

ANAESTHESIA FOR TRANSURETHRAL RESECTION OF THE PROSTATE (TURP)

Mark Porter, Royal United Hospital, Bath, Bruce McCormick, Bristol Royal Infirmary, Bristol

INTRODUCTION

TURP is a cystoscopic procedure used to alleviate the symptoms of bladder outflow obstruction, usually caused by benign prostatic hypertrophy (BPH). BPH affects 50% of males at 60 years and 90% of 85-year-olds and so TURP is most commonly performed on elderly patients, a population group with a high incidence of cardiac, respiratory and renal disease. The mortality rate associated with TURP is 0.2-6%, with the commonest cause of death being myocardial infarction. Safe anaesthesia depends on the detection and optimisation of co-existing diseases, and on weighing up the relative risks and benefits of regional and general anaesthesia for each patient.

The operation is performed under direct vision using a diathermy current passed through a loop of wire at the tip of a resectoscope, which is inserted into the bladder through the patient's urethra. This enables the hypertrophied prostate to be resected in pieces and washed out using an irrigation solution. The most commonly used irrigation fluid is 1.5 % glycine solution, which has the advantages of being optically clear and non-electrolytic (and therefore does not conduct electric current). It has an osmolarity of 200mOsm/L which is much lower than that of blood, and large amounts of this hypotonic irrigation fluid, required to facilitate the procedure, may be absorbed systemically through the vascular prostate bed. This may cause several serious complications, which are discussed in this article.

PREOPERATIVE ASSESSMENT

Reduced functional reserve should be quantified, and the presence of any organ failure noted. If the patient has ongoing medical problems that can be improved before surgery, then TURP may need to be delayed.

A decision can then be made with the patient between regional and general anaesthesia, based on consideration of the advantages and disadvantages of each technique in their particular case. For some patients the risks of anaesthesia and surgery may outweigh the potential benefits of an elective procedure such as TURP.

History and examination

- **Cardiovascular** - Hypertension, ischaemic heart disease (IHD) and arrhythmias (particularly atrial fibrillation) are common. Patients with recent onset or poorly controlled heart failure have the highest perioperative mortality. Major risk factors for IHD (hypertension, diabetes, smoking, hypercholesterolaemia and family history) will raise the likelihood of silent perioperative myocardial ischaemia.

- **Respiratory** - Marked decrease in functional ability (e.g. inability to climb one flight of stairs) suggests severe disease. Inability to lie flat because of dyspnoea from cardiac or respiratory causes will make awake spinal anaesthesia poorly tolerated.

- **Neurological** - Confused patients may be not lie still during spinal anaesthesia.

- **Musculo-skeletal** - Degenerative changes in the vertebral column may make subarachnoid block (SAB) technically difficult. Arthritic joints or joint replacements are susceptible to damage or dislocation when the patient's legs are placed in the lithotomy position for the procedure.

- **Renal impairment** may occur due to obstructive uropathy

- **Airway** - Even if SAB is planned perform a full anaesthetic assessment (e.g. anticipated airway difficulties) in case the regional technique fails or is inadequate.

- **Drug history** - A high proportion of elderly patients take cardiovascular medications. Beta-blockers suppress the compensatory tachycardic response to hypotension associated with SAB or haemorrhage, but should generally be continued for prevention of perioperative myocardial ischaemia. ACE-inhibitors limit the renin-angiotensin mediated response to hypovolaemia that may be further impaired by SAB, and most anaesthetists omit them for 24 hours preoperatively. Alpha-blockers are commonly encountered as first-line medical treatment for BPH. The combined hypotensive effects of these drugs may precipitate severe hypotension after SAB. Warfarin has implications for both the anaesthetist (regarding SAB) and the surgeon (intra- and postoperative haemorrhage). If the INR is greater than 1.4 the procedure should be postponed until the INR is acceptable.

Investigations

Most patients are elderly and should have as routine:

- Full blood count or haemoglobin level
- Creatinine and electrolytes - this will detect renal impairment or overt renal failure, commonly secondary to obstructive uropathy.
- ECG for symptomatic patients, and routinely over 60 years
- Group and save - consider cross-matching blood for anaemic patients and those suspected of having large prostates on examination or ultrasound scan.

Other tests may be indicated in particular circumstances:

- Clotting studies (prothrombin time if on warfarin)
- Blood gas and pulmonary function tests (severe respiratory disease)
- Chest radiograph (worsening cardiac or chest disease / suspicion of metastases)
- Urinalysis (for glucose, protein, blood, white blood cells)
- Blood glucose

- Test for sickle cell disease or haemoglobinopathies in patients of African or Mediterranean extraction respectively.

CHOICE OF ANAESTHETIC

In the UK, 75% of TURPs are carried out under regional anaesthesia. Although regional anaesthesia in an awake patient has theoretical advantages, such as earlier detection of TUR syndrome (see below), the procedure can be equally successfully accomplished using a general anaesthetic technique. Short-term morbidity and mortality and long-term outcome are similar irrespective of the technique used. The decision is made after consideration of the individual's medical status and detailed discussion of the relative advantages and disadvantages of each technique.

The advantages of the regional technique include:

- Early detection of complications such as TUR syndrome and bladder perforation
- Possible reduced blood loss, requiring fewer transfusions
- Avoids effects of general anaesthesia on pulmonary pathology
- Good early post-operative analgesia
- Reduced incidence of post-operative DVT/PE
- Lower cost

The advantages of general anaesthesia are:

- Patients with chest disease may not tolerate lying flat or be able to suppress their cough
- No time constraints. Although the procedure should be kept as short as possible - see later.
- May be less haemodynamically challenging than SAB in patients with cardiac problems such as aortic stenosis (and other fixed output states) and IHD
- Allows better control of CO₂, which may reduce bleeding from the prostatic bed
- Patient preference.

Anaesthetic Technique

Premedication

Consider relevant premedication if indicated:

- *Analgesics* - give pre-emptive analgesia (paracetamol +/- NSAIDs if not contra-indicated)
- *Anxiolytics* - consider a short-acting benzodiazepine if clinically indicated. In the elderly these drugs may result in postoperative confusion.

All patients should be fully monitored with blood pressure, pulse oximetry and ECG for SAB, including capnography, volatile agent levels, and airway pressure for general anaesthesia. A reliable, large-bore intravenous cannulae (14-16G) should be placed.

Subarachnoid block / spinal anaesthesia. (See Update 12)

- Check for any contra-indications to SAB (see table).

Table 1. Contra-indications to SAB include:

- Patient refusal
- Infection - either localised or generalised (e.g. sepsis)
- Raised intracranial pressure
- Hypovolaemia or shock from any cause
- Coagulopathy - platelet count < 80-100 or INR < 1.5
- Pre-existing neurological disease - postoperative exacerbation of the disease may be erroneously attributed to the SAB

- A fluid preload with 500-1000ml of warmed saline 0.9% or Hartmann's is commonly given. Patients are likely to be dehydrated for a number of reasons including fasting and use of diuretics. Preloading assists compensation of the spinal-induced vasodilation and hypotension, and provides a small sodium load to counter the hyponatraemia that often occurs with TURP (discussed later).

- A confirmed block to at least T10 (level of the umbilicus) is required prior to the start of surgery. 2.5 to 3ml of plain or heavy bupivacaine 0.5% reliably achieves this, and provides up to 3 hours of dense motor and sensory blockade. This level of block does not usually cause severe hypotension, but vasopressors (ephedrine 3- 6mg, or metaraminol 0.5-1mg) should be immediately available. As a general guide, use ephedrine if the pulse is less than 60 per minute, and metaraminol if the pulse is over 60 per minute.

- Heavy lignocaine 5% 1.2-1.4ml can also be used, although the duration of block is unlikely to be reliable after 90min. Do not use lignocaine from multi-dose vials as these contain potentially harmful preservatives. Adding adrenaline 0.2mg to hyperbaric lignocaine will extend the block duration.

- Isobaric plain 2% lignocaine (with 0.2mg adrenaline to extend the block duration) in a dose of 2-2.5mL is also an appropriate choice.

- Consider intra-operative sedation for anxious or confused patients (e.g. IV midazolam 0.5-1mg as needed), but bear in mind that confusion may also be an early manifestation of the TUR syndrome (see later).

- Ideally a thermometer, warming blanket and fluid warmer should be available for the detection and prevention of hypothermia caused by the infusion of cold fluids and the effects of the irrigation fluid.

- All patients should be given supplementary oxygen.

General Anaesthesia

- Either a spontaneously breathing technique using a facemask or laryngeal mask, or a relaxant technique is appropriate, depending on the patient.

- Elderly patients are very susceptible to the hypotensive effects of induction and maintenance agents and have reduced requirements for volatile anaesthetic agents.

- Analgesic requirements can usually be met with pre-operative paracetamol and NSAID and increments of an opioid such as fentanyl, alfentanil or morphine. Further morphine in recovery is seldom required.

- Remember to consider the patient's renal function when using drugs that are excreted renally (e.g. morphine and non-depolarising neuromuscular blocking drugs other than atracurium).

Other considerations

- Following the initial fluid infusion, i/v fluids should be given to replace blood loss. Since irrigation fluid is continually absorbed during the procedure, maintenance fluids are not required.

- Urologists often request antimicrobial prophylaxis to cover the gram-negative bacteraemia. A single intravenous dose of gentamicin 3- 4mg/kg is suitable.

- Where available, consider invasive blood pressure monitoring in patients with severe cardiac disease.

INTRA-OPERATIVE COMPLICATIONS OF TURP

Hypotension

The major complication related to anaesthesia is hypotension following the sympathetic blockade of SAB. This is uncommon with blocks extending to T10, but inadvertently high blocks may cause resistant hypotension and bradycardia is seen if the cardioaccelerator fibres (from T1-4) are blocked. Treatment is with fluid, vasopressors and/or inotropes as detailed above.

TUR Syndrome

This occurs in up to 8% of cases in a mild form, but is severe in 1-2% of cases. Resection of prostatic tissue opens an extensive network of venous sinuses, which allows the irrigation fluid to be absorbed into the systemic circulation. Features may develop preoperatively or in the recovery room.

The volume of fluid absorbed depends on:

- the duration of the procedure (associated with large gland)
- the height of the irrigation fluid bag above the patient (increased height implies increased hydrostatic pressure driving the fluid intravenously)
- the vascularity of the diseased prostate

An average of 10 to 30mL of fluid is absorbed per minute of resection time, amounting to up to 1800ml per hour. The glycine-containing irrigation solution is slightly hypo-osmotic (200mosm/l) and therefore the classical triad of features that make up TUR syndrome are:

1. **Dilutional hyponatraemia.** Encephalopathy and seizures may develop when the sodium concentration falls below 120mmol/l. Cerebral oedema may occur.
2. **Fluid overload.** This causes pulmonary oedema and cardiac failure.
3. **Glycine toxicity.** This inhibitory neurotransmitter causes depression of the level of consciousness and visual impairment at toxic levels.

Symptoms and signs of TUR Syndrome:

- tachycardia
- nausea and vomiting - caused by hyponatraemia and cerebral oedema
- confusion / disorientation - hyponatraemia and cerebral oedema
- hypertension (fluid overload), then hypotension (cardiac insufficiency)
- transient blindness - glycine toxicity
- angina
- dyspnoea and hypoxia caused by pulmonary oedema
- cardiovascular collapse and arrhythmias (VT/VF)
- convulsions
- coma (Na <100mmol/l)

If the patient is under general anaesthesia all of the symptoms and some of the signs are masked, and only unexplained tachycardia and hypotension may be present.

Factors which increase the risk of TUR syndrome

- pre-existing hyponatraemia or pulmonary oedema
- prostate size larger than 60-100g
- inexperienced or slow surgeon
- procedures longer than 1 hour
- hydrostatic pressure > 60cm H₂O (height of bag above patient)
- reduced venous pressure (dehydration)
- use of large volumes of hypotonic intravenous fluids such as 5% dextrose

It is difficult to accurately assess the volume of irrigation fluid that has been absorbed. Early detection of the problem is therefore dependent on being aware of the high-risk situation and continuous observation for the signs and symptoms of TUR syndrome. Attempts should be made to keep the surgical time below one hour. In some countries, the irrigation fluid has a small amount of alcohol added, which allows an estimation of absorbed fluid from an alcohol measurement on the patient's expired breath.

Investigations

A low serum sodium can confirm the diagnosis. Levels below 120 mmol/L are invariably symptomatic and a rapid fall is more likely to produce symptoms. ECG manifestations of hyponatraemia such as QRS widening, ST segment elevation and T wave inversion usually only occur below 115mmol/l. Hyperammonaemia is a common finding, being a by-product of glycine metabolism. A low serum osmolality and high anion gap (see Table 2), caused by the presence of glycine may be present.

Management

- Initial management should follow the airway, breathing and circulation (ABC) guidelines. Awake patients may need to be sedated and ventilated, whilst anaesthetised patients with mask airways may need intubation and positive pressure ventilation.
- Inform the surgeon and terminate surgery as soon as any bleeding points have been coagulated.

Table 2: Anion Gap

The term 'anion gap' is a diagnostic concept that is used to describe the concentration of all unmeasured anions in the plasma. The following simple formula is used to calculate the anion gap:

$$\begin{aligned} \text{Anion gap} &= [\text{Na}^+] - [\text{Cl}^-] - \text{HCO}_3^- \\ &= 140 - 105 - 25 \\ &= 10 \end{aligned}$$

The normal range is 4-12. In normal circumstances, negatively charged plasma proteins (such as albumin) make up the majority of this value. But any increase in unmeasured anions (such as glycine) will cause a 'raised anion gap'. A common example of such a situation is a metabolic acidosis, during which acidic anions such as lactates and ketones (which are not routinely measured) accumulate thus producing a surplus of unmeasured anions and a 'raised anion gap'.

Its major use is to signal the presence of an acidosis, and to differentiate between causes of a metabolic acidosis. The anion gap *increases* in acidosis caused by accumulation of organic anions such as in a lactic acidosis and ketoacidosis. It remains unchanged in acidosis due to loss of bicarbonate or increase in Cl^- .

- Initial management of fluid overload and hyponatraemia involves stopping IV fluids and commencing a fluid restriction (e.g. 800ml/24 hours can achieve a rise in the sodium level of up to 1.5mmol/l/24 hours). Give frusemide 40mg IV to promote a diuresis.
- Hyponatraemia causing encephalopathy requires more rapid correction than that achieved by fluid restriction and diuresis alone. Ideally these patients should be closely monitored on an intensive care unit. Hypertonic saline solutions (1.8%, 3% or 5%) should be used to increase the serum sodium level by about 1 mmol/l/hour, not exceeding an increase of 20mmol/l in the first 48 hours of therapy. Sodium levels should be checked every few hours. Therapy with hypertonic saline should be stopped when symptoms cease or the sodium level reaches 124-132mmol/l. Rapid correction has been implicated as a cause of central pontine myelinolysis, which causes irreversible brain damage.
- Convulsions should be acutely treated with a benzodiazepine (e.g. diazepam 5-10mg) or small doses of thiopentone (25 - 100mg). In the presence of intractable seizures, the sodium level may be corrected more rapidly at a rate of up to 8-10mmol/l/hour for the first 4 hours of therapy.

Haemorrhage

Blood loss is very difficult to quantify. The amount lost is related the mass of gland excised, the duration of the procedure and the experience of the operator. In practice, clinical judgement based on duration of procedure, mass of prostate excised, the patient's vital signs and communication with the surgeon are invaluable. If available, serial haematocrit levels are the most sensitive indicators of the need for transfusion. Haemoglobin and electrolytes should be measured the following day to exclude sub-clinical anaemia and hyponatraemia.

Severe blood loss during TURP occurs in less than 1% of cases. This may be the result of clotting abnormalities caused by the release of tissue plasminogen activator from the prostate and is possibly more common in malignant prostates. Anti-fibrinolytics

such as intravenous tranexamic acid and aprotinin can be used to minimise active blood loss.

Bladder Perforation

This complicates about 1% of cases of TURP. Most perforations are extraperitoneal and result in suprapubic, inguinal or peri-umbilical pain in the awake patient. The surgeon may notice reduced return of irrigation fluid from the bladder. Intraperitoneal perforation is far less common, but more serious. In these cases the abdominal pain is generalised, and the patient may complain of shoulder-tip pain. Pallor, sweating, peritonism, nausea and vomiting, and associated hypotension may be present, depending on the size of the perforation. Perforation may present as sudden, unexpected hypotension under general anaesthesia. Management consists of immediate laparotomy and correction of the defect.

Hypothermia

The additive effects of general anaesthesia, the use of room-temperature IV fluids and large volumes of irrigation fluids leave elderly patients hypothermic. All irrigation fluid should be warmed to body temperature prior to use. Post-operative shivering can cause massively increased myocardial oxygen requirements, reduction in cardiac output and a coagulopathy.

Bacteraemia and sepsis

In as many as 6-7% of patients, a septic picture may develop. Septic shock following TURP is rare but has a mortality rate up to 75%. Antimicrobial prophylaxis with a single dose of gentamicin 3 - 4mg/kg on induction is appropriate. Cephalosporins may also be used.

Positioning

The lithotomy position may cause nerve compression (especially involving the common peroneal nerve from pressure effects exerted by the stirrups), dislocation of hip prostheses, compartment syndrome in the lower legs and respiratory compromise in patients with pre-existing lung disease (reduction of functional residual capacity.)

CASE HISTORY - TURP Syndrome.

A 75 year old hypertensive male with a history of stable angina presented for TURP. Preoperative assessment revealed a good effort tolerance with no symptoms of cardiac failure, and a history of smoking 20 cigarettes/day for 30 years. Blood results, ECG and chest X-ray were unremarkable.

In the operating room, routine monitoring was commenced, and a spinal anaesthetic inserted after a preload of 500mL saline. Oxygen was given via a Hudson mask. Surgery began after the block was confirmed to be at T8 level.

Sixty minutes into the procedure, the patient complained of nausea and was given ondansetron 4mg IV. The heart rate was noted to have increased to 106bpm. Blood pressure remained within normal limits. After another 15 minutes, the patient became anxious, pulled his oxygen mask off and tried to get off the operating table. Oxygen saturation levels dropped quickly without oxygen. An urgent blood gas showed pH 7.33, pCO₂ 5.6, pO₂ 8.8, BE-2.8, Na 109mmol/L, Hb 9.2g/dL. A diagnosis of TURP syndrome was made on the grounds of hyponatraemia. Severe respiratory distress ensued, with the patient unable to maintain adequate oxygen saturation on high flow oxygen. Pulmonary oedema was diagnosed clinically. The patient was intubated and ventilated and surgery terminated. Transfer to the ICU was arranged urgently and frusemide 40mg i/v was given.

On arrival in ICU, the patient's temperature was 33.8 degrees. Arterial and central venous catheters were inserted, and re-warming with a hot air blower commenced. CXR showed an enlarged heart with pulmonary oedema. The hyponatraemia was treated with 3% saline via the CVP line at an initial rate of 100mL/hr. One hour later the sodium level measured 116mmol/L. The 3% saline infusion was changed for a 1.8% saline infusion at 50mL/hr. Within 24 hrs the sodium level stabilised at 127mmol/L. Pulmonary oedema resolved with frusemide boluses. After 36 hours on the ventilator, blood gases showed pO₂ = 12.6 on 30% oxygen and he was extubated uneventfully. Forty-eight hours after admission to ITU the sodium level was 132mmol/L. The patient was discharged to the ward where he made a full recovery.

Learning point

- Rapid management of the patient's ABC allowed immediate treatment of the TUR syndrome
- Surgery was completed as soon as the complication developed
- Hypertonic saline was indicated for the very low sodium level associated with CNS signs.
- The hypertonic saline was used carefully with repeated estimates on the serum sodium being performed.

Erection

This may occur as a result of surgical stimulation when anaesthesia is insufficiently deep and makes cystoscopy technically difficult. The erection usually subsides with deepening of anaesthesia, although low-dose ketamine may be tried if it persists.

POST-OPERATIVE COMPLICATIONS

Hypothermia, hypotension, haemorrhage, septicaemia and signs and symptoms of TUR syndrome can all present in the recovery room. Patients may become acutely hypotensive after lowering their legs from the lithotomy position because the reduction in venous return. Persisting hypotension that is unresponsive to fluid therapy, in the absence of excessive blood loss, may indicate bladder perforation. The symptoms of this may be masked by residual sub-arachnoid block.

Bladder spasm is a painful, involuntary contraction of the bladder caused by stimulation of the bladder neck by the indwelling catheter. The flow of irrigation fluid via the catheter often reduces, preventing the bladder from draining completely and aggravating the pain. Low-doses of a benzodiazepine such as diazepam (2.5-5mg i/v), is often effective in relieving the spasm. Hyoscine butylbromide (Buscopan) 20mg i/v slowly may also be tried.

Clot retention. Bladder clot may block the catheter causing painful distension of the bladder. If the clot cannot be dislodged with aggressive bladder washouts using the three-way tap on the catheter, it may be necessary to insert a supra-pubic catheter.

ALTERNATIVE TECHNIQUES

Open prostatectomy is the operation of choice when the prostate is either malignant, or is considered too large (more than 100g) to be removed safely transurethrally. It is performed either by a retropubic (more common) or suprapubic approach through a Pfannenstiel incision. Blood loss is usually greater than in TURP and cross-matched blood should be readily available. Epidurals provide the best post-operative analgesia. Duration of procedure, hospital stay, complication rates and recovery period are all greater for open prostatectomy, making TURP a more preferable option.

Laser prostatectomy is a new technique that uses a Holmium-YAG laser to resect the prostate instead of a diathermy current. Bleeding complications are thought to be less than with a normal resectoscope.

SUMMARY

- TURP is a procedure carried out on a predominantly elderly population with a higher incidence of coexisting disease. Consequently anaesthetising for the procedure may present a challenge to the anaesthetist, and carries a mortality risk of 0.2-6%.
- A thorough preoperative assessment is important in detecting at-risk patients, and helping to choose your anaesthetic technique. SAB is widely considered the most suitable technique for TURP, although GA has a similar morbidity and mortality profile.
- Subarachnoid block to T10 provides excellent anaesthesia without notable hypotension
- TUR syndrome is a rare but potentially fatal complication of TURP. Early recognition and prompt treatment are essential.

- Blood loss is difficult to quantify and may be significant. Close attention to the patient's clinical state and communication with the surgeon are vital.

Further Reading

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