



# Irrigation fluid absorption syndrome during HoLEP: A case study

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## ABSTRACT

The classical transurethral resection syndrome as described with monopolar prostate resection has become rare since the switch to bipolar resection and even more so since the introduction of HoLEP. We report a case of a 74-year-old male patient who presented with an irrigation fluid absorption syndrome during a HoLEP for benign prostate hypertrophy. Biochemically this presented as metabolic acidosis and hyperchloremia instead of hyponatremia. He was treated with diuretics and had a swift recovery.

## 1. Introduction

Transurethral resection (TUR) syndrome is caused by excessive absorption of irrigation fluid during resection of the prostate or bladder. Irrigation fluid absorption (IFA) > 1000ml is clinically significant and can trigger a wide range of symptoms (neurological disturbances, circulatory instability or pulmonary edema), escalating to hemodynamic collapse when exceeding absorption of 2500ml. Replacement of monopolar resection by bipolar TURP and transurethral laser enucleation resulted in better outcomes with less bleeding and quasi elimination of TUR syndrome by using a conductive medium (saline 0,9%) instead of a nonconductive irrigation fluid (glycine 1,5%).<sup>1</sup>

We report an acute irrigation fluid absorption syndrome following a Holmium laser prostate enucleation and how to recognize and prevent it.

## 2. Case presentation

We report a case of a 74-year-old patient, who has been treated medically (Tamsulosine) for benign prostate hypertrophy (prostate volume 67g, PSA 7,27 µg/L). Because of persistent urinary complaints, transurethral enucleation of prostate using holmium YAG laser was scheduled. History consisted of hypercholesterolemia and minor surgery (stapedotomy, appendectomy). No known personal or familial anesthetic problems. Normal blood results one month prior to surgery (Table 1).

Normal hemodynamic parameters at start of anesthesia (heart rate

65 bpm, blood pressure 132/59 mmHg, saturation 98%). Induction of general anesthesia with alfentanil, propofol and placement of laryngeal mask. Intravenous fluid used was ringer's lactate solution, total amount during surgery around 700ml. Maintenance of anesthesia with sevoflurane and nitrous oxide (50% N<sub>2</sub>O, 50% O<sub>2</sub>) and stable parameters after induction (heart rate 59bpm, blood pressure 101/55 mmHg, saturation 100%). Patient was positioned in lithotomy posture. The Olympus laser resectoscope and morcellator scope Ch 27 (=9mm) were used. Irrigation fluid used was NaCl 0,9% (positioned 73 cm above surgical table), with a total intraoperative amount of 90L.

Two and a half hours after onset of surgery, bilateral bloody ear canals were noticed. Hemodynamic and ventilatory parameters remained comparable.

Patient was intubated because of pronounced swelling of face and neck with facial and thoracic petechiae. An ENT specialist confirmed bilateral ruptured hemotympanum. One gram of tranexamic acid was administered. Ultrasound of the abdomen and neck revealed a small amount of perihepatic and perisplenic fluid (7mm), normal organ perfusion, dilated inferior vena cava (19 mm) with minimal variation during respiration, extensive edema of the neck expanding to the face with pronounced distention of the right jugular vein. Arterial and central catheter were placed, first blood gas revealed metabolic acidosis with low lactate and high chloride (Table 2). Massive absorption of irrigation fluid was suspected. Transesophageal ultrasound confirmed right ventricle dysfunction, most likely due to fluid overload. Patient was given 40mg of furosemide with rapid normalization of right ventricle function, blood chloride and pH (Table 2). Patient was transferred to the intensive care and recovered quickly with residual complaints of hearing

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**Abbreviations**

TUR	transurethral resection
HoLEP	Holmium laser enucleation of the prostate
IFA	irrigation fluid absorption
IVP	intravesical pressure

**Table 1**

Blood results pre-operative, during surgery, one-hour post-operative.

	Pre-operative	Per-operative	Post-operative	Unit of measurement
Hemoglobin	17,4	9.1	13.5	g/dL
Platelets	170	70	161	103/mcL
Sodium	142	148	146	mmol/L
Potassium	4,9	3.6	4.6	mmol/L
Creatinine	0,82	0.39	0.57	mg/dL

**Table 2**

Blood gas results at moment of diagnosis and 2 h after diuretics.

	Diagnosis	2h after diuretics	Unit of measurement
pH	7.14	7.46	
pO <sub>2</sub>	256	86	mmHg
pCO <sub>2</sub>	42	29	mmHg
Bicarbonate	14	21	mmol/L
Sodium	141	142	mmol/L
Potassium	3.4	4.3	mmol/L
Chloride	121	111	mmol/L
Hemoglobin	9.3	14	mg/dl
Lactate	0.45	1.2	mmol/L

loss in both ears and temporarily visual hallucinations due to posterior vitreous detachment.

**3. Discussion**

The fluid shift during HoLEP differs from the classical TUR syndrome due to the type of irrigation fluid used and the different surgical technique.

TUR syndrome with glycine (electrolyte-free, hypotonic) absorption results in an acute hypo-osmolarity causing water to enter the intracellular space with risk of hemolysis, neuronal disturbance, cardiac failure, pulmonary edema and kidney failure. TUR syndrome with saline 0.9% absorption manifests as iso-osmolar overhydration with a plasma volume expansion resulting in cardiac decompensation and acute pulmonary edema.<sup>1</sup>

During HoLEP laser energy is used instead of electrical energy. The depth of penetration does not exceed 0.5–1 mm resulting in a more superficial tissue perforation compared to the deep resection caused by a bipolar resection loop.<sup>2</sup> The risk of fluid absorption increases with the depth of resection and the number of opened venous sinuses. Laser energy combines cutting and coagulation so small blood vessels are sealed off immediately, diminishing blood loss and consequently intravascular fluid absorption.

Several factors contribute to the fluid overload in our case. First the prostate capsule was perforated, resulting in more fluid absorption. Perforation leads to direct intravascular absorption through prostatic venous sinuses, and indirect absorption through extravasation into the perivesical space and abdominal cavity.<sup>1</sup>

Secondly adequate bladder distension is required for a safe morcellation phase, leading to a high intravesical pressure (IVP). Although an IVP > 20 cmH<sub>2</sub>O is considered elevated, IFA can already occur at an IVP of

10 cmH<sub>2</sub>O. IVP is influenced by bladder compliance and thus capacity, which can be diminished by previous surgical interventions or increased by spinal anesthesia. Irrigation pressure, reported by the height at which the irrigation fluid is hung above the operating table, might influence the IVP, although this has not been confirmed.<sup>3</sup>

Thirdly, a prostate gland larger than 45g has a significantly higher incidence of intraoperative bleeding due to hypervascularity and thus a bigger risk of fluid absorption.<sup>4</sup>

A fourth contributing factor is the surgical time, ideally under 90 minutes.<sup>1</sup> When exceeding this time, the intraoperative bleeding is significantly higher as well as the amount of IFA. A factor negatively influencing the procedure time in HoLEP is the learning curve. An average of 25–50 cases is needed to reach competency with a structured mentorship aiding for faster progress.<sup>5</sup> In this case the extended operating time of 150 minutes was the most considerable cause for the high IFA.

Certain preventive measures can be taken to lower the risk of IFA syndrome. The most practically applicable measure is a correct measurement of the in-versus outflow of irrigation fluid. Another interesting method is the monitoring of the IVP through a standardized computer-controlled system. The IVP monitoring device is not widely used, but it has been introduced for intrarenal pressure measurement during ureterorenoscopy.<sup>1</sup> When IFA syndrome is diagnosed during the morcellation phase, it is possible to interrupt the operation, place a bladder catheter and continue later.

**4. Conclusion**

In the HoLEP era the TUR syndrome, or better, irrigation fluid absorption (IFA) syndrome is a rare but potentially life-threatening phenomenon. Urologists and anesthesiologists should be vigilant for the symptomatology of acute fluid overload. Biochemically metabolic acidosis and hyperchloremia can be seen instead of hyponatremia.

Factors influencing the risk of developing an IFA syndrome during HoLEP are the prostate size, bladder capacity, surgeons experience, intravesical pressure, prostate capsule perforation and operative time > 90 minutes. Potential preventive measures are the registration of the irrigation fluid volume and measurement of the IVP.

**Author statement**

Charlotte Slots: writing-original draft, conceptualization, methodology, review&editing.

Pieter Uvin: supervision, validation, writing – review&editing

Emma Van Damme: writing-original draft, conceptualization, methodology, review&editing.

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**Declaration of competing interest**

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**References**

- Ortner G, Nagele U, Herrmann TRW, Tokas T. Irrigation fluid absorption during transurethral bipolar and laser prostate surgery: a systematic review. *World J Urol*. 2022 Mar;40(3):697–708. <https://doi.org/10.1007/s00345-021-03769-4>.
- Bapat S, Umranikar S, Satav V, Bapat A, Joshi A, Ranade G. Comparison of fluid absorption during transurethral resection of prostate and Holmium-Yag laser

- enucleation of benign adenoma of prostate using breath ethanol concentration. *Indian J Urol.* 2007;23(2):126–129. <https://doi.org/10.4103/0970-1591.32061>.
3. Hahn RG, Ekengren J. Absorption of irrigating fluid and height of fluid bag during transurethral resection of the prostate. *Br J Urol.* 1993;72:80–83. <https://doi.org/10.1111/j.1464-410x.1993.tb06463.x>.
  4. Ishio J, Nakahira J, Sawai T, Inamoto T, Fujiwara A, Minami T. Change in serum sodium level predicts clinical manifestations for transurethral resection syndrome: a retrospective review. *BMC Anesthesiol.* 2015 Apr;15:52. <https://doi.org/10.1186/s12871-015-0030-z>.
  5. Kampantais S, Dimopoulos P, Tasleem A, Acher P, Gordon K, Young A. Assessing the learning curve of holmium laser enucleation of prostate (HoLEP). A systematic review. *Urology.* 2018 Oct;120:9–22. <https://doi.org/10.1016/j.urology.2018.06.012>.