily be overlooked. Absorption of fluid on a large scale causes a dramatic clinical symptoms requiring intensive care. The resection syndrome (TUR syndrome) shows symptoms of heart failure irrespective of the type of wash liquid used, although it is most marked in the case of glycine, then the sorbitol, NaCl, mannitol. The effect of low osmolarity caused by excessive absorption of fluid is a life-threatening brain edema. It does not develop when physiological salt solution is used for irrigation. In this case, however, significant cardiovascular overload, resulting in pulmonary edema and acidosis may occur. Clinical effects of excessive fluid absorption depends on its speed, volume and the nature. TURP syndrome is caused by many factors, that arise by the action of an excess of irrigating liquid absorbed on the cardiovascular system, central nervous system and cellular metabolism. Multitude of prodromal symptoms may lull the doctor because they are variable and nonspecific.

Tab.1 Sings and Symptoms Attributed Transurethral Resection of the Prostate Syndrome by Major Physiologic System and Increasing Severity

Central nervous system	Cardiopulmonary	Hematologic and renal
Restlessness	Hypertension	Hyponatremia
Headache	Tachycardia	Hyperglycinemia
Confusion	Tachypnea	Intravascular hemolysis
Convulsions	Hypoxia	Hypoosmolality
Coma	Cyanosis	Acute renal failure
Visual disturbances	Pulmonary edema	Hyperammonemia
Blindness	Hypotension	Hyperkaliemia
Nausea/vomiting	Bradycardia	Hemolysis/ anemia
Twitches	Dysrhythmia	
	Shock	

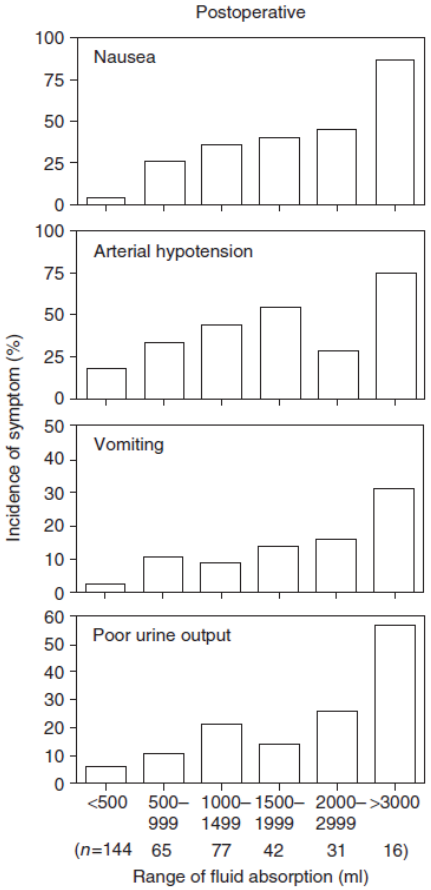


Fig.1 The incidence of nausea, arterial hypotension, vomiting and poor urinary output with increasing amounts of absorption of glycine 1,5% after TURP. The absorption was measured by etanol 1%.

Tab. 2 Factors That, Alone Or In Combination, Can Affect the Central Nervous System During Transurethral Resection of the Prostate

Drugs	Solute	Hypoxia
Benzodiazepine	Hyperammonemia	Congestive hesrt failure
Local anesthetic	Hyperglycinemia	High spinal anesthesia
Narcotic	Hypoglicynemia	Myocardial infartion
	Hyponatremia	Pulmonary edema
	Hypoosmolality	Sepsis

Pathophysiology

Pathophysiology of resection syndrome TURP is complex and therefore multisymptomatic. Understanding of this problem allows the identification of patients with the highest risk. The aim of introduction of solutions containing glycine, mannitol or sorbitol was to prevent intravascular hemolysis and not dissipate electric beam used to cut while using a resectoscope. However, the absorption of the irrigation fluids resulted in much more severe symptoms of central nervous system and cardiovascular system. Severe, life-threatening symptoms are related to the absorption of> 3-4 liters of fluid. Irrigation liquid is mostly absorbed directly into the bloodstream through a vein damage during electrosurgery. The pressure of irrigation fluid must exceed venous pressure ~ 1.5 kPa. This mechanism of absorption is common in the case of TURP and TCRE. Intraperitoneal absorption or retroperitoneal space absorption of irrigation fluid is also possible but only if the fluid pressure exceedes ~ 0.5 kPa. These types of disorders are more common in percutaneous surgery of kidneys.

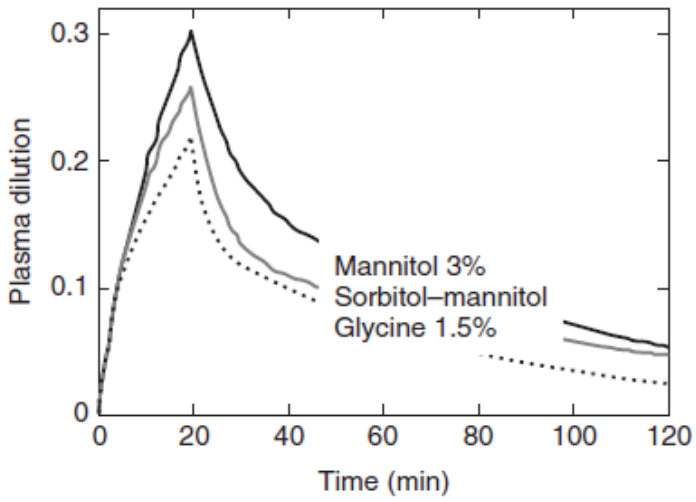


Fig.2 Computer simulation of the plasma dilution resulting from experimental infusion of 1,5 litre of three irrigating fluids for more than 20 min in 10 volunteers. There are only small differences between the fluids despite the differences in half-life of the solutes.

Fluid overload

The absorption of a small quantity of irrigating liquid is present in the majority of cases of TURP through the open prostate veins. Both hypertension and hypotension with reflexive tachycardia is noticeable within a short time after the start of treatment. It is due to a sharp increase in blood volume, which can reach a value up to 200ml/min. This is of great significance in patients with left ventricular heart failure, because it may lead to pulmonary edema. This symptom may not occur in the case of massive intraoperative bleeding. Absorption of the irrigating liquid is the cause of transient hypervolemia together with simultaneous increase of the central pressure, which regulates within the period of 15 minutes from the absorption. Negative symptoms such as shortness of breath, chest pain, pulmonary edema and anxiety may occur during the operation, when the patient is on the operating table. They can occur especially during surgical procedures in which there is not massive loss of blood.

The result of hypervolaemia is longer and more difficult hypokinetic phase , characterized by a low cardiac output, hypovolemia, and low blood pressure. Factors contributing to hemodynamic changes include osmotic diuresis and natriuresis, and together with glycine and sorbitol, intracellular water consumption. Impact on it may also have: hyponatremia, hypocalcemia, low osmolality, low body temperature and the release of prostete's endotoxin . Bradycardia causes a significant reduction in systolic blood pressure of up to 50-70 mm Hg, and is often the first sign signifying the possibility of occurrence of TUR. Pulmonary edema may also develop late, indicating that serum sodium concentration of <100 mmol / liter in combination with severe hipoosmolality.

Cardiac dysfunction resulting from an excess of water in the body of the patient, may cause cardiovascular collapse. In patients with an excessive amount of absorbed irrigation fluids, impairment of conduction, bradycardia, and ST segment depression and T wave depression may appear.

Dilution of plasma proteins rarely exceeds 25%, it may, however, achieve 40-50% in the severe case. Hyponatremia (<120 mmol / L) can cause muscle weakness, convulsions, epileptic seizures and anaphylactic shock. Often these symptoms are also accompanied by decreased osmolarity by 10-25 mOsmol / kg. This is due to the fact that most of the irrigation fluids are hipoosmolar (200 mOsmol / kg).

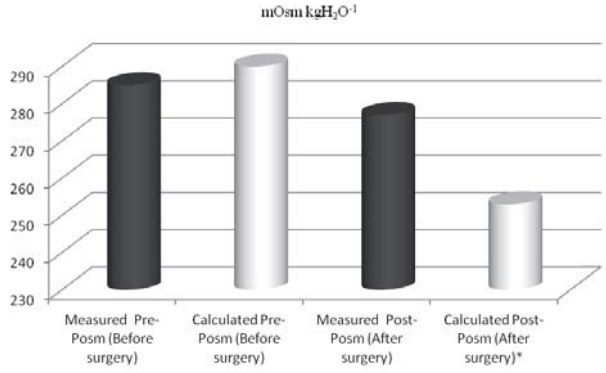


Fig.3 Mean and SD of pre- and post-Posm(measured and calculated Value) In hypo-Na group. Represenents statistical significance($p<0,01$, pai red t-test) between measured and calculated value.

Hyponatremia

Hyponatremia symptoms depend on the speed of reducing the level of sodium in the blood serum in proportion to the absorption. The decrease in sodium> 120mmol / L causes severe symptoms of TURP. Lowering sodium causes the increases of the osmotic gradient between the intracellular and extracellular space. This causes the water permeation into the brain cells causing them to swell, increased intracranial pressure and neurological symptoms such as epileptic seizure, coma, respiratory failure, brain stem cavity features and death.

Hypoosmolality

Dysfunction of the central nervous system is not only caused by the hyponatremia, but also by severe plasma hipoosmolality. It causes a rapid decrease in levels of sodium, potassium and chloride in the brain tissue. Lowering the level of ions in the cell is to prevent the accumulation of cerebral edema, which is the main cause of death of the patient.

Hyperammonemia

Glycine in the intravascular space is metabolized to ammonia. Brain tissue has an enzyme system that converts glycine to CO2 and ammonia, and the toxic effect causes neurological disorders (metabolic encephalopathy). They occur at the level of ammonia in the blood serum of> 100 mmol / L (normal range 10-35). The ideal irrigating fluid should be isotonic, non-hemolitic, electrically neutral, non-toxic, transparent, easy to sterilize and affordable. Such liquid does not exist. Each of them has potentially adverse effects.

Menagement of TURP Syndrome

The issue of TURP syndrome occurrence concerns both the urologist and anesthesiologist. They must work as a team. Most vulnerable to the onset of TURT or TURP are elderly people , and therefore with lower adaptive capacity of their organs. This concerns particularly renal function, heart and hormonal balance. Particular attention should be paid to monitoring the amount of irrigating liquid, as well as the liquid used intravenously by a team of perioperative anesthetic. Special attention should be paid to balance fluid therapy. We should also remember about expelled fluids and blood loss. Measurements of these parameters may, however, be inaccurate. One way to evaluate the quantity of the absorbed liquid is the addition of 1% ethanol to the irrigating liquid and monitoring its level in the exhaled air. It is a very useful method. It allows to detect the absorption of 75 ml of fluid in a period of 10 minutes. It is possible to use it in both procedures performed under regional anesthesia or general intratracheal, even in patients at lung diseases such as chronic obstructive pulmonary disease. A very useful method is the monitoring of central venous pressure (CVP). The absorption of 500 ml of liquid causes the increase of 2 mm Hg. Its measurement is, however, affected by the amount of blood loss.

Prevention

Operative time

It is widely believed that the maintenance of the surgery less than 1 hour prevents excessive fluid absorption during TURP. But repeatedly the massive absorption of irrigating fluid after only 15 minutes of operation have been documented. It is recommended that the operation time does not exceed 60 minutes. The risk of occurrence of TURP syndrome increases after 90 minutes of treatment.

Patient position on the operating table

It is not advisable to place the patient in the Trendelenburg position (20 degrees), since lowering the pressure in the open veins of the bladder and prostate cancer increases the risk of irrigating fluid absorption.

Fluid bag height

Optimum height placement of the bag with irrigating liquid over the the operating table is 60 centimetres. But there is no convincing evidence that compliance with this recommendation carries a reduced risk of TURP occurrence.

Low pressure irrigation

Performing TURP surgery with low-pressure flushing liquid can significantly reduce the occurrence of complications. This can be achieved through the use of irrigation with suprapubic trocar. It is more effective in combination with monitoring of intravesical pressure.

Bipolar TURP

Bipolar resectoscope as opposed to conventional monopolar TURP allows the use of saline as an irrigation liquid. In this way the risk of causing hyponatremia is reduced.

Laser prostatectomy

Laser prostatectomy performed green (green light laser) significantly reduces the risk of complications, as it causes tissue removal by evaporation and closes vessels, greatly reducing the absorption of fluid.

Treatment

Taking preventive measures is of invaluable importance and significance. However, the onset of TURP may require alternative ventilation, intensive symptomatic and casual treatment, and oxygen supplementation. Monitoring vital signs and correcting hemodynamic disorders should be implemented. Visual disturbances disappear spontaneously within 24 hours and do not require any treatment. Hypertension can be transient. Immediately taken appropriate action can interrupt cardiovascular collapse. Atropine, epinephrine and calcium should immediately be administered intravenously while bradycardia and hypotension occur. Although it is recommended to limit fluid intake, make sure the volume of plasma is sufficient. Correction of hyponatremia (level <120 mmol / L) should begin with the infusion of 3% NaCl solution (1000ml/24h). The level of sodium in the patient's body of

100mmol / L brings fatal consequences. However, the aggressive supplementation with sodium ions can cause myelinolysis. Therefore, the level of sodium in the blood serum should be supplemented at 1 mmol / L / h. Hyperglycinemia should be treated by infusion of a solution of magnesium, which is an antagonist of toxic metabolites. The primary indication for the intravenous administration of furosemide is to take control of pulmonary edema and the need to induce diuresis, when this does not occur. In fact, the administration of furosemide deepens hyponatremia and hypovolemia.

Anesthesia and TUR Syndrome

The recommended technique of anesthesia is conduction anesthesia. It allows, through permanent contact with the patient, to detect early signs of TUR. Through its antihypertensive effect it reduces the risk of pulmonary edema, but increases the absorption of irrigating liquid.

Conclusions

This work is aimed at understanding the physiology, diagnostic problems and rules of conduct in the TURP syndrome. Patient care in this, particular case is interdisciplinary. The multiplicity of symptoms does not allow for the creation of any algorithms. We attempt, however, to pay more attention to the issue of severe complications of endoscopic interventions during the times of the enormous growth in number of minimally invasive procedures. Noticing this problem may result in improving the quality and effectiveness of therapy while its omission could bring disastrous consequences.

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