Can J Anesth/J Can Anesth (2014) 61:273–277
DOI 10.1007/s12630-013-0092-7

SPECIAL ARTICLE

From the *Journal* archives: Complications of transurethral prostatic surgery: back to the future?

Étienne de Médicis, MD

Received: 30 July 2013 / Accepted: 25 November 2013 / Published online: 4 December 2013

Editors' Note: Classics Revisited

Key Articles from the *Canadian Journal of Anesthesia* Archives: 1954-2013

As part of the *Journal's* 60th anniversary Diamond Jubilee Celebration, a number of seminal articles from the *Journal* archives are highlighted in the *Journal's* 61st printed volume and online at: www.springer.com/12630. The following article was selected on the basis of its novelty at the time of publication, its scientific merit, and its overall importance to clinical practice: *Desmond J.* Complications of transurethral prostatic surgery. Can Anaesth Soc J 1970; 17: 25-36. Dr. Étienne de Médicis provides expert commentary on the historical context of this article.

Hilary P. Grocott MD, Editor-in-Chief
Donald R. Miller MD, Former Editor-in-Chief

Summary

Author *John Desmond MBBS FRCP(C)*

Citation *Complications of transurethral prostatic surgery. Can Anaesth Soc J 1970; 17: 25-36.*

Purpose *To review complications of transurethral resection of the prostate (TURP) as they pertain to anesthesiologists.*

Principal findings *In this article published in January 1970 in the Canadian Anaesthetists' Society Journal, now the Canadian Journal of Anesthesia (the Journal), the author reviews complications relating to TURP, including age group, cardiovascular status, plasminogen activation, bacteremia, hemorrhage, too-light general anesthesia, perforation of the bladder, inadvertently high spinal anesthetic, the danger of using vasopressors, and burns. Complications involving the endocrine system, erection, adductor spasm, explosions, and hypothermia are also mentioned. Furthermore, there is a detailed discussion regarding the composition of the irrigation solution and the effects of its intravenous absorption on the cardiovascular system and on serum osmolality and natremia. The results of slow absorption of irrigation fluid at the prostatic level combined with good left-ventricular function are associated with slight dilutional hyponatremia ($\leq$ 10 mEq·L^{-1}) and a good outcome. Rapid absorption of irrigation fluid and/or poor left-ventricular function in the context of possible acute blood loss, hypotension following spinal anesthesia, or myocardial depression with general anesthesia can lead to a marked drop in osmolality and more severe dilutional hyponatremia. This may lead to cerebral edema, pulmonary edema, heart failure, and cardiovascular collapse. In a series of 72 randomly chosen patients at the author's institution, 18 patients experienced a reduction in serum sodium of $>$ 10 mEq·L^{-1}; eight patients experienced a reduction of $>$ 20 mEq·L^{-1}, and two patients experienced a decrease in both osmolality and natremia, with both developing cerebral and pulmonary edema.*

Conclusions *With an understanding of the possible complications and physiological implications of TURP, anesthesiologist caring for such patients may help reduce adverse outcomes or decrease their impact with proper management. In the late 1960s, mortality at the author's institution was reduced from 1.5-0.4% in three years.*

É. de Médicis, MD (✉)
Département d'Anesthésiologie-Réanimation, Centre Hospitalier Universitaire de Sherbrooke, 3001 12e Avenue Nord, Sherbrooke, QC J1H 5N4, Canada
e-mail: estria1@cgocable.ca

Anesthesiologists know that transurethral resection of the prostate (TURP) is far from being a benign procedure. It has been performed since the 1930s when its 30-day mortality was calculated at 5%.[1] These days, a favourite staff assignment is testing residents about their knowledge and management of the well-known complications of TURP syndrome. In this context, the review article, *Complications of* transurethral prostatic surgery, by John Desmond published in January 1970[2] summarized the accumulated knowledge about complications of this procedure and clearly laid the foundation for the pathophysiology and treatment of TURP syndrome.[3]

This article is partly a review paper with a basic science section and a pathophysiology section, but it also consists of a case report, a series of short investigations of patients undergoing TURP, and a quality (mortality) review at the author's own institution.

The multiple investigations performed in this patient population reflect the highly scientific, inquisitive, and surprisingly innovative mind of John Desmond.

Desmond begins his article by recapping a paper previously published in 1962[4] and then presents his own list of complications of TURP (Table).

He continues his fascinating narrative by describing various issues— which he considers more significant — in further detail, highlighting them with various reports from his institution.

After a short description of the procedure, Desmond discusses and asserts the benefit of using glycine and cytal (sorbitol) for the irrigation fluid. He states that "water as an irrigation fluid must be condemned." Due to cost issues, he considered cytal ideal for small institutions and glycine preferable for large ones (at that time, 140 L·day^{-1} at the Toronto General Hospital). In the first series that Desmond presents in over 400 patients "which have been closely followed by the authors and in which large amounts of irrigant were absorbed with marked falls in plasma sodium levels, we saw none of the toxic signs and symptoms referred to by other investigators"[2] (i.e., glycine and its metabolism into ammonia with its ensuing toxicity, including visual disturbances).

Desmond describes the demographic (age) and cardiac status of the patients studied at his institution, and he provides tables with particulars of the patients undergoing TURP, including age breakdown of 68 patients (60% were older than 70 yr) and cardiac status of 60 patients (two-thirds had evidence of myocardial ischemia or cardiac arrhythmia). Electrocardiogram findings on more than one-third of patients showed a history of myocardial infarction, 3% showed complete heart block, 10% showed bundle branch block, and 16% showed myocardial ischemia, hypertension (in the 1970s, hypertension was defined as systolic blood pressure > 100 + age and was rarely treated below 165/95), or ventricular extrasystole. As it was then, it remains today, in other words, TURP patients are older with more morbidity.

Desmond deals at length with vascular overloading with irrigation fluid and the effects of intravascular absorption of irrigation solutions. After a short description of the factors influencing the amount and rate of absorption of irrigation fluid (size of the prostate, duration of the procedure, number of sinuses open, irrigation fluid pressure, experience of the surgeon, congestion of the prostate, and presence of infection), he explains the physiology/pathophysiology of vascular "hyperhydration". It is well tolerated by patients with good cardiovascular status (hence his description and table on cardiac status) and with slow irrigant absorption. If there is either poor left ventricular function or rapid irrigant absorption, the volume of the intravascular compartment may increase, and there may be a decrease in osmolality and natremia, possibly resulting in cerebral edema, pulmonary edema, and cardiovascular collapse (Figure). At the time, right ventricular failure or diastolic dysfunction were not well recognized. In the case of decreased osmolality and natremia, Desmond suggests diuretics and 5% hypertonic saline (855 mEq·L^{-1}). Desmond did not recognize the direct effects of hyponatremia on the central nervous system, and there was no discussion on the speed of

Table Reproduced with permission from: *Desmond J.* Complications of transurethral prostatic surgery. Can Anaesth Soc J 1970; 17: 25-36

COMPLICATIONS OF PARTICULAR INTEREST TO THE ANAESTHETIST
1. Non-specific
cardiovascular system
central nervous system
respiratory system
endocrine systems
2. Intravenous infusion
through prostatic veins
irrigating solution
plasminogen activators
bacteria
3. Haemorrhage
4. Perforation
extraperitoneal
intraperitoneal
urethra
5. Erection
6. Adductor spasm
7. Burns
8. Explosions
9. Hypothermia
10. Too-light general anaesthesia
11. Vasopressors

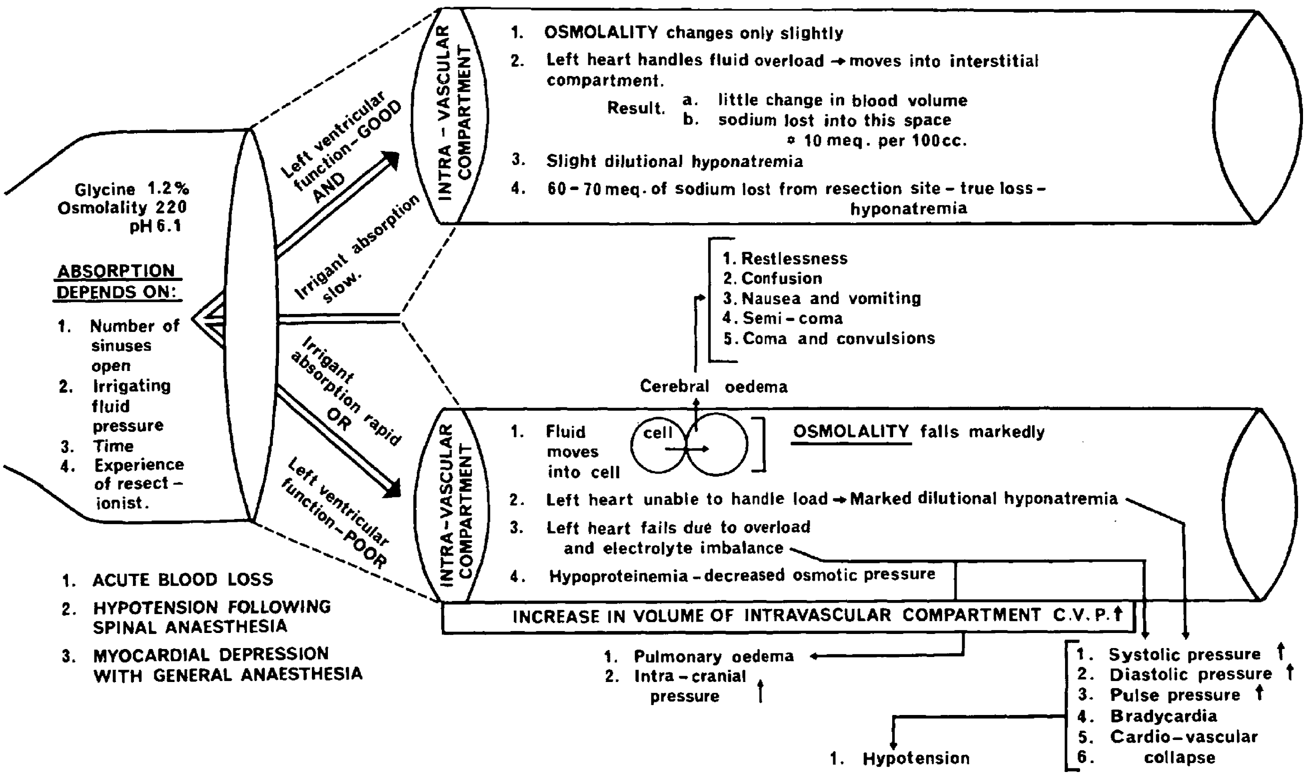

Figure Reproduced with permission from: *Desmond J.* Complications of transurethral prostatic surgery. Can Anaesth Soc J 1970; 17: 25-36

remedying hyponatremia. As mentioned in the above summary, he did provide results on 72 randomly chosen patients. Natremia decreased more than 10 $mEq{\cdot}L^{-1}$ in 18 patients and more than 20 $mEq{\cdot}L^{-1}$ in eight patients. Both natremia and osmolality decreased in two patients (3%) with concurrent pulmonary and cerebral edema.

In his discussion on plasminogen activation, Desmond mentions using epsilon-aminocaproic acid with good results in the case of active bleeding in the recovery room. A short MEDLINE® search with the search words, “tranexamic acid” and “transurethral resection of the prostate”, yielded two articles in the past ten years.[5,6] It is not used in this reviewer’s institution.

In Desmond’s discussion on bacteremia, he describes performing blood culture tests on all patients who shivered in the operating room or the recovery room; however, results showed no positive blood culture (numbers not provided). He points out that early shivering is most likely due to halothane anesthesia, a reaction to a cold blood transfusion, a cerebrovascular accident, or spinal anesthesia. Still, his institution experienced a 3% rate of gram-negative septicemia in the first 36-hr postoperative period, and Desmond reinforced the importance of sterility in all steps of the procedure.

In his brief discussion on hemorrhage, Desmond refers to one of his previously published papers.[7] In an impact study on measuring blood loss, he commented that the amount of blood transfused in an eight-month period decreased by two-thirds compared with the previous eight-month period.

When addressing the issue of too-light general anesthesia, Desmond commented on the inadequacy of the anesthetic technique of using N_20/halothane following induction with thiopentone, the need for an analgesic, innovar (a mixture of fentanyl and droperidol), and the importance of keeping the patient comfortable in the recovery room: “The importance of this latter condition cannot be stressed enough. To see a patient shivering and straining in the recovery room with severe muscle rigidity and blood pouring from his catheter is not very pleasant.”

In his discussion on signs and symptoms of perforation of the bladder, Desmond follows the classification proposed by Nesbitt *et al.* in 1966, i.e., intraperitoneal and extraperitoneal extravasation into periprostatic tissue.

The most controversy surrounds Desmond’s commentary regarding inadvertently high spinal anesthetic and the danger of using vasopressors. In his view, vasopressors, by shutting down the patient’s arterioles, impede the removal of the irrigant fluid absorbed through the venous sinuses, causing heart failure: “… the use of vasopressors to raise the blood pressure at the expense of closing down the peripheral arterioles must be deplored.” Desmond describes a case of a patient given spinal anesthesia and four doses of VASOXYL® (methoxamine hydrochloride) who, after

30 min of prostate resection, needed tracheal intubation for pulmonary edema and hyponatremia (110 $mEq \cdot L^{-1}$). He advised a reverse Trendelenburg position during the injection of the spinal solution to prevent hypotension and recommended cancellation of the case if hypotension occurred.

Desmond finishes his article by describing the potential complication of burns. If the jelly of the grounding plate should dry (i.e., there is no hydrogel cautery pad), resistance to the current would increase and place the patient at risk of a dermal burn at the point of contact. The following is a tribute to the surgeon (urologist)/ anesthesiologist collaboration: "A gowned and gloved surgeon cannot check the ground plate-patient contact. An astute and helpful anaesthetist can do this for him."

In his conclusion, Desmond states, "It should have become apparent by now that much of the morbidity and mortality associated with this type of surgery can be avoided with proper understanding and management. It is an operation in which the surgeon and the anaesthetist must be aware of and at all times alert to the dangers confronting the patient." This was true then and is still true today. As a final investigation, he states, "In our institution we have reduced the morbidity considerably and the mortality during the past three years from 1.5 to 0.4 per cent." Indeed, this was published in January 1970. In a current textbook, mortality was quoted as 1.3% in 1974 and reduced to about 0.2% today.[1]

The TURP syndrome has been defined as complications secondary to intravascular absorption of irrigation fluid.[3] Desmond states that these complications are not easy to deal with: "There is (…) no classic triad which we can depend on to guide us. It has been our experience (…) that measurements of blood pressure, pulse central venous pressure, blood loss, serum osmolality, plasma electrolytes and hematocrits are all necessary and important if proper evaluations are to be made with regards to the clinical conditions of the patient at any particular time."[2] Where are we 43 years later?

The basic pathophysiology has been well defined in Desmond's article, and more emphasis has been placed on both glycine and ammonia toxicity in more recent publications.[3] There has been some debate regarding the rate of hyponatremia correction. With the feared complication of central pontine myelinolysis, the suggested rate is 1.5 $mmol \cdot L^{-1} \cdot hr^{-1}$. Others have reported that the pathophysiology of chronic hyponatremia is different from that of acute hyponatremia and that, at the time, there was no report of demyelinating lesions after correction of acute hyponatremia in patients undergoing TURP.[8] With time, more emphasis is being placed on regional anesthesia, as this enables anesthesiologists to detect the early signs of central nervous system toxicity, visual disturbances, or shoulder pain secondary to bladder perforation.[9] The consensus of some experts is that neuraxial anesthesia in patients undergoing TURP reduces mortality (moderate evidence) and morbidity (strong evidence).[10] Finally, the basic concept of TURP syndrome has expanded in all surgeries in which there is a significant risk of intravascular absorption of irrigation fluid, (e.g., hysteroscopy).[11] Back to the future? We were already there in 1970.

Key points

- Transurethral resection of the prostate (TURP) dates back to the 1930s.
- Complications of TURP relating to the general health of the patient (mainly cardiac status) were well recognized in the early 1970s.
- Complications of TURP relating to the absorption of the irrigation solution (i.e., volume and composition) were well understood in the 1970s and eventually led to the full description of TURP syndrome.
- Although pharmaceutical agents may have evolved since the early 1970s, the basic management of patients undergoing a TURP has not changed.

Funding sources None.

Conflicts of interest None declared.

References

1. *Barash PG, Cullen BF, Stoelting RK, Cahalan MK, Stock MC*. Clinical Anesthesia Sixth Edition. Wolters Kluwer/Lippincott Williams & Wilkins; 2009: 1365-74.
2. *Desmond J*. Complications of transurethral prostatic surgery. Can Anaesth Soc J 1970; 17: 25-36.
3. *Gravenstein D*. Transurethral resection of the prostate (TURP) syndrome: a review of the pathophysiology and management. Anesth Analg 1997; 84: 438-46.
4. *Marx GF*, *Orkin LR*. Complications associated with transurethral surgery. Anesthesiology 1962; 23: 802-13.
5. *Al'-Shukri SKh*, *Goloshchapov ET*, *Lukichev GB*. Application of fibrinolysis inhibitor tranexam in transurethral resection of the prostate (Russian). Urologiia 2011; 2: 41-3.
6. *Rannikko A*, *Petas A*, *Taari K*. Tranexamic acid in control of primary hemorrhage during transurethral prostatectomy. Urology 2004; 64: 955-8.
7. *Desmond JW*, *Gordon RA*. Bleeding during transurethral prostatic surgery. Can Anaesth Soc J 1969; 16: 217-24.
8. *Jensen V*. The TURP syndrome. Can J Anaesth 1991; 38: 90-7.
9. *Malhotra V*. Transurethral resection of the prostate. Anesthesiol Clin North America 2000; 18: 883-97.
10. *Breivik H*, *Bang U*, *Jalonen J*, *Vigfusson G*, *Alahuhta S*, *Lagerkranser R*. Nordic guidelines for neuraxial blocks in

disturbed haemostasis from the Scandinavian Society of Anaesthesiology and Intensive Care Medicine. Acta Anaesthesiol Scand 2010; 54: 16-41.

11. *Mushambi MC*, *Williamson K*. Anaesthetic considerations for hysteroscopic surgery. Best Pract Res Clin Anaesthesiol 2002; 16: 35-51.