中文題目：經尿道內視鏡電刀攝護腺刮除手術後溶血導致急性腎損傷

英文題目：Hemolysis and Acute Kidney Injury Requiring Hemodialysis Following Transurethral Resection of the Prostate, A Case Report

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Introduction

Transurethral resection of the prostate (TURP) is currently the gold standard for the surgical treatment of benign prostatic hyperplasia (BPH), which is the most common nonmalignant disorder of the prostate. The term TURP syndrome is used to describe various complications involving neurologic, renal and cardiovascular systems, which include but are not limited to, respiratory distress, hypoxia, pulmonary edema, nausea, vomiting, visual disturbance, confusion, convulsions, hemolysis, and bradyarrhythmia.

TURP syndrome occurs in 10% to 15% of patients undergoing the procedure, with a mortality rate ranging from 0.2% to 0.8%. Acute kidney injury (AKI) after TURP has also been reported. It is suggested that hypotonicity and hypervolemia with subsequent increased vascular leakage leads to hypotension and rapidly impaired renal function. However, AKI directly induced by hemolysis after TURP is rare. We report the development of an AKI attributing directly to hemolysis after TURP in a patient with BPH.

Case report

A 65-year-old man with 5 years of symptomatic benign prostatic hyperplasia was admitted in the urology department for monopolar transurethral resection of the prostate. Physical examination showed no obvious abnormalities. Preoperative laboratory tests revealed serum sodium of 137 mEq/L, potassium of 4.4 mEq/L, chloride of 100 mEq/L, blood urea nitrogen of 12.4 mg/dL, creatinine of 1.03 mg/dL (estimated glomerular filtration rate [GFR], 77 mL/min/1.73 m2), hemoglobin of 17 g/dL, hematocrit of 51 % and white blood cell count of 6440 /mm3 with a normal differential count. Chest radiography and electrocardiogram were normal.

During the surgery, distilled water was used as irrigant. The patient presented with sinus bradycardia on the electrocardiogram monitor after the surgery was complete. Also, the patient was confused and hard to arouse, with arterial blood pressure decreasing to 93/57 mmHg. Thus he was transferred to the intensive care unit for close monitoring.

Laboratory tests shortly after transferal to the intensive care unit revealed decrease of serum sodium concentration (115 mEq/L), hemoglobin (10.8 g/dL), and haptoglobin (< 7.0 mg/dL). Elevated reticulocyte count (113680/mm3) and elevated lactate dehydrogenase level (2174 U/L) were found. Antinuclear antibody, C3, C4, and anti-CTD antibody were within the normal range. Both direct and indirect Coombs test were negative. Renal ultrasonography and non-contrast abdominal computed tomography did not show any hydronephrosis, stone, or other structural abnormalities. Hyponatremia was slowly corrected to a level of 135 mEq/L by 3% saline, and patient's mental status improved. However, subsequent blood urea nitrogen and creatinine levels continued to rise (with blood urea nitrogen of 84 mg/dL; creatinine of 9.54 mg/dL [estimated GFR, 5.9 mL/min/1.73 m2]) despite daily urine amount of approximately 2000 ml, thus ruling out prerenal AKI. Renal function deterioration did not respond to intravenous fluid therapy. Eventually we arranged hemodialysis for the patient due to an edematous status with bilateral moderate transudative pleural effusion and metabolic acidosis.

Eight hemodialysis sessions were performed. Fortunately, we were able to wean the patient off hemodialysis, and he was discharged with blood urea nitrogen of 45 mg/dL and creatinine of 4.0 mg/dL (estimated GFR, 16.1 mL/min/1.73 m2). One month later, serum creatinine level was stable

around 3.0 mg/dL (estimated GFR, 22.4 mL/min/1.73 m2).

Discussion

Transurethral resection of the prostate, associated with significant morbidity, is still the standard surgical procedure for treatment of benign prostatic hyperplasia. The occurrence of TURP syndrome can be fatal.6 The conventional monopolar TURP systems necessitate the use of nonconductive fluid irrigation such as distilled water, glycine, sorbitol, or mannitol. TURP syndrome is due to absorption of irrigation fluid via open prostatic venous sinuses in sufficient quantities to cause hypervolemia and hyponatremia, which lead to encephalopathy, and cardiac, respiratory and renal failure.

Distilled water serving as irrigating fluid would lead to sudden osmotic alteration, which induces erythrocytes to liberate hemoglobin into plasma, where hemoglobin is bound by haptoglobin, thereby forming a haptoglobin-hemoglobin protein complex. This complex, too large to be filtered by the glomerulus, is taken up by the reticuloendothelial cells of the liver, spleen, and bone marrow, and degraded. When plasma haptoglobin is fully saturated in hemoglobin complexes, free plasma hemoglobin dissociates from its usual tetrameric globin structure to dimeric hemoglobin. Dimeric hemoglobin is filtered more easily by the glomerulus than tetrameric hemoglobin, and after filtration, hemoglobin is incorporated into proximal tubules through the megalin-cubulin receptor system present on the apical surface of these cells. Intracellular hemoglobin then dissociates into heme and globin. The increased intracellular levels of heme are potentially cytotoxic due to its lipophilic, oxidant, proinflammatory, and apoptotic effects. Heme proteins also cause acute kidney injury through other two mechanisms in addition to cytotoxicity: decreased renal perfusion and intratubular casts formed from the interaction of heme proteins with Tamm-Horsfall protein. Heme proteins can directly induce renal vasoconstriction and promote free radical formation that result in renal tubular injury.

Irrigating solutions such as 3 % sorbitol, 5 % mannitol, and 1.5 % glycine have been used to avoid TURP induced hemolysis. However, Grundy et al reported that the alternative osmotic bladder solutions such as glycine had no significant advantage. The development of bipolar resectoscope allows resection be done by using normal saline irrigation, thus completely avoids TURP syndrome. A meta-analysis of all randomized controlled studies by Mamoulakis et al disclosed not a single instance of TURP syndrome among all the bipolar TURP groups.

Our patient enjoyed healthy living, without hypertension, obesity, atherosclerotic vascular disease, diabetes mellitus, or chronic kidney disease, before receiving TURP surgery. This background condition unlikely rendered him susceptible to additional kidney insults. Despite transient mild hypotension, with mean arterial pressure 69 mmHg, was found during the first hour after the surgery, no evidence of end organ hypoperfusion was noted and blood pressure returned to his baseline level without any treatment. During the course of his progressive renal function deterioration, intravascular hemolysis associated with TURP syndrome was the only identifiable cause of renal tubular injury.

In conclusion, hemolysis caused by TURP in healthy patients can lead to severe kidney injury requiring hemodialysis, and irreversible kidney function impairment can develop. Though uncommon, the occurrence and severity of TURP syndrome-induced acute kidney injury deserves highlighted awareness. The risk of its occurrence should be kept in mind before the surgery and be thoroughly explained to patients in advance.

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