ANAESTHESIA FOR TRANS-URETHRAL PROSTATECTOMY — A REVIEW OF THE PROBLEMS, COMPLICATIONS AND THEIR MANAGEMENT

E. K. Lim

**Department of Anaesthesia,
Singapore General Hospital,
Outram Road, Singapore.**

E.K. Lim, MBBS, FFARCS (Ireland), FFARACS
M. Med (Anaethesia)

SNYOPSIS

The need for continous irrigation of the bladder and prostatic bed in trans-urethral prostatectomy introduces problems and complications during anaesthesia and the immediate post-operative period. A basis for rational anaesthetic management to overcome these problems is presented.

INTRODUCTION

The procedure of trans-urethral surgery entails the excision of tissue and the electro-coagulation of bleeding vessels, both of which are performed with a modified cystoscope. During the process of dissection, the bladder and the prostatic urethra are continuously irrigated so that the operative field can be kept clear, and the dissected tissues can be removed. The complications and the problems that can arise are related to the necessity for irrigation and to the instrumental procedure itself, and these have been well elucidated.[22] A knowledge of the neuro-anatomy of the bladder and the urethra will enable a better understanding of the problems involved and their management.

NEURO-ANATOMY[12]

The bladder and urethra are supplied by both components of the autonomic nervous system.

The sympathetic nervous system (T10 to L3) innervates this region through the superior hypogastric plexus. The motor component of the sympathetic nervous system supplies a continous sheet of muscle stretching from the ureters to the trigonal muscles and finally to the internal sphincter of the bladder. From the trigonal area, sensory fibres pass up to the spinal cord through the sympathetic fibres.

The parasympathetic nervous system (S2 to S4) innervates the region through the pelvic splanchnics or the nervi erigentes. The parasympathetic fibres are motor to the detrussor muscles (the muscles of micturition) and sensory to the bladder neck. In addition to the autonomic nervous system, this region is also supplied by the somatic pudendal nerve (S2 to S4). The pudendal nerve is motor to the

sphincter urethrae (external sphincter) and sensory to the glans penis and urethra.

From the considerations of the neuro-anatomy mentioned above, it will be seen that a block to the thoraric 10 dermatome is essential for complete pain block and for loss of the "capsular sign" during instrumentation and irrigation.

COMPLICATIONS OF TRANS-URETHRAL SURGERY

The main complications of trans-urethral prostatectomy are:—

1. intra-vascular absorption of irrigating fluid
2. significant blood loss
3. perforation of the bladder and urethra

INTRA-VASCULAR ABSORPTION OF IRRIGATING FLUID

In a procedure where numerous venous sinuses are opened and irrigation performed under a pressure head, intra-vascular absorption of the irrigating solution being used is unavoidably present. The dangers associated with intra-vascular absorption are all well documented.[14,21] However, the amount of irrigating fluid which is ultimately absorbed would depend on 4 factors:

1. hydrostatic pressure of the irrigating solution
2. number and sizes of venous sinuses opened
3. duration of operative procedure
4. skill and experience of the endoscopist

Thus, an inexperienced surgeon performing a lengthy and bloody procedure with the irrigating chamber placed a considerable height above the patient's bladder, would result in considerable intra-vascular absorption. Volumetric studies have shown that absorption of up to the patient's blood volume can take place. Aasheim[1], in a review of 146 cases undergoing trans-urethral prostatectomy, reported 2 deaths from intra-vascular absorption. One patient absorbed 4 litres of irrigating fluid into his blood-stream and the other absorbed 7.1 litres. Derangements in fluid and electrolyte during operation and the immediate post-operative period have been the subject of many reviews in the literature.[1,2,14,21]

The propensity for intra-vascular absorption of irrigating fluids brings with it many potential adverse effects. As such, to minimise these adverse effects, it is important to appreciate the qualities of an ideal solution for irrigation. These qualities should include the following:

a) provide good visibility

b) be isotonic

c) be non-electrolytic

d) be non-toxic to local tissues or when absorbed intra-venously

e) be in-expensive

By virtue of the fact that 15 to 20 litres of irrigating fluid is usually used in the average case, the last consideration (of being in-expensive) is important. However, various fluids have been satisfactorily used besides water; these include glucose, urea[8], 1.2% glycine[23], mannitol,[11] sorbitol and Cytal^{R}.[26] (0.54 gm mannitol and 2.7 gm sorbitol in 100 mls) Cytal^{R} appears nearest to the ideal solution for irrigation, fulfilling most of the qualities enumerated for an ideal solution.

Intra-vascular absorption can lead to the following:

1. Over-hydration with cardiac failure and dilutional hyponatraemia. Clinically, the patient presents with dypsnoea, fall in heart rate, rise in pulse pressure and blood pressure, and central nervous symptoms of restlessness, confusion, semi-coma, nausea, retching and headache. A case of paraplegia following trans-urethral surgery has even been reported.[7] The possible cause of paraplegia in this patient has been ascribed to water intoxication causing swelling of spinal cord nerve cells which are adjacent to an epidural metastatic prostatic carcinoma. Ceccorelli and Mantell[2] has shown a lack of time relationship in the production of hyponatraemia.
2. Haemolysis[4], when hypotonic solutions like water is used. Clinically, the patient presents with chills and nausea, haemoglobinuria and anaemia out of proportion to blood loss. Over the next day or two, he can develop haemolytic jaundice.
3. Bacteremia. This occurs when bacteria invade the blood-stream from the infected urinary tract during the process of resection and irrigation. The patient presents with post-operative pyrexia and may go into septicaemic shock. The incidence of bacteremia has been drastically reduced by the administration of antibiotics pre-operatively and post-operatively.[5]

BLOOD LOSS

Assessment of blood loss during trans-urethral surgery poses great difficulties for the anaesthetist because of the following reasons:

1. Visual estimation is almost impossible because of dilution of lost blood with irrigating fluid
2. Classical signs of tachycardia and hypotension seen in haemorrhage may be masked by the bradycardia and mild hypertension due to intra-vascular absorption. Nevertheless, various methods have been advocated in the measurement of blood loss.[10,17,18,24]

The blood loss is aggravated by the defects in the clotting system (involving the fibrinolytic system), which is sometimes seen in patients undergoing prostatic surgery.[19,20] Here, a potent fibrinolytic enzyme (a plasminogen activator) urokinase is liberated.

Prompt replacement of blood loss is important as most patients underoing this operation are elderly and thus have diminished cardiovascular reserves.

PERFORATION

This can be caused by the instrument or can be caused by overdistension of the bladder and the prostatic fossa during the process of irrigation. The clinical manifestations and management of perforation have been well documented by Kenyon.[16]

ANAESTHETIC MANAGEMENT

An awareness of the anaesthetic requirements for trans-urethral surgery, and the complications that can arise, provide the basis for rational anaesthetic management.

1. SUB-ARACHNOID BLOCK with a level between T8 to T10 appears to be the best form of anaesthesia. At this level of block anaesthesia is adequate, cardio-respiratory depression is minimal, and most important of all, subjective signs and symptoms of hypervolemia and perforation are not obtunded. Should spinal block be contra-indicated due to patient's refusal or active neurological disease, general anaesthesia is offered. This can be either under spontaneous respiration was gas-oxygen and inhalational agent, or using mechanical ventilation with gas-oxygen and muscle relaxant. The dangers of too light general anaesthesia should be appreciated as this can cause straining resulting in perforation and more bleeding. In patients breathing spontaneously, it is advisable to give small doses of neuroleptic agents.
2. INFUSION FLUID (intravenous): Hartman Solution 5% Dextrose in Normal Saline Blood, if necessary

Avoid the use of 5% Dextrose in water, as this will aggravate the hyponatraemia following metabolism of the dextrose.

3. MONITOR:

   Mental status
   Blood Pressure
   Pulse
   Respiration
   Blood gas, if necessary
   Serum sodium, if necessary
   ECG

ECG monitoring provide another parameter to forestall the onset of serious hyponatraemia. A serum sodium level of less than 115 mEq/1 can cause S-T segment elevation and widening of the QRS complex. A serum of less than 100 mEq/1 can result in ventricular tachycardia or ventricular fibrillation.

4. TYPE of solution for IRRIGATION. Cytal^{R} appears best. However, many centres still use sterile water owing to economic constraints and also water provide perhaps the best visibility.
5. DURATION OF PROCEDURE should not exceed 1 hour. Should the operation proved to be unavoidably protracted and is beginning to exceed 1 hour, the procedure should be terminated after securing haemostasis. In case of poorly-controlled bleeding, recourse should be made to have open prostatectomy done rather than to risk more intra-vascular absorption and more bleeding. Although we believe time restriction would limit the amount of intra-vascular absorption, Ceccorelli and Mantell have shown no consistent relationship between duration of operation and development of hyponatraemia.[2]
6. Awareness of DILUTIONAL HYPONATRAEMIA. Serum sodium concentration of 120 mEq/1 appears to be the borderline between mild and severe reactions.[15] Before sedating a restless patient, it is necessary to determine the cause of the restlessness. If no obvious cause is found, an immediate serum sodium is done. In any obvious case of over-hydration and hyponatraemia, treatment concists of abandoning the procedure and giving diuretics and digoxin. Some authorities would advocate the use of hypertonic saline,[2] but its use is not without dangers[25] as the hypotonic state can be converted to a hyperosmolar state — and this ultimately increases intra-vascular volumes and aggravate heart failure.
7. Awareness of the possibility of PERFORATION. The patient with his bladder perforated will complained of acute abdominal pain if he is under regional anaesthesia. However, when he is under general anaesthesia breathing spontaneously, the only tell-tale sign of perforation are loss of abdominal relaxation together with tachypnoea or irregular respiration.
8. Post-operative DIURESIS, BLEEDING and INFECTION. Post-operative diuresis is encouraged with frusemide. With a brisk diuresis there is less problems with catheter management. Post-operative blood loss is definitely decreased in

the first 24 hours by administration of EACA[9], which is a competitive of plasminogen, and thus block the fibrinolytic pathway. EACA has the unique property of being filtered at the glomerulus and not being reabsorbed. A dose of 8 gm/day will ensure adequate urine level and low blood level, thus this will stop localised bleeding in the urinary tract. Smart, Turnbull and Jenkins have shown that patients given both EACA and frusemide had a significant reduction in post-operative blood loss, and fewer problems related to catheter management and infection.[27] Post-operative chills and pyrexia should be viewed with caution, and if there is any evidence of septicaemia, full supportive therapy and antibiotics should be instituted.

9. Trans-urethral prostatectomy in the patient with a CARDIAC PACEMAKER. Most patients undergoing prostatectomy are elderly. Desmond[6], in his series of 68 patients, reported that 60% of his patients were between the ages of 70 to 90. Moreover, evidence of myocardial disease were present in 67% of his patients. Bearing these figures in mind, and the fact that the recently-introduced implantable cardiac pacemakers have enabled many patients with complete heart block and Stokes-Adam attacks to have a few more years of useful life, it is not inconceivable that many of these cardiac patients will appear for urological surgery because of prostatic hypertrophy or bladder tumours. Initially, there was fear that the current generated by the electro-surgical unit may interfere with the function of the pacemaker and cause ventricular fibrillation. However, it is now well-known that fixed-rate pacemakers are relatively much safer than demand pacemakers.[3] Greene, Myers and McCallister documented a series of 8 patients with cardiac pacemakers who had trans-urethral surgery done successfully.[13] They proposed that if the following precautions are undertaken, all patients with cardiac pacemakers can undergo trans-urethral surgery safely:-

a) The elctro-cautery ground plate, coated with a thick film of electro-cardiographic electrode jelly should be placed underneath the patient's buttocks to keep the radio-frequency field small.

b) If an external battery pacemaker is used, the pack should be as far removed from the cautery field as possible

c) The wires connecting the electro-cautery knife and the ground plate to the power unit should be perpendicular to the wires of the pacemaker electrodes. This will cause the least electro-magnetic induction.

d) The ECG and the electro-cautery apparatus should be grounded in the same ground, i.e. there should be no potential difference between them

e) Defibrillators, resuscitative equipments and oxygen should always be on standby when patients with cardiac pacemakers are undergoing trans-urethral surgery.

†epsilon-amino-caproic acid

CONCLUSION

It can thus be seen that the procedure of trans-urethral prostatectomy, with its accompanying irrigation, can result in peri-operative and post-operative morbidity and mortality. Spinal block, together with a rational basis of management, can reduce all the adverse risks of the operations to minimal levels.

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