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A rare case of hyperchloraemic normal anion gap metabolic acidosis due to absorption of normal saline irrigation fluid during holmium laser enucleation of prostate

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ABSTRACT

Holmium laser enucleation of the prostate (HoLEP) is the preferred technique for surgical management of benign prostatic hyperplasia in prostates over 80 cc in size. A 72-year-old male underwent a HoLEP for catheter-dependent urinary retention in the context of a 204 cc prostate. At the end of the procedure he was clinically overloaded and had developed a combined respiratory and hyperchloremic normal anion gap metabolic acidosis secondary to excessive absorption of normal saline irrigation fluid. He was transferred to the ICU for diuresis and supportive care where he made a full recovery.

1. Introduction

Holmium laser enucleation of the prostate (HoLEP) is the preferred technique for surgical management of benign prostatic hyperplasia (BPH) in prostates over 80 cc in size. Advantages of HoLEP over transurethral resection of the prostate (TURP) include its clinical effectiveness and cost-effectiveness.[1] The irrigation fluid of choice in HoLEP is normal saline, which confers the added advantage of a lower likelihood of serum electrolyte derangement due to intraoperative fluid absorption. We report an instance of severe metabolic acidosis following excessive absorption of normal saline irrigation fluid during a lengthy HoLEP procedure.

2. Case presentation

A 72-year-old male was referred to the Urology clinic for management of his catheter-dependent urinary retention and preceding two-year history of worsening voiding lower urinary tract symptoms (LUTS). A planning magnetic resonance imaging (MRI) scan of his pelvis showed a prostate volume of 204 cc (Fig. 1) in the context of BPH as well as an incidental obstructive 18mm calculus in his left distal ureter with resultant upstream hydroureter and hydronephrosis (Fig. 2).

Our patient had an American Society of Anesthesiologists (ASA) score of 2 with a past medical history of peripheral vascular disease and diverticulitis; and a body mass index of 25.1kg/m^2. Ureteroscopy was complicated due to the patient's large prostate making access to the left vesicoureteric junction (VUJ) difficult. His 18mm stone was therefore only partially lasered on two occasions and left renal decompression was instead achieved with insertion of a left ureteric stent. Following a multidisciplinary team meeting (MDM) discussion, consensus was reached to perform a HoLEP in the first instance followed by a third attempt at stone clearance at a later date.

On the day of surgery, he was intubated (endotracheal tube size 8; 23cm at lips; grade 3 view) with no complications. The en-bloc HoLEP was performed with a high-power laser (550 μm fibre/50Hz/1600mJ/narrow pulse width/Moses technology). The surgical planes of the prostate were tough in places and morcellation was also challenging due to densely fibrous nature of the large adenoma. A total of 66 litres of 0.9% sodium chloride solution (placed at the standard height of 60–80cm above the level of the operating table) was used to irrigate the bladder during the procedure. Despite the challenging nature of the case, no capsular breach, bladder perforation, or undermining of the bladder neck occurred during the procedure.

While the patient remained haemodynamically stable throughout the operation, his fraction of inspired oxygen (FiO2) rose from 50% to 90% towards the end of the procedure in order to maintain an oxygen

Abbreviations: HoLEP, Holmium laser enucleation of the prostate; BPH, Benign prostatic hyperplasia; LUTS, Lower urinary tract symptoms; NAGMA, Normal anion gap metabolic acidosis; eGFR, Estimated glomerular filtration rate.

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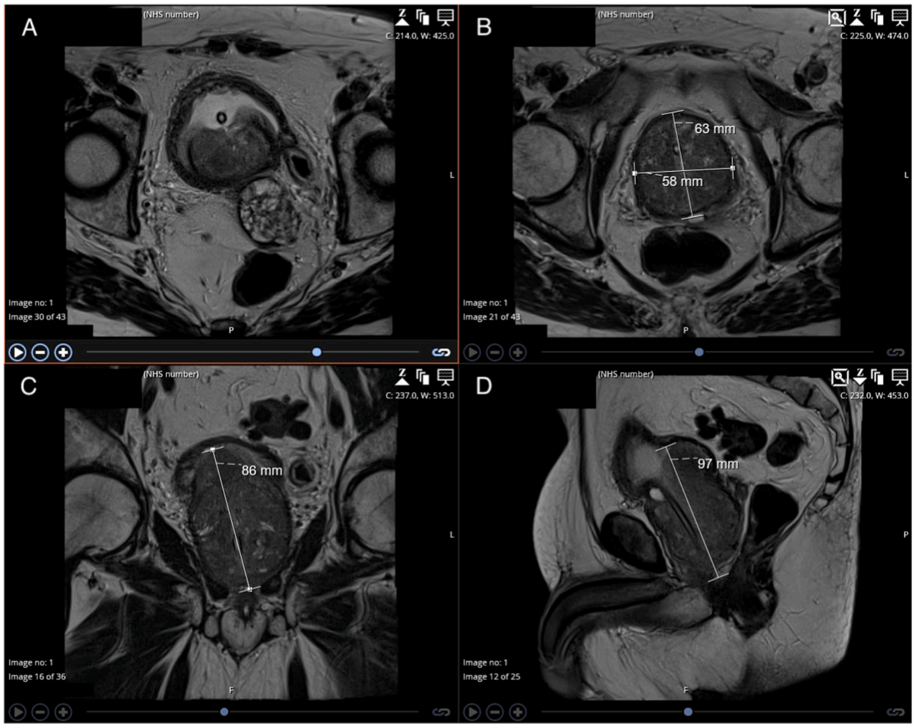

Fig. 1. Magnetic resonance imaging (MRI) images of the prostate: (A) axial section showing the median lobe of the prostate and catheter in situ, (B) axial section showing prostate dimensions, (C) coronal section, and (D) sagittal section.

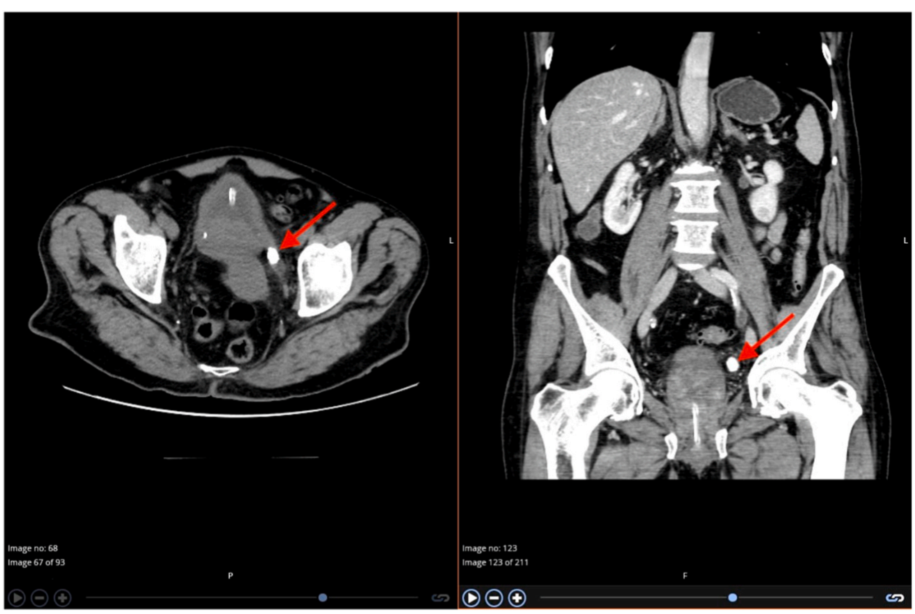

Fig. 2. Axial (left) and coronal (right) computed tomography (CT) images of the left ureteric calculus (red arrows). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

saturation (SpO2) of 92–93%. He was noted to be oedematous, and an arterial blood gas (ABG) demonstrated hyperchloraemic normal anion gap metabolic acidosis (NAGMA) (Table 1), likely due to secondary absorption of irrigation fluid. The decision was therefore made not to proceed with primary ureteroscopy and lasertripsy but instead swiftly change the stent only. The entire operation lasted 3 hours (enucleation time: 47 minutes; morcellation time: 33 minutes) with 155g of prostate enucleated in total.

Post-operatively, the patient developed post-extubation laryngospasm with oxygen saturations dropping to as low as 66% and a repeat ABG reaffirmed the persistence of a combined respiratory acidosis and NAGMA (Table 1).

He was reintubated, stabilised, and transferred to the intensive care unit (ICU). A chest x-ray confirmed fluid overload, but reassuringly, the Computerised Tomography (CT) of the brain did not show any cerebral oedema or mass-effect.

He improved in ICU with intravenous (IV) Furosemide and supportive management. Table 1 details his biochemical improvement in the hours of post-operative stabilisation. He was stepped down to the ward on Day 2 and discharged on Day 4 catheter-free, without any

Table 1
Arterial blood gas (ABG) results intra-operatively and in the post-operative hours showing severe hyperchloraemic normal anion gap metabolic acidosis and a high oxygen requirement that improved with fluid offloading and supportive management.

ABG parameters	Intraoperative	Day 0 (1h post-op)	Day 0 (7h post-op)	Day 0 (10h post-op	Day 0 (13h post-op)	Day 1 (16h post-op)	Day 1 (18h post-op)	Day 1 (30h post-op)	Day 2 (37h post-op)
FiO2 (%)	40.0	65.0	50.0	30.0	28.0	28.0	28.0	21.0	21.0
pH	7.115	7.168	7.178	7.357	7.272	7.247	7.249	7.343	7.383
pCO2 (mmHg)	6.51	7.03	6.94	4.42	5.71	5.73	6.71	6.00	6.04
pO2 (mmHg)	27.9	16.9	17.3	16.2	11.0	10.9	9.09	7.57	7.75
cHCO3 (mmol/l)	15.7	19.1	19.3	18.6	19.7	18.7	22.0	24.4	26.9
ABE (mmol/l)	−13.4	−9.5	−9.1	−6.1	−6.8	−8.1	−5.3	−1.4	1.5
cNa+ (mmol/l)	142	141	142	142	142	144	141	142	142
cK+ (mmol/l)	4.5	5.1	4.4	4.1	4.0	3.6	4.5	4.0	3.6
cCa+ (mmol/l)	1.11	0.98	0.97	1.0	1.0	1.04	1.13	1.07	1.04
cCl- (mmol/l)	123	118	118	116	117	120	116	114	112
cLac (mmol/l)	0.4	0.7	0.6	0.8	0.7	0.5	0.6	0.7	0.7
Glucose (mg/dl)	6.1	7.9	7.6	7.5	6.4	5.4	5.9	5.5	5.9
Anion gap (mmol/l)	3.3	3.9	4.7	7.4	5.3	5.3	3.0	3.6	3.1

physical, cardiorespiratory, or neurological deficit.

3. Discussion

To the best of our knowledge, only three other incidences of hyperchloraemic NAGMA following significant absorption of normal saline irrigation fluid during HoLEP have been reported to date. One of these cases was precipitated by a perforated bladder resulting in translocation of a large amount of the irrigating normal saline into the peritoneal cavity,[2] while the other two cases – like our above case – were otherwise uncomplicated HoLEP procedures with no obvious precipitant.[3,4] There has also been one case of NAGMA in a non-surgical setting following continuous bladder irrigation for haemorrhage cystitis.[5]

Our reported complication is distinct from TURP syndrome, where non-electrolyte irrigation fluid (such as glycine-based fluid) causes expansion of the intracellular space and dilutional hyponatraemia. The iso-osmotic nature of normal saline results in its redistribution within – and thus, expansion of – the extracellular space comprising of the intravascular and interstitial compartments. This manifests as oedema, with airway and pulmonary oedema appearing to be earliest clinically discernible signs. Shared risk factors between our case and the two previous reports of this complication include large prostate size (67g–400g) and increased total operation time (>150 minutes). Our patient had a previously-diagnosed obstructive stone and hydronephrosis. Although renal decompression – and thus, significant optimisation of his renal function – had been achieved with a ureteric stent prior to his elective HoLEP procedure, his renal function was off baseline (eGFR 53; baseline 70) on the day of his procedure and this could have impacted his ability to excrete fluid. The ureteric stent remained in place during the procedure and was exchanged at the end of the surgery.

For patients with lengthy procedures, we suggest careful intra-operative monitoring of oxygen requirements and signs of fluid overload, along with continued fluid balance recording which should be communicated by the scrub team to the operating surgeon and anaesthetist at regular intervals during the procedure. Prompt acid-base testing should be performed if there are suspicions of excessive absorption of irrigation fluid. If concerns of NAGMA or fluid overload arise, we recommend IV diuresis with strict negative fluid balance maintained, along with supportive care (which may include ventilatory support and correction of electrolyte abnormalities). In less severe cases with minor respiratory sequelae, IV diuresis may be achievable in the ward setting.

4. Conclusion

Significant absorption of irrigation fluid during HoLEP may result in severe hyperchloraemic NAGMA and fluid overload. Early identification and careful diuresis are recommended for managing this rare complication.

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Consent

Written informed consent was obtained from the patient.

Declaration of conflicts of interest

The authors declare no conflicts of interest.

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