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Urology

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Diagnostic Transurethral (Endoscopic) Procedures

Surgical Considerations

Description: Many urologic diseases are diagnosed and evaluated endoscopically through the urethra with the use of specialized instruments, such as cystoscopes and resectoscopes. With the patient in a lithotomy position, the cystoscope is introduced into the urethra and advanced under direct vision all the way into the bladder (Figs 9-1, 9-2), allowing inspection of the urethra (**urethroscopy**) and bladder (**cystoscopy**). If pathology is noted, a biopsy can be obtained easily through the cystoscope. It is also possible to introduce a small catheter into the ureteral orifice and advance it up to the kidney for radiologic evaluation (**retrograde pyelography**) to collect a urine specimen or to bypass areas of obstruction. If the upper urinary tract needs to be visualized, a ureteroscope is introduced through the urethra into the bladder and through the ureteral orifice into the ureter and advanced up to the kidney, allowing inspection of the ureter (**ureteroscopy**) and intrarenal collecting system (**nephroscopy**). These procedures often precede a major surgical operation.

Usual preop diagnosis: Hematuria; hydronephrosis; benign prostatic hypertrophy; cancer of the urethra, prostate, bladder, ureter, and renal pelvis; urinary tract stones; strictures; ureteropelvic junction obstruction; hemorrhagic or interstitial cystitis

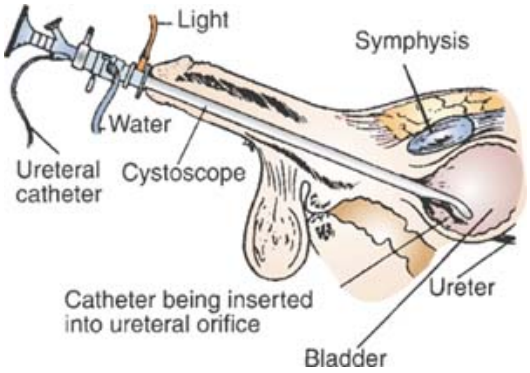

Figure 9-1. Cystoscope introduced into bladder via urethra (male anatomy). (Reproduced with permission from Hardy JD: *Textbook of Surgery*. JB Lippincott, 1988.)

Summary of Procedures

	Urethroscopy/Cystoscopy	Ureteroscopy/Nephroscopy
Position	Lithotomy	
Incision	None	
Special instrumentation	Cystoscope	Ureteroscope
Unique considerations	Use of x-ray and fluoroscopy	
Antibiotics	Gentamicin 80 mg iv, slowly	
Surgical time	15 min	45 min
EBL	None	
Postop care	PACU → home	
Mortality	Minimal	

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Morbidity	Infection: 5%	Ureteral perforation: < 5%
Pain score	1	1

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Patient Population Characteristics

Age range	All ages	
Male:Female	1:1	
Incidence	30% of all urologic procedures	
Etiology	Hematuria Urethral and bladder tumors Stones Urethral strictures	
Associated conditions	Prostatic hypertrophy Cystitis	Ureteropelvic junction obstruction Hydronephrosis

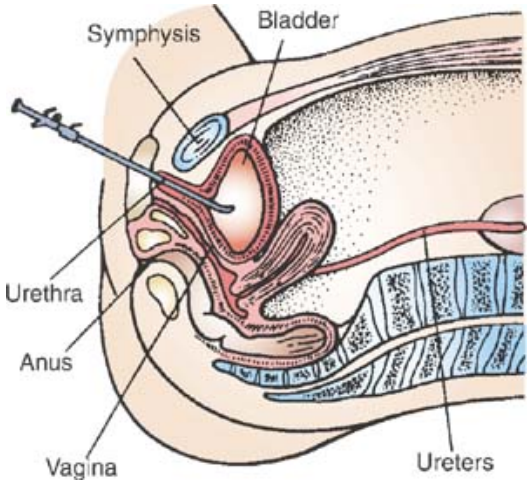

Figure 9-2. Cystoscope introduced into bladder (female anatomy). (Reproduced with permission from Govan DE: *Roche Manual of Urologic Procedures*. Hoffmann-LaRoche, 1976.)

Anesthetic Considerations

See Anesthetic Considerations following Therapeutic Transurethral Procedures (Except TURP), p. 861.

Suggested Readings

1. Bagley, DH: Ureteroscopy. In *Smith's Textbook of Endourology,* Vol 1, 1st edition. Smith AD, Badlani G, Bagley D, et al, eds. Quality Medical Publications, St. Louis: 2000, 369–513.

2. Wein AJ et al: Basics of urologic surgery. In: *Campbell-Walsh Urology,* 9th edition. WB Saunders, Philadelphia: 2006.

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Therapeutic Transurethral Procedures (Except Turp)

Surgical Considerations

Description: Therapeutic transurethral procedures, the most common urologic operations, require the use of specialized instruments, such as cystoscopes and resectoscopes. Because of continuously improving instrumentation and fiber optics, the range and complexity of these operations are widening, and more operations are being done transurethrally now than ever before. These operations are: **transurethral resection** (**TUR**) of any urethral, prostatic or bladder pathology; **fulguration** of bleeding vessels; **instillation of chemicals,** such as oxychlorosene (Chlorpactin) and formalin, into the bladder; **extraction** of stones; and **incision and dilation** of strictures.

With the patient in the lithotomy position, the cystoscope or resectoscope is introduced into the urethra and advanced under direct vision into the bladder, allowing inspection of the urethra and bladder (Figs 9-1 and 9-2). The pathology is identified. If it is a tumor, it is resected piecemeal with the electrode of the resectoscope, using the cutting current and cauterizing the base of the tumor with the coagulating current. If the pathology is a stone, it is extracted with special forceps or a stone basket. Large stones have to be fragmented, prior to extraction, with a mechanical lithotrite, electrohydraulic probe, ultrasound lithotrite or laser (Holmium or pulsed-dye). Chemicals can be instilled through the cystoscope to control interstitial and hemorrhagic cystitis. Bleeding vessels can be coagulated with the electrode. Strictures of the urethra can be dilated or incised with an endoscopic knife. Strictures of the ureter also can be treated endoscopically by dilatation with a balloon catheter or by incision with electrocautery. Balloon catheters with attached cutting electro-wires (Acucise) often are used. A temporary ureteral stent is placed at the end of most endoscopic ureteral surgeries.

Variant procedure or approaches: Occasionally, access to the intrarenal collecting system (renal pelvis and calyces) and upper ureter is easier and more appropriately done by a **percutaneous nephrostomy** than a transurethral procedure. The patient is placed in a prone or flank position, a percutaneous stab wound is made at the costovertebral angle, and a tube is introduced into the kidney under fluoroscopic control.

Usual preop diagnosis: Tumors of the urinary tract; stones; interstitial or hemorrhagic cystitis; strictures

Summary of Procedures

	Transurethral	Percutaneous
Position	Lithotomy	Flank or prone
Incision	None	Stab wound
Special instrumentation	Cystoscope; resectoscope; catheters; stents	Percutaneous nephrostomy kit; nephroscope; urethroscope; catheters; stents
Unique considerations	Use of x-rays, fluoroscopy, and electrocautery	
Antibiotics	Gentamicin 80 mg iv, slowly	
Surgical time	1 h	2–3 h
EBL	100 mL	500 mL
Postop care	Irrigation of tubes and catheters to clear clots and prevent obstruction	
Mortality	< 1%	
Morbidity	Bleeding: 10% Infection: 5% Perforation: 2% Retained stones: 2%	
Pain score	1	3

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Patient Population Characteristics

Age range	All ages

Male:Female	1:1	
Incidence	10% of urologic diseases involve these procedures	
Etiology	Urethral and bladder tumors; bladder and ureteral stones; interstitial cystitis; hemorrhagic cystitis; urethral stricture	Kidney stones; upper ureteral stones; ureteropelvic junction obstruction

Anesthetic Considerations for Transurethral Procedures (Except Turp)

Preoperative

Patients of all ages may present for ureteral stone extraction. Paraplegics and quadriplegics have a predilection for nephrolithiasis and may present for repeated cystoscopies. Bladder tumors usually are seen in older patients, who may present for cystoscopy or TUR. These patients may have preexisting medical problems, including CAD, CHF, PVD, cerebrovascular diseases, COPD, and/or renal impairment. Preop evaluation should be directed toward the detection and treatment of these conditions prior to anesthesia.

Neurological	Paraplegics and quadriplegics may present for repeated cystoscopies and stone extractions. Note Hx of autonomic hyperreflexia; Sx may include flushing, headache, and nasal stuffiness, associated with voiding or noxious stimuli below the level of spinal cord injury (see below).
Musculoskeletal	Contractures and pressure sores may make positioning difficult in paraplegics or quadriplegics.
Laboratory	Tests as indicated from H&P.
Premedication	Sedation prn anxiety (e.g., lorazepam 1–2 mg po 1–2 h before surgery; midazolam 1–2 mg iv in preop area).

Intraoperative

Anesthetic technique: Spinal, continuous lumbar epidural, and GA are acceptable, with the choice dependent on type and length of procedure, age, coexisting disease, and patient preference. Simpler transurethral procedures (e.g., cystoscopy) are amenable to topical anesthesia, while longer and more complex procedures (e.g., ureteral stone extraction) will require regional or GA (see discussion below regarding autonomic hyperreflexia). Note that many of these procedures are done on an outpatient basis and the anesthetic should be planned accordingly. For regional anesthesia, a sacral block is required for urethral procedures (T9-T10 level for procedures involving the bladder and as high as T8 for procedures involving the ureters).

Regional anesthesia:

Topical	2% lidocaine jelly
Spinal	0.75% bupivacaine 10–12 mg. For shorter procedures (< 1 h), consider low-dose bupivacaine (0.75%, 7.5 mg); mepivacaine (1.5%, 45 mg); or procaine (10%, 100–150 mg). Lidocaine may be used, but the incidence of transient neurologic symptoms may be as high as 30% for procedures performed in the lithotomy position.
Lumbar epidural	1.5–2.0% lidocaine with epinephrine 5 mcg/mL, 15–25 mL; supplement with 5–10 mL boluses as needed. Supplemental iv sedation.

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General anesthesia:

Induction	Standard induction (see p. B-2). ET intubation may not be necessary for shorter procedures; consider LMA. Succinylcholine should be avoided in paralyzed (e.g.,

	paraplegic, quadriplegic) patients 2° ↑ K+ → VF or asystole.	
Maintenance	Pure inhalation anesthetic (e.g., N_2O, sevoflurane/desflurane) for short cases. IV technique (e.g., propofol 100–200 mcg/kg/min; supplement with N_2O ± volatile anesthetic ± narcotic). Muscle relaxation not essential. Narcotics unnecessary, because postop pain is usually minimal.	
Emergence	No specific considerations	
Blood and fluid requirements	Usually minimal blood loss IV: 18 ga × 1 NS/LR @ 2–4 mL/kg/h	
Monitoring	Standard monitors (see p. B-1).	
Positioning	and pad pressure points. eyes.	* **NB:** In lithotomy position, peroneal nerve compression at lateral fibular head → foot drop.
Complications	Anticipate ↓ BP upon returning from lithotomy position. Autonomic hyperreflexia (**AH**): • Severe HTN • Bradycardia • Dysrhythmias • Cardiac arrest	Rx: volume (200–500 mL NS/LR) or ephedrine (5 mg iv) may be necessary. Patients with spinal cord injury level above T10 are at risk for autonomic hyperreflexia (**AH**) associated with stimulation below the level of transection. Transection levels below T5 may be associated with less severe manifestations. AH can be prevented by GA, spinal, or epidural anesthesia. If AH occurs intraop, it should be treated by deepening the level of anesthesia, and iv antihypertensive agents (e.g., SNP 0.5–5 mcg/kg/min; labetalol 5–10 mg iv; phentolamine 2–5 mg iv), if necessary.

Postoperative

Complications	Peroneal nerve injury 2° lithotomy position Fever/bacteremia	Peroneal nerve injury manifested as foot drop with loss of sensation over dorsum of foot. Seek neurology consultation.
	Bladder perforation	Bladder perforation may present as shoulder pain in the awake patient, but may go unnoticed in a patient under GA. Sx include unexplained HTN, tachycardia, ↓ BP (rare).
Pain management	Pain usually mild	Rx: morphine 2–4 mg iv q 10–15 min prn, fentanyl 25–50 mcg iv, ketorolac 15–30 mg im or iv

Suggested Readings

1. Amzallog M: Autonomic hyperreflexia. *Int Clin Anesth* 1993; 31:87–102.

2. Hambly PR, Martin B: Anesthesia for chronic spinal cord lesions. *Anesthesia* 1998; 53:273–89.

3. Mebust WK: Transurethral surgery. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

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Transurethral Resection of the Prostate (Turp)

Surgical Considerations

Description: TURP is one of the most common urologic operations, performed to relieve bladder outlet obstruction by an enlarging prostate gland. It is often preceded by **cystoscopy,** which is used to evaluate the size of the prostate gland and to rule out any other pathology, such as bladder tumor or stone. The operation is performed with the resectoscope, a specialized instrument having an electrode capable of transmitting both cutting and coagulating currents. Resectoscopes are either single inflow only, or continuous flow with an inflow and outflow system. The latter allows the surgeon to maintain low pressure in the bladder and prostatic fossa and thus limiting fluid absorption. Two different electrical options are available. The traditional resectoscope is a monopolar system, and this requires a grounding pad and possible interference with electric devices, such as pace makers. Bipolar resectoscopes have both the active and return electrode fitted in the resectoscope and do not cause any electrical interference with cardiac electrical devices.

The resectoscope is introduced into the bladder (Fig. 9-3) and the tissue protruding into the prostatic urethra is resected in small pieces called “chips.” Bleeding vessels are coagulated with the coagulating current. The resection is performed with continuous irrigation using an isotonic solution, such as sorbitol 2.7% with mannitol 0.54% in monopolar resectoscopes and normal saline in bipolar resectoscopes. After the obstructing prostatic tissues are completely resected and bleeding vessels coagulated, the chips are irrigated from the bladder and the resectoscope is removed. An indwelling Foley catheter is introduced into the bladder. The time of transurethral resection should not exceed 2 h, because excessive absorption of the irrigating fluid may → dilutional hyponatremia, confusion, seizures, and heart failure. However, this is less of an issue with a continuous flow bipolar resectoscope where saline is used as an irrigant. Although fluid absorption can occur, hyponatremia does not occur with the use of saline. The size of the enlarged prostate or adenoma, therefore, needs to be carefully assessed preop to determine if it is possible to complete the resection within 2 h. If not, an **open prostatectomy** is performed. This variant approach is discussed under Open Prostate Operations, p. 867.

Variant procedure or approaches:
A number of techniques have been developed to avoid the morbidity of TURP. These are either **vaporization** (electrocautery or laser) or **thermocoagulation** of the prostate (laser, microwave, radiofrequency). The following techniques are available and approved:

TUVP: Transurethral vaporization of the prostate with a standard resectoscope using a roller ball electrode at 275–300 watts setting.

Laser Ablation: Laser coagulation of the prostate is done with Nd:YAG or Ho:YAG laser through a standard cystoscope. This procedure has been largely replaced by laser ablation with the KTP laser (PVP, green light laser) or diode laser. This wavelength allows vaporization of the prostate tissue with minimal blood loss. This is currently the most popular minimally invasive technique used for treatment of BPH. It can also be done on patients while on anticoagulation or with bleeding disorders. All personnel in the OR, including the patient, must wear protective glasses to protect the eyes from inadvertent exposure from a break in the laser fiber.

TUNA: Transurethral needle ablation of the prostate is done with a special disposable device connected to a radiofrequency generator.

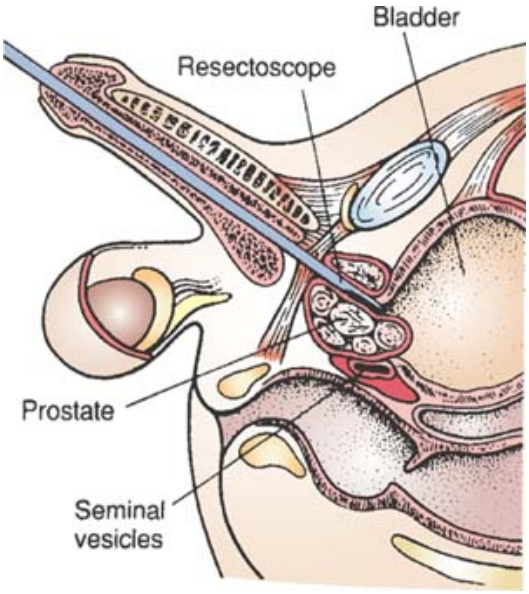

Figure 9-3. Transurethral resection of prostate using a resectoscope. (Reproduced with permission from Govan DE: *Roche Manual of Urologic Procedures.* Hoffmann-LaRoche, 1976.)

TUMT: Transurethral microwave thermotherapy is done with a catheter that has a microwave antenna attached to it. A microwave generator is needed for this procedure.

All of the above have several advantages over TURP, including shorter surgical time, no blood loss, reduced risk of fluid absorption, and all can be done as outpatient procedures.

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Usual preop diagnosis: Benign prostatic hypertrophy; prostate cancer

Summary of Procedures

	TURP	Thermotherapy
Position	Lithotomy	
Incision	None	
Special instrumentation	Cystoscope; resectoscope; catheters; electrocautery	Cystoscope; resectoscope; catheters; electrocautery (standby); laser equipment
Unique considerations	During resection, the patient should be absolutely still, because any movement may lead to perforation or injury to the external sphincter, → postop incontinence.	During laser resection, the patient and all personnel should wear protective eyeglasses.
Antibiotics	Gentamicin 80 mg iv, slowly	
Surgical time	1–2 h (not to exceed 2 h)	1 h
EBL	500 mL	None
Postop care	Irrigation of the Foley catheter to clear it of clots and keep it from being blocked. Determination of serum Na^+	
Mortality	< 1%	
Morbidity	Significant intraop bleeding: 10% Intraop perforation and fluid extravasation which may require placement of retropubic drain: <0.5% Postop bleeding, which may necessitate a return to OR for fulguration of bleeding vessels: <5% Absorption of irrigating fluid, which may → dilutional hyponatremia, mental confusion, and heart failure: 2–5%	Prolonged catheterization: 10% Postop bleeding: 1%
Pain score	1	1

Patient Population Characteristics

Age range	49–90 yr; typically, 70s and 80s
Incidence	Very common; 90% of men will develop benign hypertrophy; 20% may need surgical intervention.
Etiology	Aging; benign prostatic hypertrophy; prostate cancer
Associated conditions	COPD (10%); heart disease (10%); HTN (10%); diabetes mellitus (DM) (5%); DIC (1–2% of patients with prostate cancer may also have a low-grade, subclinical DIC, which becomes clinically manifest postop).

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Anesthetic Considerations

Preoperative

Patients presenting for prostate surgery are generally elderly and may have preexisting medical problems, including CAD, CHF, PVD, cerebrovascular disease, COPD, and renal impairment. Preop evaluation should be directed toward the detection and treatment of these conditions before anesthesia.

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Respiratory	COPD common in this age group. Patients with > 50 pack/year smoking Hx, or with any respiratory Sx, may need PFTs. For dyspnea with moderate exercise, VC, FEV_1 MMEF. If VC < 80%, FEV_1 < 60%, or MMEF < 40% predicted, ABG. If ABG and PFT markedly abnormal, consider postponing surgery until patient's respiratory condition has been optimized. **Tests:** PFT; CXR; ABG, as indicated from H&P.
Cardiovascular	HTN, CAD common in this age group. Assess exercise tolerance by H&P (e.g., should be able to climb a flight of stairs without difficulty or SOB). **Tests:** ECG; others as indicated from H&P.
Neurological	Cerebrovascular disease, Alzheimer's, and other neurologic problems may be present in this age group. Assess mental status to guide evaluation of any intraop or postop changes.
Renal	Anticipate renal impairment 2° chronic obstruction. **Tests:** BUN; Cr; electrolytes. If ↑ BUN and ↑ Cr, creatinine clearance (nl = 95–140 mL/min).
Musculoskeletal	Various arthritides in this age group may cause problems with positioning for regional anesthesia and surgery.
Endocrine	Increased incidence of DM.
Hematologic	Moderate blood loss expected with larger glands. If gland < 80 g, no T&C necessary. **Test:** Hct
Laboratory	Other tests as indicated from H&P.
Premedication	Continue commonly used drugs (e.g., digitalis, β-blockers, NTG) to prevent cardiovascular problems. Sedation prn anxiety (e.g., lorazepam 1–2 mg po 1–2 h before surgery).

Intraoperative

Anesthetic technique: Regional or GA. Choice of technique depends on the coexisting disease and the patient's preference. Regional anesthesia may hold some advantage over GA for TURP in that it allows evaluation of mental status and, thus, earlier detection of TURP syndrome. The incidence of postdural puncture headache is very low in this age group (< 1%). A T9 level is optimal. Continuous lumbar epidural anesthesia has no advantage over spinal anesthesia for TURP, because a sacral block may be less reliable, the procedure is relatively short and supplemental doses are usually not necessary.

Regional anesthesia:

Spinal	0.75% bupivacaine, 12 mg in 7.5% dextrose solution (1.6 mL)

General anesthesia:

Induction	Standard induction (see p. B-2).
Maintenance	Standard maintenance (see p. B-2). Muscle relaxation is not mandatory, although patient movement during the procedure must be avoided.

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Emergence	Postop pain is usually not significant. Anticipate ↓ BP when legs are repositioned from lithotomy. Avoid stress on lumbar spine by slowly and simultaneously bringing legs together and returning to supine position.	
Blood and fluid requirements	Moderate blood loss (TURP) Minimal blood loss (thermotherapy) IV: 16–18 ga × 1 NS/LR @ 2–4 mL/kg/h	Blood loss can be large (TURP) if venous sinuses are entered; it also can be difficult to quantify because of irrigant. To flush away blood and tissue and to promote visibility during TURP (or thermotherapy), continuous irrigation is used. For monopolar procedures, irrigating fluid must be nonelectrolytic to prevent dispersion of current, but near iso-osmotic to prevent hemolysis. For these reasons, sorbitol (2.7%) with mannitol (0.54%) or glycine (1.5%) is added to distilled water to produce solutions that are nearly isotonic.
Monitoring	Standard monitors (see p. B-1).	Regional anesthesia allows monitoring of mental status. Invasive monitoring, if indicated from H&P.
TURP syndrome	Intravascular volume overload Hyponatremia Hypotonicity 2° absorption of irrigant Symptoms include: • N/V • Visual disturbances • Mental status changes • Coma • Sz • HTN • Angina • Cardiovascular collapse	Factors that influence the absorption of irrigant include: surgical technique (TURP or thermotherapy); hydrostatic pressure of irrigant (height of bag); number of venous sinuses opened; peripheral venous pressure; duration of surgery; and experience of the surgeon. Resections should optimally be limited to 1 h or less. Some CNS manifestations are 2° glycine and its metabolites. Rx may include observation, diuresis (e.g., furosemide 5– 20 mg iv), and administration of hypertonic saline (e.g., 100 mL of 3% saline over 1–2 h). Serum sodium < 120 is associated with more severe symptoms, and the goal of therapy is to restore sodium to > 120. In milder cases, observation and water restriction may be sufficient.
Positioning	and pad pressure points. eyes.	***NB:** In lithotomy position, peroneal nerve compression at lateral fibular head → foot drop.
Complications	Bladder perforation TURP syndrome	Bladder perforation may produce shoulder pain in the awake patient. Bladder perforation (and TURP syndrome) may go unnoticed under GA; Sx: ↑ BP, ↑ HR (occasionally ↓ BP).

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Postoperative

Complications	TURP syndrome Bladder perforation Fever/bacteremia/sepsis Hypothermia	See discussion of TURP syndrome, above.
Pain management	Minimal postop pain	Rx: Morphine 1–4 mg iv prn until comfortable.
Tests	Hct; electrolytes Blood cultures if febrile	Consider serum osmolarity, CXR, ECG in TURP syndrome

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Suggested Readings

1. Abrams PH, Shah PJ, Bryning K, et al: Blood loss during transurethral resection of the prostate. *Anaesthesia* 1982; 37(1): 71–3.

2. Hanson RA, Zornow MH, Conlin MJ, et al: Laser resection of the prostate: implications for anesthesia. *Anesth Analg* 2007; 105 (2): 475–9.

3. Jensen V: The TURP syndrome. *Can J Anaesth* 1991; 38(1):90–6.

4. Malhotra V: Transurethral resection of the prostate. *Anesthesiol Clin North Am* 2000; 18(4):883–97.

5. Mebust WK: Transurethral surgery. In *Campbell-Walsh Urology,* 9th edition. WB Saunders, Philadelphia: 2006.

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Open Prostate Operations

Surgical Considerations

Description: Open (in contrast to transurethral or endoscopic) operations on the prostate gland are common. They include: **simple prostatectomy, radical prostatectomy,** and are done through either a midline extraperitoneal incision, which extends from the umbilicus to the symphysis pubis, or through a Pfannenstiel's incision (Fig. 9-4, inset).

Simple prostatectomy: When the benign prostatic hypertrophy or adenoma is too large to be resected transurethrally, it is removed by a simple prostatectomy. The prostate gland is exposed through a retropubic approach (Fig. 9-4A) and the anterior capsule is incised, exposing the adenoma—the central part of the prostate which is excised, "shelled" out by blunt dissection (Fig. 9-4B), leaving behind the peripheral prostate and all the associated structures. A Foley catheter is left indwelling in the urethra, and the incision in the prostate capsule is closed. In a **suprapubic prostatectomy,** the incision is made in the bladder and the adenoma shelled from within the bladder.

Radical prostatectomy: The term **radical prostatectomy** is used because the entire prostate, both seminal vesicals and pelvic nodes, are removed. It is used to differentiate this cancer operation from a simple prostatectomy (used for benign prostatic hypertrophy). Radical prostatectomy can be achieved through a **retropubic** or **perineal approach,** the choice being a matter of training, expertise, and surgeon's preference. In radical prostatectomy, all of the prostate gland is removed, together with the bladder neck, the seminal vesicles, and the ampullae of the vas deferens. A **limited pelvic lymphadenectomy** (Fig. 9-5) also is performed. After the prostate gland and its associated structures are removed, the bladder neck is reduced to 1 cm diameter and anastomosed to the membranous urethra over an indwelling Foley catheter. Most of the blood loss occurs during control of the dorsal vein complex. In early stage cancers, which nowadays comprise 90% of patients, a nerve sparing procedure is done. This involves preserving *(Print pagebreak 868)* potency by preserving the nerves to the corpora cavernosa. More recently, radical prostatectomy is being done by laparoscopy. This procedure has been popularized with the use of robots. Please see section of robotic urologic surgery.

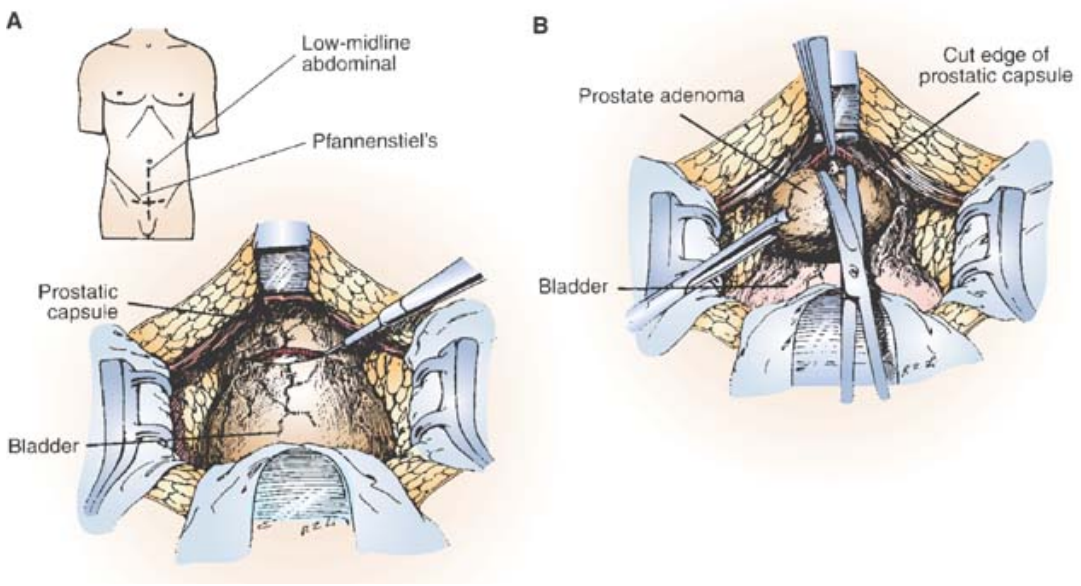

Figure 9.4. Retropubic prostatectomy: **A:** A transverse capsulotomy is made between heavy hemostatic stay sutures. **B:** The cleavage plane between the adenoma and the surgical capsule is developed with scissors. (Reproduced with permission from Fowler JE: *Urologic Surgery.* Little & Brown, 1990.)

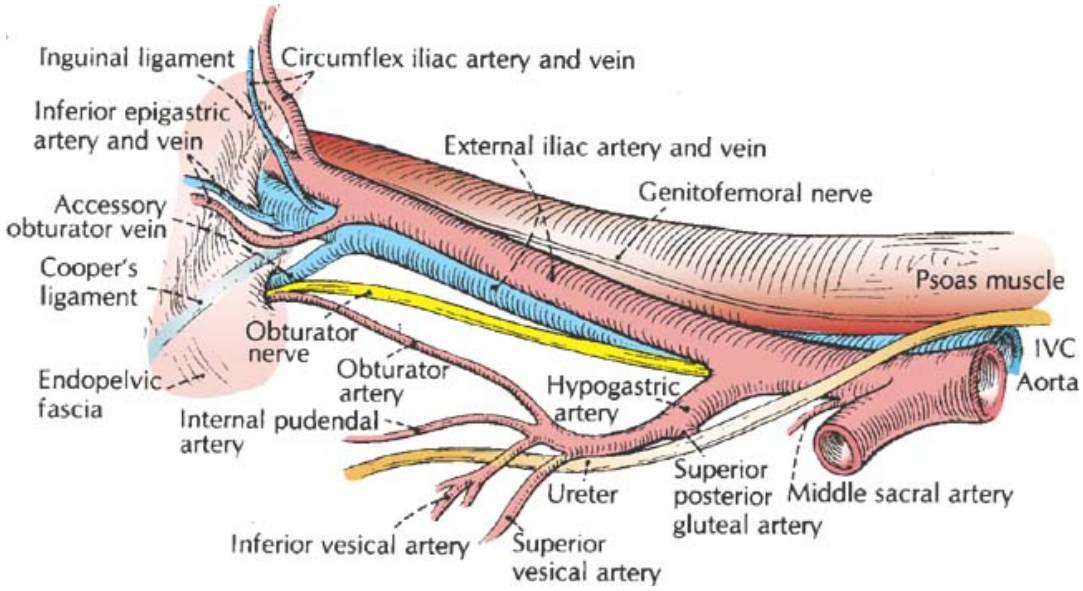

Figure 9-5. Right lateral pelvic wall. Anatomy of pelvic blood vessels and nerves encountered in a pelvic lymph node dissection. (Reproduced with permission from Graham SD Jr: *Glenn's Urologic Surgery*. Lippincott Williams & Wilkins, 1998.)

Variant approach: Minimally invasive prostate cancer surgery has expanded with the use of the **Da Vinci Robotic system**. Most laparoscopic radical prostatectomies are done with the assistance of the robot. With the robotic system the surgeon sits at a console away from the patient and has a three-dimensional view with 10× magnification. A bedside assistant is necessary for instrument change and retraction. See page 902 for special Anesthetic Considerations for Robotic-Assisted Laparoscopic Surgery.

Usual preop diagnosis: Benign prostatic hypertrophy; prostate cancer

Summary of Procedures

	Simple Prostatectomy	Radical–Retropubic	Radical–Perineal
Position	Supine		Lithotomy

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Incision	Extraperitoneal, low midline, or Pfannenstiel's (Fig. 9-4A, inset)		Perineal (Fig. 9-6)
Unique considerations	None		Extreme hip flexion
Antibiotics	Gentamicin 80 mg iv, slowly	Keflex 1Gram IV	
Surgical time	1 h	3 h	
EBL	500 mL	1,500 mL	500 mL
Postop care	Irrigate catheter to clear blood clots and prevent obstruction; frequently, if urine is bloody.		
Mortality	<1%		
Morbidity	Bleeding: 2% DVT: 2% Infection: 2% PE: 1%	Impotence: Non nerve-sparing: 100% Nerve-sparing: 20–50% Lymphocele: 4%	
Pain score	8	8	6

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Patient Population Characteristics

Age range	40–80 yr
Incidence	20% of men will develop symptomatic benign prostatic hypertrophy; 9% will develop clinically evident prostate cancer.
Etiology	Aging
Associated conditions	COPD (10%); CAD (10%); HTN (10%); diabetes mellitus (5%); renal failure (1%)

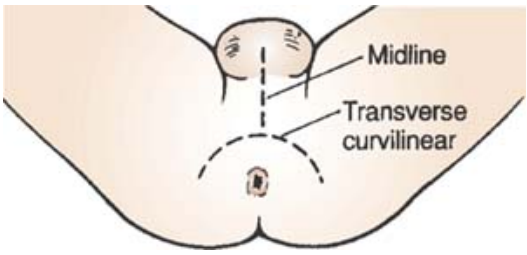

Figure 9-6. Perineal incisions.

Anesthetic Considerations

Preoperative

Patients presenting for prostate surgery are generally elderly and may have preexisting medical problems, including CAD, CHF, PVD, cerebrovascular disease, COPD, and renal impairment. Preop evaluation should be directed toward the detection and treatment of these conditions prior to anesthesia.

COPD common in this age group. Patients with Hx of > 50 pack-

Respiratory	year smoking, or with respiratory Sx, may require PFTs. For dyspnea with moderate exercise, check VC, FEV_1, MMEF. If VC < 80%, FEV_1 < 60%, or MMEF < 40% predicted, ABG. If ABG and PFT are markedly abnormal, consider postponing surgery until patient's respiratory condition has been optimized. **Tests:** PFT; CXR; ABG, as indicated from H&P.
Cardiovascular	HTN, CAD common in this age group. Assess exercise tolerance by H&P (e.g., should be able to climb a flight of stairs without difficulty or SOB). **Tests:** ECG; others as indicated from H&P.
Neurological	Cerebrovascular disease, Alzheimer's, and other neurologic problems may be present in this age group. Assess mental status to guide evaluation of any intraop or postop changes.
Renal	Anticipate renal impairment 2° chronic obstruction. **Tests:** Cr
Musculoskeletal	Various arthritides may cause problems with positioning for regional anesthesia and surgery.
Endocrine	Increased incidence of diabetes mellitus.
Hematologic	Moderate blood loss expected with larger glands. For glands < 30 g, no T&C necessary; for glands 30–80 g, T&C 2 U PRBCs; for glands > 80 g, T&C 4 U PRBCs. **Tests:** Hct
Laboratory	Other tests as indicated from H&P.
Premedication	Continue commonly used drugs (e.g., digitalis, β-blockers, diuretics, NTG) to prevent cardiovascular complications. Sedation prn anxiety (e.g., lorazepam 1–2 mg po on call to OR).

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Intraoperative

Anesthetic technique: Regional (spinal, continuous spinal, continuous lumbar epidural), GA, or combined techniques are acceptable. If regional anesthesia used, optimal block level is T8-T10 (depending on incision site). Advantages of regional anesthesia include potential for lower intraop blood loss, possible lower incidence of DVT postop, and faster return of bowel function. Disadvantages include positioning considerations (see below).

Regional anesthesia:

Spinal	Bupivacaine (0.75%) 12 mg in 7.5% dextrose solution (1.6 mL)
Epidural	1.5–2% lidocaine with epinephrine 5 mcg/mL, 15–25 mL, supplemental iv sedation as necessary. Additional epidural lidocaine (5–10 mL boluses) may be needed, depending on length of procedure. Alternatively, smaller volumes of bupivacaine (0.25–0.5%) or ropivacaine (0.5–1%) may be used. The addition of opiates has been associated with ↑ urinary retention in noncatheterized patients.

General anesthesia:

Induction	Standard induction (see p. B-2).	
Maintenance	Standard maintenance (see p. B-2).	
Emergence	No special considerations	
Blood and fluid requirements	Moderate-to-large blood loss 1V: 14–16 ga × 1–2 NS/LR @ 4–6 mL/kg/h	Additional requirements dependent on type of anesthesia. Regional techniques are associated with higher fluid requirement because of sympathectomy and systemic vasodilation; they also may be associated

		with lower blood loss than GA.
Monitoring	Standard monitors (see p. B-1). Depending on underlying disease: ± CVP ± Arterial line	Some patients require CVP to aid in assessment of volume status. Arterial line is often useful for continuous BP monitoring and frequent blood draws. Patients at particularly high risk (e.g., Hx of preexisting cardiopulmonary disease) should probably have both.
Positioning	Anticipate ↓ BP on return from lithotomy position. and pad pressure points. eyes.	Rx: volume (200–500 mL NS/LR) or ephedrine (5 mg iv) may be necessary. Elderly patients with arthritis or respiratory impairment may not tolerate the extreme positioning associated with perineal prostatectomy for extended periods of time, thus precluding the use of regional anesthesia. *(A combined technique with GA maybe considered.) * **NB:** In lithotomy position, peroneal nerve compression at lateral fibular head → foot drop.
Complications	Indigo carmine reaction Hemorrhage Hypothermia VAE	Indigo carmine → false ↓ O_2sat ± ↑ BP; rare allergic reaction → rash + bronchoconstriction + ↓ BP.

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Postoperative

Complications	Peroneal nerve injury 2° lithotomy position DVT	Manifested by foot drop with loss of sensation on dorsum of foot. Seek neurology consultation. Incidence of DVT less with regional than GA. Sx: variable, with pain and tenderness over involved area.
Pain management	Significant postop pain. Rx: morphine 0.1–0.3 mg/kg iv in incremental doses (e.g., 2–4 mg q 10–15 min prn).	Consider epidural infusion of dilute local anesthetics/opiates or PCA (see p. C-3).
Tests	Hct	

Suggested Readings

1. Donald JR: The effect of anaesthesia, hypotension, and epidural analgesia on blood loss in surgery for pelvic floor repair. *Br J Anaesth* 1969; 41(2):155–66.

2. Eastham JA, Scardino PT: Radical prostatectomy. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

3. Gibbons RP: Radical perineal prostatectomy. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

4. Hendolin H, Mattila MA, Poikolainen E: The effect of lumbar epidural analgesia on the development of deep-vein thrombosis of the legs after open prostatectomy. *Acta Chir Scand* 1981; 147(6):425–9.

5. Nelson JB: Debate: open radical prostatectomy vs. laparoscopic vs. robotic. *Urol Oncol* 2007; 25(6): 490–3.

6. Oesterling JE: Retropubic and suprapubic prostatectomy. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

7. Whalley DG, Berrigan MJ: Anesthesia for radical prostatectomy, cystectomy, nephrectomy, pheochromocytoma, and laparoscopic procedures. *Anesthesiol Clin North Am* 2000; 18(4):899–917.

Nephrectomy

Surgical Considerations

Description: Nephrectomies fall into three basic groups: simple, partial, and radical. (Surgical anatomy is shown in Fig. 9-7.)

Simple nephrectomy, performed for benign conditions, is the surgical excision of the kidney and a small segment of proximal ureter. The dorsal approach is well suited for this operation, and begins with an incision extending from *(Print pagebreak 872)* the 12th rib to the iliac crest along the lateral edge of the sacrospinalis muscle and quadratus lumborum muscle. The dorsolumbar fascia is opened, exposing Gerota's fascia and the perinephric fat (Fig. 9-8). The kidney is mobilized until the hilum is exposed. The artery and vein are tied, suture-ligated, and transected. The ureter is followed distally as far as possible, tied, and transected. The kidney is delivered out of the incision, which is then closed by approximating the dorsolumbar fascia and the fascia of the sacrospinalis muscle.

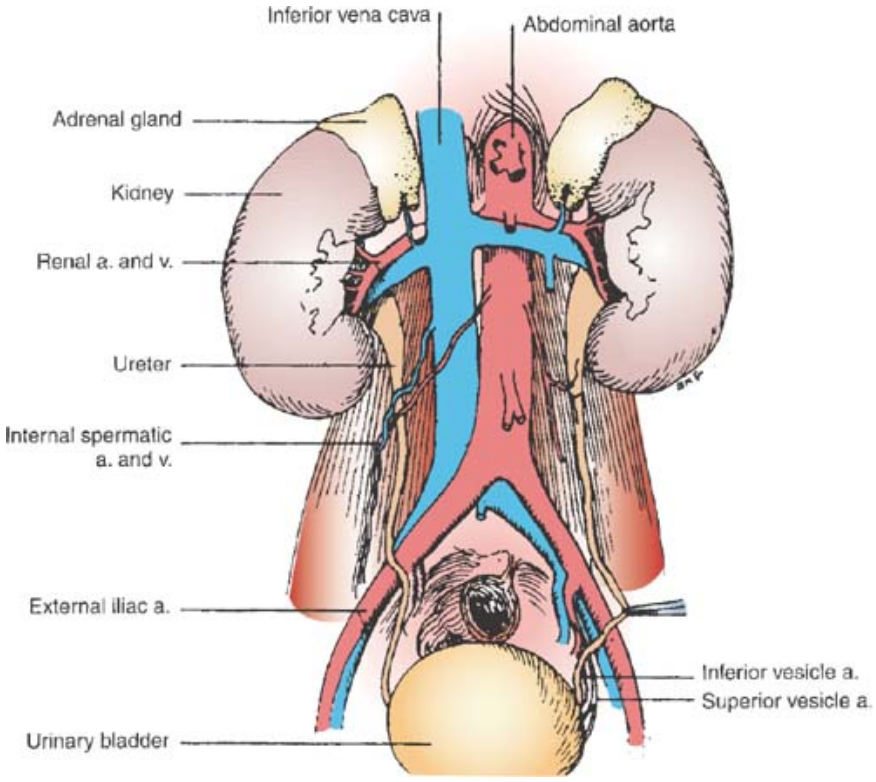

Figure 9-7. Surgical anatomy of the urinary tract. (Reproduced with permission from Hardy JD: *Textbook of Surgery*. JB Lippincott, 1988.)

Usual preop diagnosis: Chronic hydronephrosis; hypoplastic kidney; renovascular HTN; double collecting system

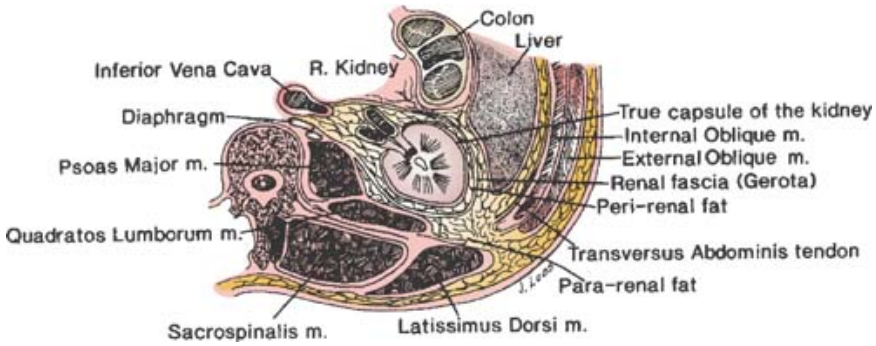

Figure 9-8. Transverse section showing the relation of the renal fascias to the right kidney. (Reproduced with permission from Baker RJ, Fischer JE: *Mastery of Surgery,* 4th edition. Lippincott Williams & Wilkins, 2001.)

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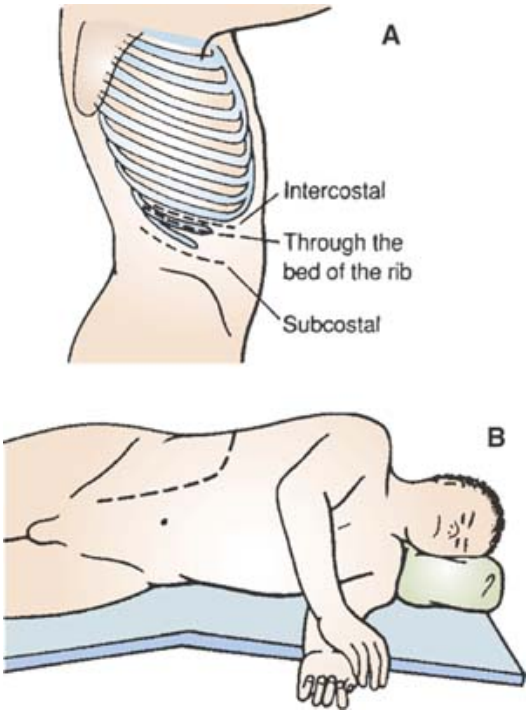

Figure 9-9. A: Flank incisions. **B:** Subcostal transabdominal incision.

Partial nephrectomy is the surgical excision of the segment of the kidney harboring the pathology. It is performed for small renal-cell carcinomas and benign tumors of the kidney, such as angiomyolipomas, and for duplicated collecting systems with a diseased moiety. If the partial nephrectomy is being done for renal-cell carcinoma, it may be accompanied with a **regional lymphadenectomy.** The flank approach (Fig. 9-9A) is well suited for this operation and begins with an incision over the 12th or 11th rib, or in between, and extends anteriorly over the external and internal oblique muscles, which are transected. The transversalis muscle and fascia are opened, exposing Gerota's fascia. The renal capsule is exposed at the planned site of resection. Control of the renal vessels is advised for control of bleeding, if excessive. Incision in the renal parenchyma is made by sharp and blunt dissection, suture-ligating all bleeders. If the collecting system is opened, it should be closed with absorbable sutures. After complete hemostasis, Gelfoam, thrombin, Floseal, or perinephric fat is used to cover the raw surface of the kidney.

Usual preop diagnosis: Renal-cell carcinoma; double collecting system

Radical nephrectomy is the surgical excision of the kidney with its surrounding perinephric fat and Gerota's fascia and the proximal 2/3 of the ureter, accompanied by paracaval or para-aortic **lymphadenectomy.** It is performed for renal-cell carcinoma. Early control of renal vessels is advised before excessive manipulation of the tumor to minimize blood loss and hematogenous spread. Transabdominal or flank approaches (Fig. 9-9A, B) are best suited for this operation. Surgery in patients with renal vein or inferior vena cava involvement is more complex and prone to more intraoperative complications, including blood loss. When the tumor thrombus involves a large segment of the vena cava or is in the right atrium, a team approach with cardiac surgeons is used. Often patients have to be put on cardiopulmonary bypass under hypothermia.

Laparoscopic simple or radical nephrectomy: A pneumoperitoneum is created by insufflating CO_2 to a pressure of 14–16 mmHG. Three to four trochars are inserted as necessary (Fig. 9-10). Typically, the patient is placed in a flank position as in an open radical nephrectomy. This procedure can be either **transperitoneal** or **retroperitoneal,** depending on the surgeon's preference or experience. The transperitoneal approach may be modified by using a hand-assistance device through one of the ports (**hand-assisted laparoscopic nephrectomy**). Most radical nephrectomies can be done by an experienced laparoscopic surgeon.

Usual preop diagnosis: Renal-cell carcinoma, nonfunctioning kidney 2° infection or obstruction; kidney donation

Nephroureterectomy is a radical nephrectomy with ureter resection, including the ureteral orifice and a cuff of bladder wall around it. It is accompanied by a regional lymphadenectomy, since it is performed for a cancerous condition. The approach is either **transabdominal** or **extraperitoneal** through an extended flank incision, starting at *(Print pagebreak 874)* the tip of the 11th rib and

curving caudally along the lateral edge of the rectus abdominis muscle down to the pubic bone (Fig. 9-9B). Some surgeons prefer two separate incisions: a flank incision for the radical nephrectomy part and a lower abdominal incision for the ureterectomy. This procedure can be done by laparoscopy with a lower midline incision made to remove the specimen.

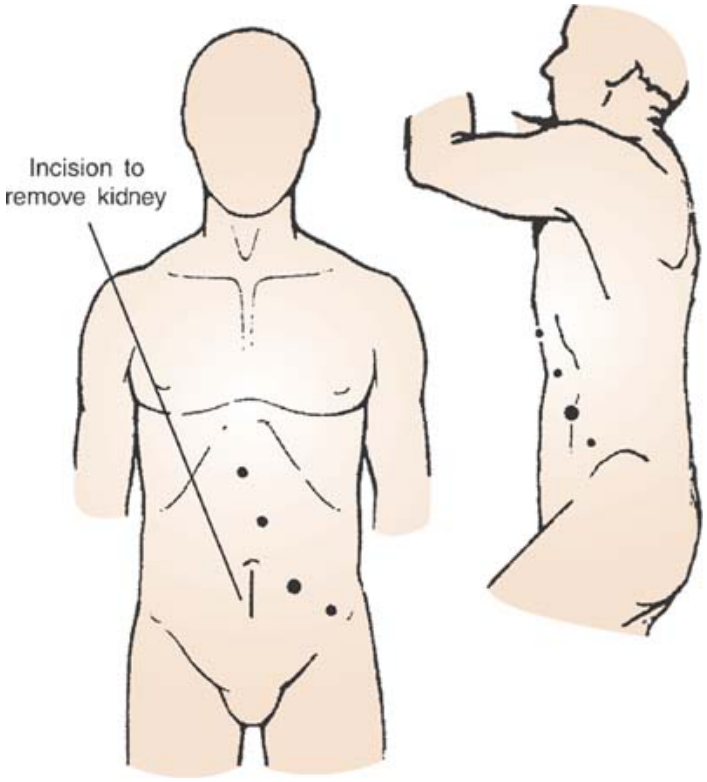

Figure 9-10.
Incision and placement of trocars in laparoscopic nephrectomy. (Reproduced with permission from Scott-Conner CEH, Dawson DL: *Operative Anatomy,* 2nd edition. Lippincott Williams & Wilkins, 2003.)

Usual preop diagnosis: Transitional-cell carcinoma of the renal collecting system or ureter

Summary of Procedures

	Simple Nephrectomy	Partial Nephrectomy	Radical Nephrectomy	Laparoscopic Nephrectomy or Nephroureterectomy
Position	Flank or prone	Flank	Supine or flank	Flank
Incision	Flank (Fig. 9-9A) or dorsal along paraspinous muscles	Flank (Fig. 9-9A)	Midline or subcostal transabdominal (Fig. 9-9B) or flank; subcostal or intercostal or through bed of 11th or 12th rib (Fig. 9-9A)	3–4 ports (Fig. 9-10)
Unique considerations	None		If tumor involves renal vein and/or IVC, clamp IVC.	Risk of emergent conversion to open case
Antibiotics	None			
Surgical time	2–3 h	3–4 h		
Closing considerations	Chest tube may be required if pleura opened with flank incision.			A small incision is made at the end of the case to remove the specimen.
EBL	500 mL	1,200 mL	500 mL	300 mL

Mortality	< 1%		1%	
Morbidity	Prolonged ileus: 5% Pneumothorax 2° unrecognized pleural perforation: 2%			Vascular injury requiring conversion to open case
Pain score	10	10	10	4

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Patient Population Characteristics

Age range	All ages		
Male:Female	1:1		
Incidence	<1%		
Etiology	Double collecting system; chronic hydronephrosis; hypoplastic kidney; renovascular HTN	Localized renal-cell carcinoma	Wilms' tumor (8% of all childhood malignancies); transitional cell carcinoma (7% of all kidney tumors); renal-cell carcinoma (3% of adult malignancies)
Associated conditions	HTN if nephrectomy is used for renovascular HTN.		

Anesthetic Considerations

See Anesthetic Considerations following Operations on the Renal Pelvis and Upper Ureter, p. 877.

Suggested Readings

1. Cadeddu JA, Ono Y, Clayman RV: Laparoscopic nephrectomy for renal cell cancer. Evaluation of efficacy and safety: a multicenter experience. *Urology* 1998; 52:773–7.

2. Coleman DL: Control of postoperative pain: non-narcotic and narcotic alternatives and their effect on pulmonary function. *Chest* 1987; 92(3):520–8.

3. Conacher ID, Soomro NA, Rix D: Anaesthesia for laparoscopic urological surgery. *Br J Anaesth* 2004; 93(6): 859–64.

4. Novic AC, Streem SB: Surgery of the kidney. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

Operations on the Renal Pelvis and Upper Ureter

Surgical Considerations

Description: Operations on the renal pelvis and upper ureter are becoming less common because of the increasing use of endoscopic and percutaneous procedures. The basic surgical approach is the same as that for nephrectomy (see p. 871). Specific procedures include the following:

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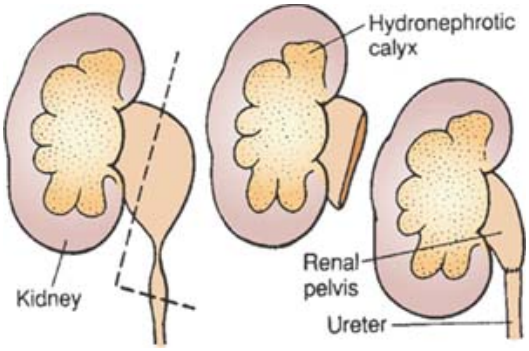

Figure 9-11. Dismembered pyeloplasty.

Pyeloplasty is the surgical correction of congenital ureteropelvic junction stenosis to relieve obstruction. The most commonly used is the **dismembered pyeloplasty,** or **Anderson-Heinz pyeloplasty,** wherein the diseased ureteropelvic junction is excised, the redundant renal pelvis is reduced, and an anastomosis is established between the renal pelvis and ureter (Fig. 9-11).

Usual preop diagnosis: Ureteropelvic junction obstruction

Pyelolithotomy and ureterolithotomy are used to remove calculi from the renal pelvis or ureter. The upper ureter and renal pelvis are exposed, usually through a flank approach, the calculus is palpated and an incision is made in the ureter or renal pelvis over the calculus, which is then delivered. The incision is closed with fine, absorbable sutures.

Usual preop diagnosis: Renal pelvic or ureteral stone

Transureteroureterostomy is the transposition of one ureter across the midline and anastomosing it to the other ureter (Fig 9-12). This operation is performed whenever the distal ureter is traumatized or diseased, and the proximal ureter is not long enough to reimplant into the bladder. The recipient ureter should be normal.

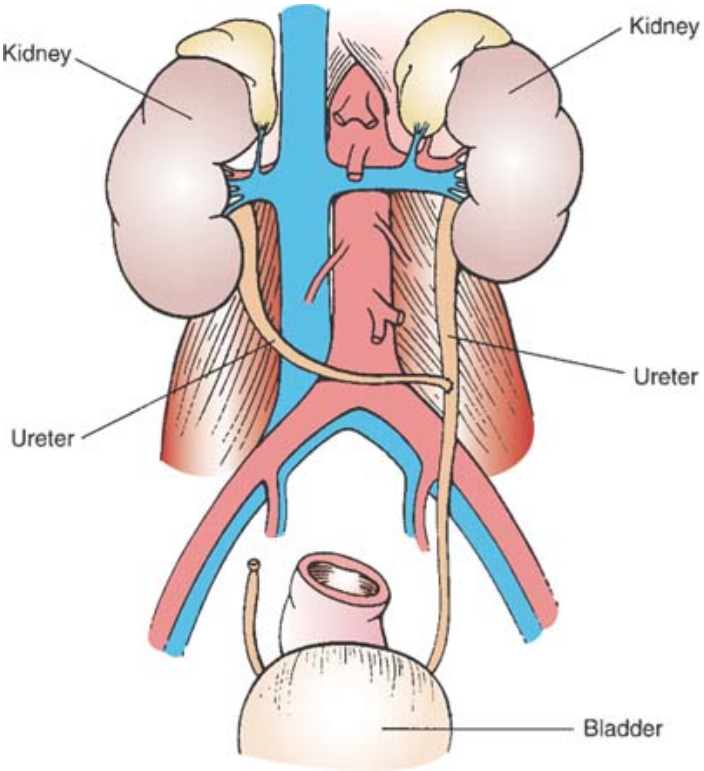

Figure 9-12. Transureteroureterostomy.

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Usual preop diagnosis: Traumatic loss of distal ureter; distal ureteral tumor requiring distal ureterectomy

Summary of Procedures

	Pyeloplasty	Pyelolithotomy/Ureterolithotomy	Transureteroureterostomy
Position	Flank or prone		Supine
Incision	Flank (Fig. 9-9A) or dorsal		Midline abdominal (Fig. 9-9A, inset)
Antibiotics	None		
Surgical time	3 h	1–2 h	3 h
EBL	Minimal		
Mortality	< 1%		
Morbidity	Urinary leakage: 5% Infection: 2%		
Pain score	10	10	10

Patient Population Characteristics

Age range	All ages		
Male:Female	1:1		
Incidence	Rare	Extremely rare	
Etiology	Ureteropelvic junction obstruction: 80% (of causes of dilated collecting system in the newborn)	Renal pelvic and upper ureteral stone	Traumatic loss of lower ureter; lower ureteral tumor
Associated conditions	Renal failure: 1%		

Anesthetic Considerations

(Procedures covered: nephrectomy and operations on the renal pelvis and upper ureter)

Preoperative

Patients presenting for nephrectomy and operations on the renal pelvis and upper ureter may be of any age, depending upon the etiology of the abnormality. Many patients may have renal insufficiency 2° the underlying problem or from renovascular HTN. Elderly patients frequently have preexisting medical problems, including CAD, CHF, PVD, cerebrovascular disease, COPD, and renal impairment. Preop evaluation should be directed toward the detection and treatment of these conditions prior to anesthesia.

Respiratory	Increased postop pulmonary complications because of location of incision (nonlaparoscopic). If Hx of pulmonary disease (e.g., asthma, COPD), consider postop respiratory therapy. **Tests:** As indicated from H&P.
Cardiovascular	Consider possibility of renal HTN.
Hematologic	Polycythemia may be seen in association with polycystic kidney disease, renal-cell carcinoma. Consider preop blood donation for autologous transfusion. **Tests:** Hct
Laboratory	Electrolytes; BUN; Cr; other tests as indicated from H&P.
Premedication	Standard premedication (see p. B-1).

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Intraoperative

Anesthetic technique: GA is recommended for these procedures; technique depends on underlying disease. Regional techniques (spinal or epidural) may be alternatives for some open procedures, but are less than optimal because of awkward positioning that may → patient discomfort and pain resulting from diaphragmatic stimulation. Consider combined technique with regional opiates.

Induction	Standard induction (see p. B-2).	
Maintenance	Standard maintenance (see p. B-1). If intraperitoneal or laparoscopic approach is used, consider limiting N_2O to avoid distention of bowel and interference with operative field.	
Emergence	No specific considerations	
Blood and fluid requirements	Mild-to-moderate blood loss IV: 14–16 ga × 1 NS/LR @ 6–8 mL/kg/h Warm all fluids.	Intraperitoneal approach associated with higher fluid requirements (8–10 mL/kg/h). When renal vessels are to be cross-clamped, mannitol (0.5 g/kg) is often given prior to occlusion (20 min maximum).
Monitoring	Standard monitors (see p. B-1). Urinary catheter Arterial line (partial nephrectomy) ± CVP line	Invasive monitoring if indicated from H&P. CVP line useful for partial nephrectomy in patients with solitary kidneys (↑↑ blood loss).
Positioning	Use axillary roll if lateral. Avoid stretching brachial plexus – limit abduction to 90°. If prone, repeatedly eyes and pressure points. Assure free excursion of abdomen.	The lateral position with kidney rest and table flexion may →↓ BP, possibly 2° vena cava obstruction. Moderate iv volume administration and gradual assumption of the position are recommended to avoid this complication.
Complications	Pneumothorax ↓ BP with positioning (see above). Indigo carmine →↑ BP, ↑ SVR Methylene blue →↓ BP	Sx of pneumothorax include: ↑ RR, ↑ PIP, hypoxemia, hypercarbia. If in doubt, CXR.

Postoperative

Complications	Postnephrectomy syndrome Eye injury (if prone) Brachial plexus injury (if lateral) Pneumothorax Atelectasis Pneumonia	Postnephrectomy syndrome 2° retractor injury. L1 nerve root damage with resulting pain, dysesthesia, and sensory loss in L1 dermatome distribution.
Pain management	Morphine 0.1–0.3 mg/kg iv in incremental doses Consider epidural narcotic	Postop analgesia critical to minimize pulmonary complications. PCA. See p. C-3.
Tests	Hct CXR	Others dependent on operative course, coexisting disease.

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Suggested Reading

1. Franke JJ, Smith JA: Surgery of the ureter. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

Cystectomy

Surgical Considerations

Description: Open (in contrast to transurethral or endoscopic) bladder operations (cystectomies) account for 15–20% of all urological procedures. They are grouped as simple, partial, and radical procedures.

Simple cystectomy is performed for benign conditions of the bladder, such as severe hemorrhagic cystitis, radiation cystitis, and contracted bladder. It involves the removal of the bladder only. The operation is performed through a lower abdominal incision. The peritoneal reflections are incised down to the pouch of Douglas; the vasa deferentia and superior vesical arteries are identified, cross-clamped, transected, and tied. The ureters are identified, separated from the surrounding tissues, cross-clamped near the bladder, transected, and tied. The bladder is bluntly separated from the anterior rectal wall all the way to the apex of the prostate. The lateral pedicles of the bladder are cross-clamped, cut, and tied. The endopelvic fascia is incised, separating the prostate from the lateral pelvic wall. The puboprostatic ligaments are transected and the dorsal vein of the penis is suture-ligated. The tied dorsal vein and urethra are incised just distal to the apex of the prostate. The specimen is delivered out of the incision and hemostasis secured with electrocautery. An ileal conduit is then performed (see below).

Partial cystectomy is the excision of only the part of the bladder containing the pathology. This is not a commonly performed operation and is reserved for tumors located in the dome of the bladder of older patients who are poor surgical risks for major operations, such as radical cystectomy. The operation is preceded by a cystoscopy to identify the site of pathology. Beginning with a lower abdominal incision, the dome and lateral walls of the bladder are separated from the surrounding tissues, which are covered by wet packs to minimize contamination. An incision is made in the dome of the bladder at least 2 cm away from the pathology. The inside of the bladder is inspected and the pathology identified. The incision in the bladder is continued around, and at least 2 cm away from, the pathology, until the latter is completely excised. Bleeders in the wall of the bladder are electrocoagulated. The bladder wall is then closed in two layers—a through-and-through layer and an inverting layer—using absorbable material. Wet packs are removed, a drain is left in the region, and the abdominal incision is closed.

Radical cystectomy (or **radical cystoprostatectomy**) is performed for treatment of invasive bladder cancer. It encompasses the removal of the bladder and the lower ureters, the prostate gland, and seminal vesicles in men (Fig. 9-13A), and the uterus, ovaries, and anterior vaginal wall in women (Fig. 9-13B). Accompanied by a **pelvic lymphadenectomy,** it is performed in the supine position, except when a concomitant **urethrectomy** is required, wherein a lithotomy position is used.

Following cystectomy, whether radical or simple, some form of **urinary diversion** is required. This can be accomplished with either a standard ileal conduit or a bladder substitution. The **ileal conduit** is constructed from 6–8 inches of terminal ileum isolated, with its blood supply, from the small intestine. The continuity of the small intestine is accomplished by a simple anastomosis. The ureters are implanted into the proximal end of the conduit and the distal end is brought through the abdominal wall as a stoma (Fig. 9-14). **Bladder substitution** is a more complex operation wherein a longer segment of bowel is isolated, with its blood supply, and fashioned into a pouch. The ureters are implanted in the pouch and the most dependent part of the pouch is connected to the membranous urethra, avoiding a stoma (Fig. 9-15). Not all patients undergoing cystectomies are candidates for bladder substitution. For example, patients who require a urethrectomy are not candidates because of the need to remove the urethra.

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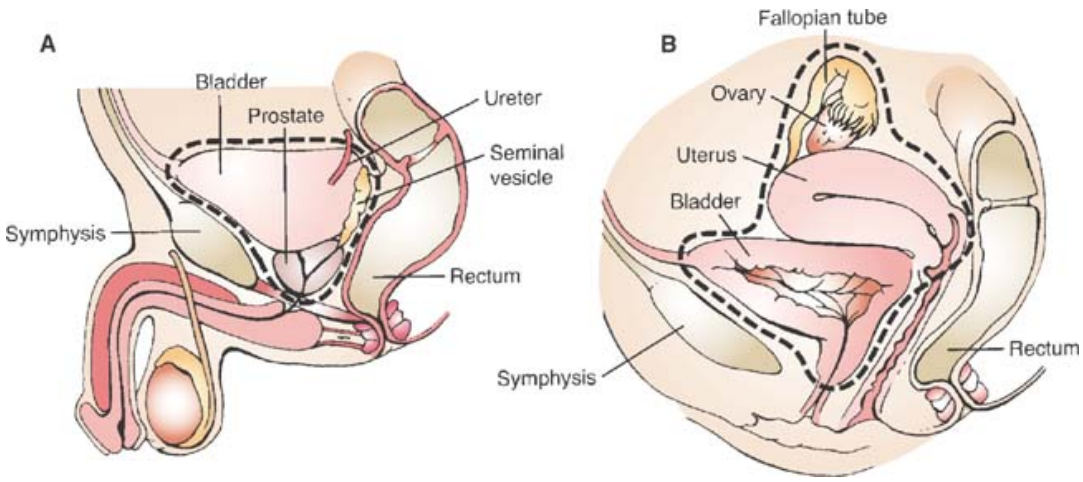

Figure 9-13. Anatomy of the pelvis with tissue to be excised outlined by dashed line: **(A)** male; **(B)** female.

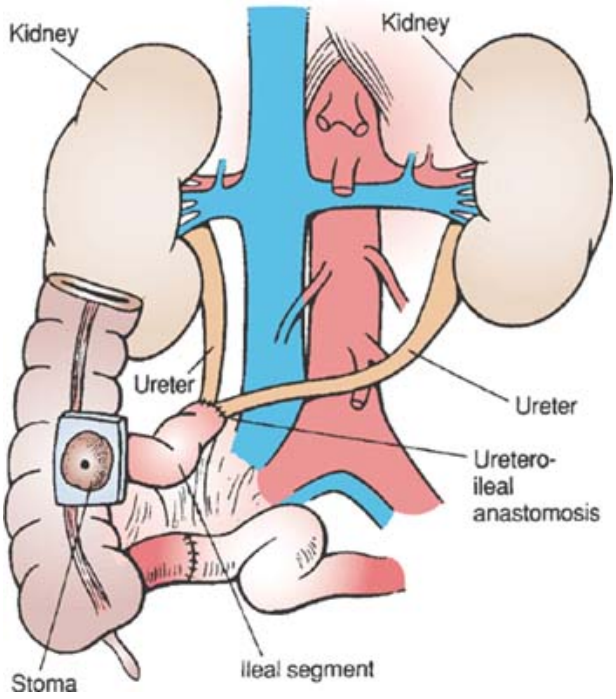

Figure 9-14. Ileal conduit: A segment of ileum is isolated from terminal ileum and continuity of the bowel is reestablished with an end-to-end anastomosis. Ureters are joined to the proximal end of the ileal segment and the distal end is brought out to the skin as a stoma.

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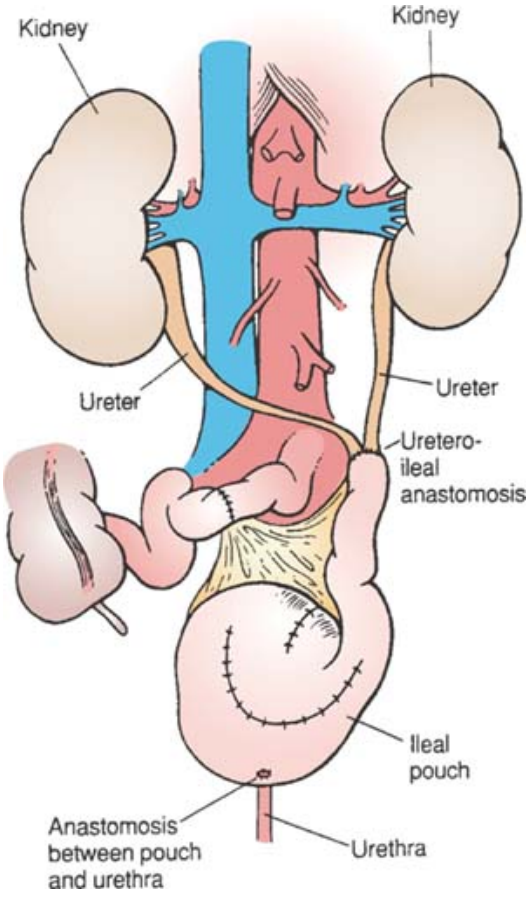

Figure 9-15. Bladder substitution: A segment of ileum is fashioned into a pouch and anastomosed to the urethra. The ureters are joined to the proximal, nondetubularized segment.

Usual preop diagnosis: Bladder cancer; contracted bladder; hemorrhagic cystitis; radiation cystitis; bladder diverticulum

Summary of Procedures

	Simple Cystectomy	Partial Cystectomy	Radical Cystectomy
Position	Supine		Supine or lithotomy
Incision	Transperitoneal, midline		
Antibiotics	Cefotetan or ceftriaxone 1 g		
Surgical time	4 h	2 h	6 h
EBL	1,000 mL	Minimal	1,500 mL
Postop care	Care of the stoma	Catheter care	Care of the stoma
Mortality	1%	< 1%	2%
Morbidity	Prolonged ileus: 5% Infection: 2%	– – Hematuria: 5%	5% 2%
Pain score	10	10	10

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Patient Population Characteristics

	Simple Cystectomy	Partial Cystectomy	Radical Cystectomy
Age range	40–80 yr		
Male:Female	3:1		
Incidence	60,000 new cases of bladder cancer diagnosed/yr; 20% treated with cystectomy.		
Etiology	Contracted bladder; hemorrhagic and radiation cystitis	Bladder cancer; bladder diverticulum	
Associated conditions	Heart disease (10%); HTN (10%); COPD (5%); diabetes mellitus (5%)	Heart disease (10%)	

Anesthetic Considerations

Preoperative

Patients presenting for cystectomy are frequently elderly and may have preexisting medical problems, including CAD, CHF, PVD, cerebrovascular disease, COPD, and renal impairment. Preop evaluation should be directed toward the detection and treatment of these conditions prior to anesthesia.

Respiratory	for pulmonary disease in older patients. **Tests:** As indicated from H&P.
Cardiovascular	for cardiac disease, HTN in older patients. **Tests:** Consider ECG; others as indicated from H&P.
Gastrointestinal	Bowel prep likely and may cause dehydration and electrolyte disturbances. **Tests:** Electrolytes, if indicated.
Hematologic	T&C for 2–4 U PRBC. **Tests:** Hct
Laboratory	Other tests as indicated from H&P.

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Premedication	Sedation prn anxiety in adults (e.g., lorazepam 1–2 mg po 1–2 h preop; midazolam 1–2 mg iv in preop area).

Intraoperative

Anesthetic technique: Spinal, continuous lumbar epidural, or GA are acceptable, with choice dependent on length of procedure, coexisting disease, and patient preference. A combined technique using GA and regional anesthesia may be preferable. A T4 sensory level is recommended, because peritoneal stimulation is likely during this procedure.

Regional anesthesia:

Spinal	0.75% bupivacaine 12–15 mg in 7.5% dextrose; hyperbaric tetracaine 10–15 mg with 200 mcg epinephrine for procedures > 3 h.
Epidural	1.5–2% lidocaine with epinephrine 5 mcg/mL, 15–25 mL; supplement with 5–10 mL as needed. Supplemental iv sedation (e.g., midazolam 1 mg iv prn; fentanyl 50 mcg iv prn). Bupivacaine (0.25–0.5%), levobupivacaine (0.25–0.5%), or ropivacaine (0.5–0.75%), with or without sufentanil or fentanyl, may also be used. The addition of opiates has been associated with ↑ urinary retention in noncatheterized patients.

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General anesthesia:

Induction	Standard induction (see p. B-2). These patients may be significantly dehydrated and require volume replacement before induction.	
Maintenance	Standard maintenance (see p. B-2).	
Emergence	No specific considerations	
Blood and fluid requirements	Significant blood loss possible IV: 16 ga × 1 NS/LR @ 6–10 mL/kg/h Warm fluids. Humidify gases.	Blood loss may be less with regional than GA.
Monitoring	Standard monitors (see p. B-1). Arterial line CVP line	Consider PA catheter in patients with cardiopulmonary disease. UO as measure of volume status may be lost during procedure.
Complications	Major blood loss 3rd-space losses Hypothermia	

Postoperative

Complications	Hypothermia	
Pain management	Morphine 0.1–0.3 mg/kg iv in incremental doses	
	Consider epidural narcotics or PCA.	See p. 1548.
Tests	Hct	Others as indicated by intraop course.

Suggested Readings

1. Marshall FF: Surgery of the bladder. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

2. Whalley DG, Berrigan MJ: Anesthesia for radical prostatectomy, cystectomy, nephrectomy, pheochromocytoma, and laparoscopic procedures. *Anesthesiol Clin North Am* 2000; 18(4):899–917.

Open Bladder Operations (Other Than Cystectomy)

Surgical Considerations

Description: Open bladder operations include:

Augmentation cystoplasty (or **enterocystoplasty**): Small, contracted bladders can be enlarged and their size and capacity augmented with a segment of intestine. The bladder is opened widely, anteroposteriorly, or from side-to-side, or with a cruciate incision. A segment of intestine— small bowel, cecum, or colon—is isolated from the intestinal tract, detubularized, and added onto the bladder.

Variant procedure: The antrum of the stomach can also be used (**gastrocystoplasty**).

Usual preop diagnosis: Contracted bladder from chronic cystitis

Repair of vesicovaginal or enterovesical fistulas: The communication between the vagina and bladder or bladder and bowel is identified and excised, and the edges freshened until normal, noninflamed tissues are exposed. The *(Print pagebreak 884)* openings in the bladder and in the vagina or bowel are closed, and omentum is interposed in between to promote healing and prevent recurrence. With enterovesical fistulas, often the diseased segment of the intestine is excised and an **end-to-end anastomosis** of the intestine is performed.

Variant procedure: Transvaginal repair of vesicovaginal fistula (see Vaginal Operations, p. 898).

Usual preop diagnosis: Vesicovaginal or enterovesical fistula

Ureteral reimplantation, performed to correct vesicoureteral reflux, is more commonly used in the pediatric group than in adults. In adults, it is performed mainly for lower ureteral injuries, iatrogenic or traumatic. The lower ureter is identified and dissected proximally until adequate length is obtained. The bladder is opened and a 2–3 cm submucosal tunnel is created in or near the trigone, and the ureter is brought into the tunnel and fixed with sutures. If there is a large gap between the ureter and the bladder, a **psoas hitch procedure** is necessary. The bladder is mobilized and stitched to the psoas muscle in order to reach the ureter. In children, if the ureter is dilated, its diameter is reduced by imbrication before reimplantation. In adults, a nonrefluxing implantation is usually not necessary if the operation is being performed for ureteral injury.

Usual preop diagnosis: Vesicoureteral reflux; lower ureteral injuries

Summary of Procedures

	Augmentation Cystoplasty	Repair of Fistulas	Ureteral Reimplantation
Position	Supine	Supine or lithotomy	Supine
Incision	Low abdominal		
Antibiotics	Gentamicin 80 mg iv, slowly		
Surgical time	4 h	3 h	
EBL	Minimal		
Postop care	Care of catheters and stents		
Mortality	< 1%		
Morbidity	Infections: 5% Urinary leakage: 1%		
Pain score	10	10	10

Patient Population Characteristics

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Age range	All ages		
Male:Female	1:4		
Incidence	Rare		
Etiology	Contracted bladders from chronic cystitis	Traumatic fistulas; vesicovaginal; regional enteritis; diverticulitis; colon cancer	Vesicoureteral reflux; injury to lower ureters

Anesthetic Considerations

Preoperative

Patients presenting for open bladder operations may be of any age, depending on the etiology of the abnormality. Elderly patients frequently have pre-existing medical problems, including CAD, CHF, PVD, cerebrovascular disease, COPD, and renal impairment. Preop evaluation should be directed toward the detection and treatment of these conditions prior to anesthesia.

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Respiratory	for pulmonary disease in elderly patients. **Tests:** As indicated from H&P.
Cardiovascular	for of cardiac disease in elderly patients. **Tests:** Consider ECG; others, if indicated from H&P.
Neurological	Paraplegics and quadriplegics may present for operations on the bladder and urinary tract. Obtain Hx of autonomic hyperreflexia (AH). Sx are: flushing, HA, nasal stuffiness, and HTN associated with voiding or noxious stimuli below level of transection.
Laboratory	Other tests as indicated from H&P.
Premedication	Sedation prn anxiety (e.g., lorazepam 1–2 mg po 1–2 h before surgery; midazolam 1–2 mg iv in preop area).

Intraoperative

Anesthetic technique: Spinal, continuous lumbar epidural, or GA are acceptable, with choice dependent on length of procedure, coexisting disease, and patient preference. A combined technique using light GA with regional anesthesia is also acceptable. A T10 sensory level is sufficient to provide anesthesia for procedures on the bladder, but a T4 level is recommended if the peritoneum is opened. (See Anesthetic Considerations for Transurethral Procedures [except TURP)] p. 861, for patients with AH.)

Regional anesthesia:

Spinal	0.75% bupivacaine 10–12 mg. For shorter procedures (< 1 hr), consider low dose bupivacaine (0.75%, 7.5 mg); mepivacaine (1.5%, 45 mg); or procaine (10%, 100–150 mg). Lidocaine may be used, but the incidence of transient neurologic symptoms is significant (30%).
Epidural	1.5–2% lidocaine with epinephrine 5 mcg/mL, 15–25 mL; supplement with 5–10 mL as needed. Supplemental iv sedation. Bupivacaine (0.25), levobupivacaine (0.25–0.5%), or ropivacaine (0.5–0.75%), with or without sufentanil or fentanyl, may also be used. The addition of opiates has been associated with ↑ urinary retention in noncatheterized patients.

General anesthesia:

Induction	Standard induction (see p. B-2).

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Maintenance	Standard maintenance (see p. B-2). Consider limiting N_2O for long intraperitoneal procedures to minimize bowel distention.	
Emergence	No specific considerations	
Blood and fluid requirements	Minimal-to-moderate blood loss IV: 16–18 ga × 1 NS/LR @ 2–4 mL/kg/h Warm fluids. Humidify gases for lengthy procedures.	Intraperitoneal procedures have considerably higher requirements (e.g., NS/LR @ 6–10 mL/kg/h).
Monitoring	Standard monitors (see p. B-1) for simpler procedures. ± Arterial/CVP lines	UO as a measure of volume status may be lost during the procedure. Consider arterial line, CVP for longer, more complex procedures.
Positioning	and pad pressure points. eyes.	* **NB:** In lithotomy position, peroneal nerve compression at lateral fibular head → foot drop.
Complications	AH in spinal cord injured patients	See discussion in Anesthetic Considerations for Transurethral Procedures, p. 862.

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Postoperative

Complications	Hypothermia Fever, bacteremia	
Pain management	Morphine 0.1–0.3 mg/kg in incremental doses. Consider epidural narcotics or PCA.	See p. C-3.
Tests	Hct Blood cultures if febrile	Others as indicated by intraop course.

Suggested Reading

1. Marshall FF: Surgery of the bladder. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

Inguinal Operations

Surgical Considerations

Description: Inguinal operations are very common, and are usually performed on an outpatient basis. Groin dissection, however, may necessitate inpatient care.

Inguinal herniorrhaphy: A 3″ inguinal incision is made, starting 1″ medial to the anterior-superior iliac spine, and ending at the pubic tubercle. The external oblique aponeurosis is excised, opening the external inguinal ring. The spermatic cord and the hernial sac are freed off the inguinal canal; then the hernial sac is dissected off the spermatic cord and followed proximally into the internal inguinal ring, where it is suture-ligated and excised. The floor of the inguinal canal is strengthened by approximating the conjoined tendon to the reflected part of the inguinal ligament. Modifications include laparoscopic repair and use of surgical mesh. Please see section 7.9 for details.

Usual preop diagnosis: Inguinal hernia (See Figs 9-16 and 9-17 for details of anatomic relationships.)

Orchiopexy is performed through the same incision as used in herniorrhaphy. After the inguinal canal is exposed, a search for the undescended testis begins. The testis and cord are dissected free from all surrounding tissue until adequate length is obtained to bring the testis down to the scrotum. Next, a pouch is created in the wall of the scrotum by incising the scrotal skin and dissecting it off dartos fascia. The testis is brought down into the pouch and fixed to the dartos fascia with sutures, and the incisions are closed.

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Often a **herniorrhaphy** is performed at the same time.

Unusual preop diagnosis: Undescended testis.

Radical orchiectomy is performed through a herniorrhaphy incision (described above). The spermatic cord is freed and cross-clamped at the internal inguinal ring, transected, and suture-ligated. The testis, with its tunica vaginalis, is then delivered through the incision by blunt and sharp dissection and the inguinal incision is closed. Sometimes, a testicular prosthesis is inserted and fixed in the scrotum before the inguinal incision is closed.

Usual preop diagnosis: Testicular cancer

Ligation of spermatic vein is performed through a small, transverse incision 1–2″ above the internal inguinal ring. Muscles are split and peritoneum reflected medially to expose the spermatic vessels; the vein is identified and ligated. This operation can also be done through a scrotal incision.

Usual preop diagnosis: Varicocele causing infertility

Groin dissection, or **inguinofemoral lymphadenectomy** (lymph node dissection), is the most critical of the inguinal operations. It is performed through either an inguinal incision (Fig. 9-17, inset) curved distally over the femoral *(Print pagebreak 887) (Print pagebreak 888)* vessels or through 2 incisions, inguinal and upper-thigh (Fig. 9-17, inset), over the femoral triangle. A complete inguinal and femoral lymphadenectomy is performed.

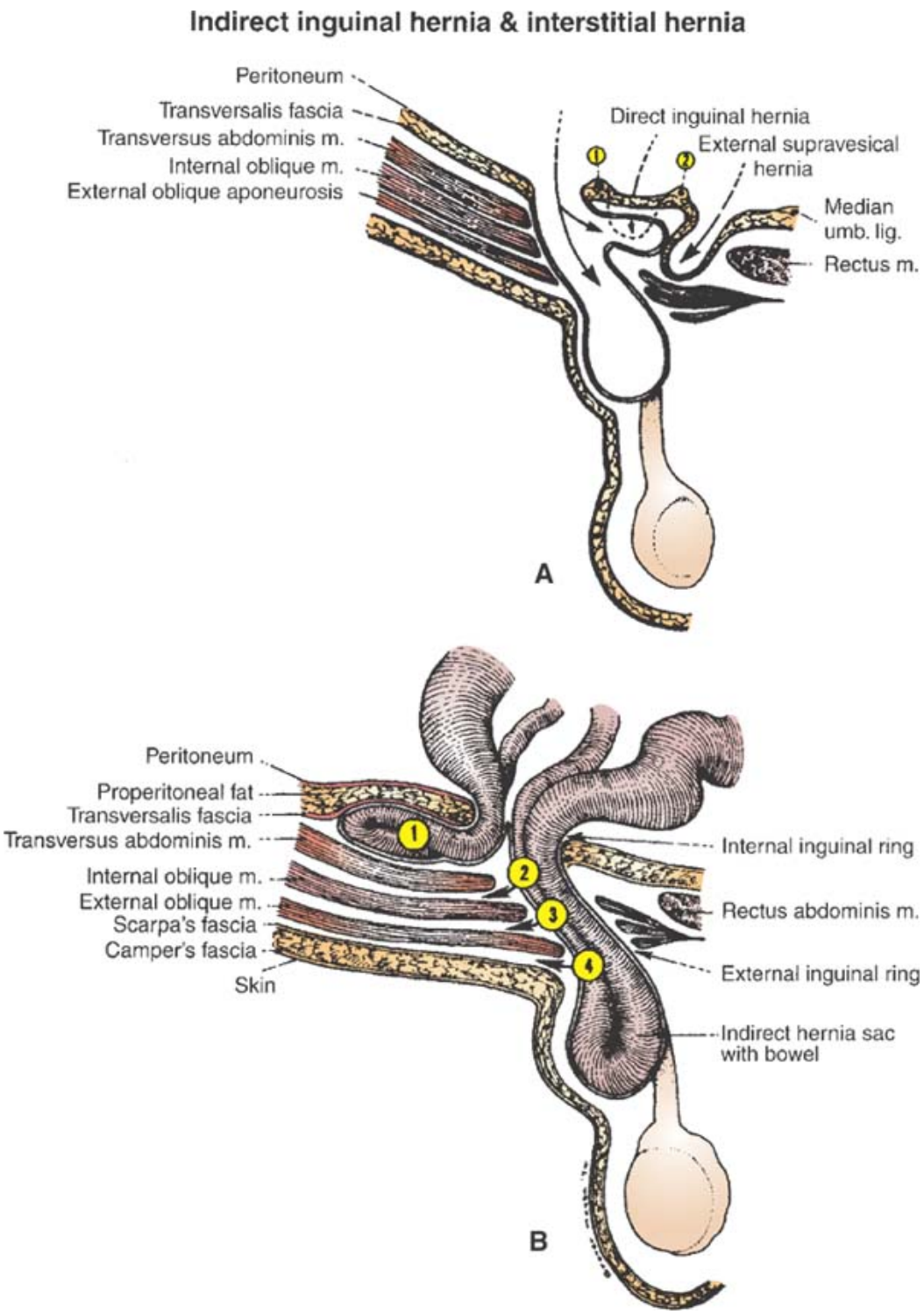

Figure 9-16. A: Relationships of four groin hernias in one patient. Indirect inguinal hernia with intraparietal diverticulum, direct hernia, and external supravesical hernia. 1 = lateral umbilical ligament; 2 = medial umbilical ligament. Arrows indicate different sites of origin of each hernia. (Reproduced with permission from Skandalakis JE, Gray SW, Burns WB, et al: Internal and external supravesical hernia. *Am Surg* 1976; 42:142.) **B:** Diagram of intraparietal hernia. The sac, entering at the internal ring may pass into any one or more spaces between layers of the abdominal wall. 1, properitoneal; 2 and 3, interstitial; 4, superficial. An indirect hernia also may be present. (Reproduced with permission form Skandalakis JE, Gray SW, Akin JT Jr: The surgical anatomy of hernial rings. *Surg Clin North Am* 1974; 54:1227.)

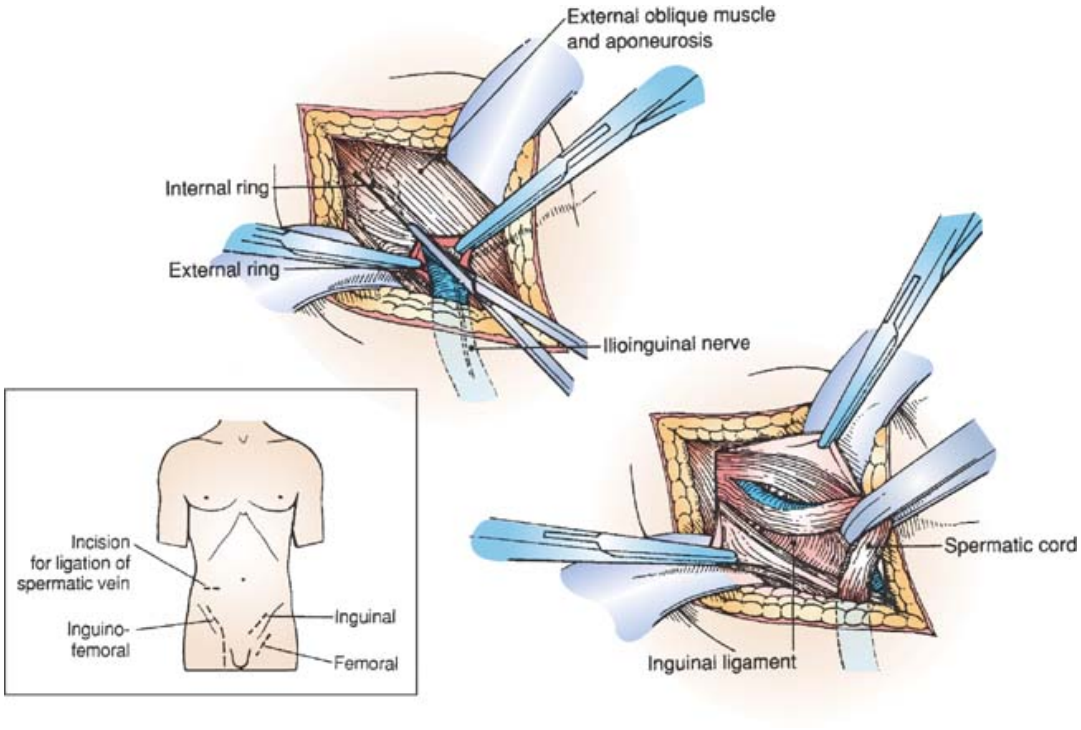

Figure 9-17. Incisions and exposure of the spermatic cord for inguinal hernia repair. (Reproduced with permission from Scott-Conner CEH, Dawson DL: *Operative Anatomy*, 2nd edition. Lippincott Williams & Wilkins, 2003.)

Usual preop diagnosis: Penile cancer

Summary of Procedures

	Herniorrhaphy, Orchiopexy, Orchiectomy	Ligation of Spermatic Vein	Groin Dissection
Position	Supine		
Incision	Inguinal (Fig. 9-17, inset)	Transverse groin (Fig. 9-17, inset)	Inguinal and upper thigh (Fig. 9-17, inset)
Antibiotics	None		
Surgical time	1 h		3 h
EBL	Minimal		200 mL
Postop care	PACU → home		PACU → ward; leg elevation
Mortality	< 1%		
Morbidity	Wound infection: 2%		
Pain score	7	5	7

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Patient Population Characteristics

Age range	All ages	Young adults	Middle age
Incidence	Hernia: 5% of population Undescended testis: 0.8% of male children Testis cancer: 6/100,000	1% of young men	Extremely rare, < 1% of all males
Etiology	Unknown; congenital	Varicocele	Penile cancer (very rare)

Anesthetic Considerations

Preoperative

Typically, patients presenting for inguinal operations are healthy, with most returning home on the day of surgery. The most common inguinal operation is herniorrhaphy. In these patients, consider causes of increased intraabdominal pressure during H&P. (Pediatric inguinal operations are discussed in Pediatric General Surgery, p. 1305.) A hernia may strangulate → acute abdomen.

Respiratory	Chronic cough is a common precipitating factor.
Gastrointestinal	Constipation may be a precipitating factor.
Laboratory	Tests as indicated from H&P.
Premedication	Sedation for adults prn anxiety (e.g., lorazepam 1–2 mg po 1–2 h before surgery; midazolam 1–2 mg iv in preop area).

Intraoperative

Anesthetic technique: Local anesthesia (with sedation), spinal, epidural, or GA are acceptable techniques with the choice dependent on patient age and coexisting disease, type and length of procedure, and patient preference. Local anesthesia is acceptable for simple herniorrhaphy, although discomfort may be elicited if the peritoneum is manipulated. If a spinal or epidural anesthetic is chosen, a T6 level should be sought. Most inguinal procedures are done on an outpatient basis, and the anesthetic should be planned appropriately.

Regional anesthesia:

Spinal	0.75% bupivacaine 10–12 mg. For shorter procedures (< 1 h), consider low-dose bupivacaine (0.75%, 7.5 mg); mepivicaine (1.5%, 45 mg); or procaine (10%, 100–150 mg). Lidocaine may be used, but the incidence of transient neurologic symptoms is significant.
Epidural	1.5–2.0% lidocaine with epinephrine 5 mcg/mL, 15–25 mL; supplement with 5 10 mL as needed. Supplemental iv sedation with local or regional technique in adults; e.g., midazolam (1–2 mg iv), fentanyl (25–50 mcg iv prn anxiety or discomfort); or propofol infusion (25–50 mcg/kg/min).

General anesthesia:

Induction	Standard induction (see p. B-2). ET intubation and/or controlled ventilation may not be needed for shorter cases; consider LMA.	
Maintenance	Standard maintenance (see p. B-2); consider propofol infusion (100–200 mcg/kg/min). Muscle relaxation usually not required.	
Emergence	No specific considerations	
Blood and fluid requirements	Usually minimal blood loss IV: 18 ga × 1 NS/LR @ 1–2 mL/kg/h	Minimize NS/LR to avoid postop urinary retention after herniorrhaphy.
Monitoring	Standard monitors (see p. B-1).	

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Postoperative

Complications	PONV Failure to void	May delay discharge from PACU → home.

Pain management	Local anesthesia Ketorolac 30 mg im or iv in adults ± morphine 2–4 mg iv or fentanyl 25-50 mcg iv	Instillation (2 min) or infiltration of wound with 0.25% bupivacaine or ilioinguinal nerve block provides prolonged postop analgesia and decreases need for narcotics in outpatients. This can be used in both adult and pediatric patients.

Suggested Readings

1. Casey WF, Rice LJ, Hannallah RS, et al: A comparison between bupivacaine instillation versus ilioinguinal/iliohypogastric nerve block for postoperative analgesia following inguinal herniorrhaphy in children. *Anesthesiology* 1990; 72(4):637–9.

2. Goldstein M: Surgical management of male infertility and other scrotal disorders. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

3. Herr HW: Surgery of penile and urethral carcinoma. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

4. Rozanski T, Bloom DA, Colodny A: Surgery of the scrotum and testis in childhood. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

Penile Operations

Surgical Considerations

Penectomy is the total or partial resection of the penis for squamous-cell carcinoma of the penile skin. If the tumor can be resected with a safe margin of at least 2 cm, partial penectomy is usually enough. A tourniquet is placed at the base of the penis, which is amputated at least 2 cm proximal to the tumor. The corpora cavernosa are sutured and the tourniquet is released, followed by inspection for bleeding. The edges of the urethra are sutured to the ventral skin and the lateral and dorsal skin edges are approximated over the ends of the corpora cavernosa. Often, an **inguinal lymph node biopsy** follows the penectomy.

Usual preop diagnosis: Squamous-cell carcinoma of the penile skin

Insertion of penile prosthesis is performed for impotence. The prosthesis is inserted into the corpora cavernosa (Fig. 9-18) through a penile or suprapubic incision. Penile prostheses are either malleable or inflatable. The latter have a reservoir in the retropubic space and a pump in the scrotum.

Usual preop diagnosis: Impotence

Hypospadias repair is performed primarily on children < 5 yr. (See Pediatric Urology, p. 1333.)

Summary of Procedures

	Penectomy	Insertion of Penile Prosthesis
Position	Supine	
Incision	Circumferential penile	Bilateral incisions at base of penis
Special instrumentation	None	
Unique considerations	None	
Antibiotics	None	Gentamicin 80 mg iv, slowly; ampicillin 2 g iv
Surgical time	2 h	
Closing considerations	None	
EBL	200 mL	

Postop care	PACU → home	
Mortality	< 1%	
Morbidity	Penile hematoma: 5%	Malfunction: 10% Edema: 5% Infection: 2% Extrusion of the prosthesis: 1%
Pain score	5	5

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Patient Population Characteristics

Age range	Adults	
Incidence	< 1% of all males	1–2% of all males
Etiology	Poor hygiene	Organic impotence

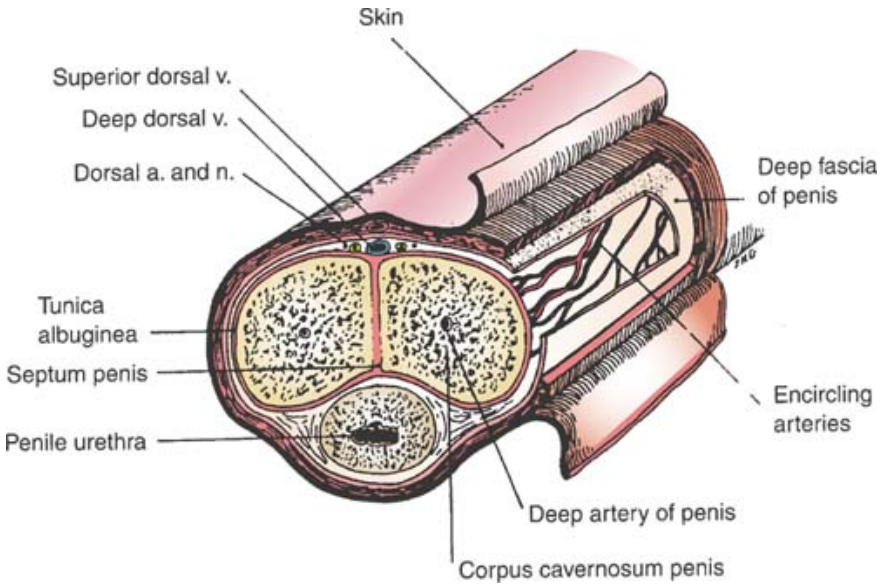

Figure 9-18. Anatomy of the penis. (Reproduced with permission from Hardy JD: *Textbook of Surgery*. JB Lippincott, 1988.)

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Anesthetic Considerations

Preoperative

Patients presenting for insertion of a penile prosthesis are frequently elderly and often have preexisting medical problems, including CAD, CHF, PVD, cerebrovascular disease, COPD, and renal impairment. Preop evaluation should be directed toward the detection and treatment of these conditions prior to anesthesia.

Neurological	Patients presenting for insertion of a penile prosthesis often have Hx of diabetes or spinal cord injury. Note presence of neuropathy or Hx of autonomic hyperreflexia (AH) (see Anesthetic Considerations for Transurethral Procedures [except TURP], p. 861). Sx suggestive of AH include HA, flushing, nasal stuffiness, and HTN associated with voiding or noxious stimuli below the level of transection. It is important to document neurological

	deficits prior to regional anesthesia.
Hematologic	Coagulation defects may be present in patients with priapism. There is a high incidence of priapism in patients with sickle-cell anemia.
Laboratory	**Tests:** Hct, if indicated from H&P. Other tests as indicated from H&P.
Premedication	Sedation prn anxiety in adults (e.g., lorazepam 1–2 mg po 1–2 h prior to surgery; midazolam 1–2 mg iv in preop area).

Intraoperative

Anesthetic technique: Spinal, caudal, or lumbar epidural and GA are acceptable, with choice dependent on length of procedure, patient age, coexisting disease, and patient preference. Sacral anesthesia (saddle block) is sufficient; lumbar epidural anesthesia may be less reliable than spinal or caudal at blocking sacral fibers.

Regional anesthesia:

Spinal	5% lidocaine 50 mg (controversial); 0.75% bupivacaine 10 mg in 7.5% dextrose; hyperbaric tetracaine 10 mg with epinephrine for longer procedures
Caudal	0.5% bupivacaine with epinephrine 5 mcg/mL 15–20 mL
Epidural	1.5% lidocaine with epinephrine 5 mcg/mL 15–25 mL; supplement with 5–10 mL as needed. Supplemental iv sedation

General anesthesia:

Induction	Standard induction (see p. B-2). ET intubation may not be necessary for shorter procedures; consider LMA.	
Maintenance	Standard maintenance (see p. B-2). Deeper levels of anesthesia usually are required to obtund autonomic reflexes (e.g., HTN, laryngospasm) resulting from intense surgical stimulation that may occur during these procedures.	
Emergence	No specific considerations	
Blood and fluid requirements	Minimal blood loss IV: 18 ga × 1 NS/LR at 2 mL/kg/h	
Monitoring	Standard monitors (see p. B-1).	
Complications	AH	See Anesthetic Considerations for Transurethral Procedures, p. 862.

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Postoperative

Complications	Urinary retention
Pain management	Morphine 0.05–0.1 mg/kg iv or fentanyl 25–50 mcg iv prn; ketorolac 30 mg im or iv

Suggested Readings

1. Herr HW: Surgery of penile and urethral carcinoma. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

2. Lewis R: Penile prosthesis. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

3. Lewis R: Surgery for erectile dysfunction. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

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4. Lynch DF, Schellhammer PF: Tumors of the penis. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

Scrotal Operations

Surgical Considerations

Description: Scrotal operations are minor, common urologic procedures, performed on an outpatient basis.

Simple orchiectomy is performed as an alternative to medical castration, using either estrogens or LH-RH agonists on men with metastatic prostate cancer for androgen ablation. It is always bilateral. A small scrotal incision is made and the testis delivered. The spermatic cord is cross-clamped, transected, and suture-ligated.

Usual preop diagnosis: Metastatic prostate cancer

Vasovasostomy is the reestablishment of the continuity of the vas deferens and restoration of fertility following a previously performed vasectomy. Through a small scrotal incision, the testis and spermatic cord are delivered. The site of previous vasectomy is identified and excised and the two ends of the vas deferens anastomosed. It is bilateral and requires the use of either the operating microscope or magnifying loupes.

Usual preop diagnosis: Infertility 2° vasectomy

Hydrocelectomy: The testis, with the surrounding hydrocele (Fig. 9-19), is delivered through a scrotal incision. The wall of the hydrocele is excised and the edges sutured around the epididymis to prevent recurrence.

Variant procedure or approach: Aspiration used as a temporizing approach since recurrence is almost 100%.

Usual preop diagnosis: Hydrocele

Spermatocelectomy: A spermatocele is a cyst of the epididymis, usually excised with the part of the epididymis from which it arises.

Variant procedure: Aspiration as a temporizing maneuver until the operation can be performed.

Usual preop diagnosis: Spermatocele or epididymal cyst

Insertion of testicular prosthesis: A small incision is made in the scrotal skin and a pouch is created by blunt dissection in dartos fascia. The prosthesis is placed in the pouch and fixed to the dartos fascia to prevent prosthesis migration.

Usual preop diagnosis: Absent testis, either congenital or following orchiectomy

Reduction of testicular torsion is an emergency operation which must be performed within 6 h of occurrence to prevent irreversible ischemic damage to the testis. Through a small scrotal incision, the testis is reduced and fixed to the dartos fascia to prevent retorsion.

Usual preop diagnosis: Acute testicular torsion

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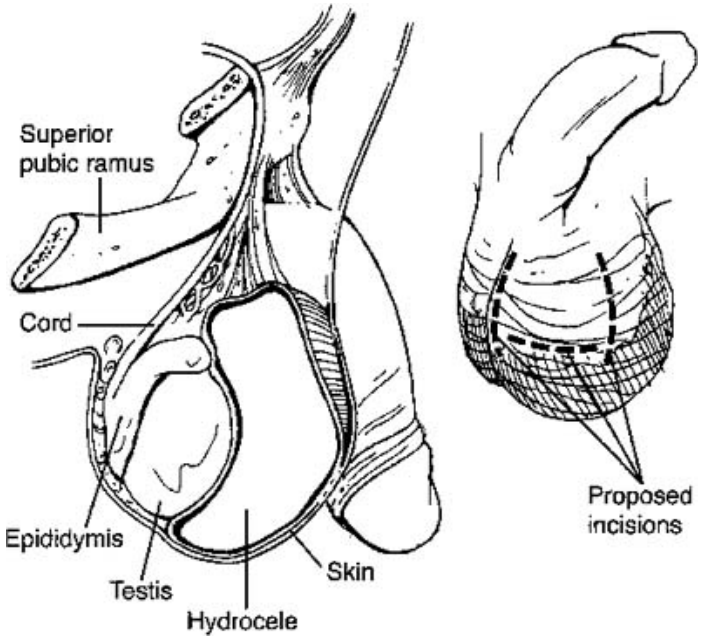

Figure 9-19. Scrotal hydrocele: scrotal incision.

Summary of Procedures

Position	Supine
Incision	Scrotal (Fig 9-19, inset)
Special instrumentation	Operating microscope: magnifying loupe for vasovasostomy
Antibiotics	None
Surgical time	1 h
EBL	Negligible
Postop care	PACU → home
Mortality	< 1%
Morbidity	Scrotal hematoma: 2% Wound infection: 2%
Pain score	4

Patient Population Characteristics

Age range	All ages
Incidence	Common
Etiology	See preop diagnosis for each procedure, above.

Anesthetic Considerations

Preoperative

Patients presenting for scrotal operations typically fall into two groups: young, otherwise healthy patients and an older population who may present with metastatic prostate cancer accompanied by other medical conditions. The latter group is the focus of this preop evaluation.

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Respiratory	Pulmonary disease may be present in elderly patients requiring orchiectomy. **Tests:** As indicated from H&P.
Cardiovascular	Cardiac disease may be present in elderly patients requiring orchiectomy. **Tests:** Consider ECG; others, if indicated from H&P.
Neurological	Document neurologic exam before regional anesthesia in patients with metastatic prostate carcinoma (spinal-cord or nerve-root compression may be present preop).
Musculoskeletal	for presence of spinal metastases if orchiectomy is done for palliation of prostate carcinoma. Extensive lumbar metastases may preclude the use of spinal or epidural anesthesia (relative contraindication). **Tests:** L-spine films if Hx suggestive of spinal metastases.
Laboratory	Other tests as indicated from H&P.
Premedication	Sedation prn anxiety (e.g., lorazepam 1–2 mg po 1–2 h prior to surgery; midazolam 1–2 mg iv in preop area).

Intraoperative

Anesthetic technique: Local anesthesia (with sedation) is acceptable for simpler operations (vasectomy, orchiectomy). Procedures that are longer or more complex may require spinal, epidural, or GA. A sensory level of T10 is required to block pain 2° testicular manipulation. Many of these procedures are done on an outpatient basis, and the anesthetic should be appropriately planned to facilitate early discharge.

Regional anesthesia:

Spinal	0.75% bupivacaine 10–12 mg. For shorter procedures(< 1 h), consider low-dose bupivacaine (0.75%, 7.5 mg) or mepivicaine (1.5%, 45 mg). Lidocaine may be used, but the incidence of transient neurologic symptoms is significant.
Epidural	1.5–2% lidocaine with epinephrine 5 mcg/mL, 15–20 mL; supplement with 5–10 mL as needed. Supplemental iv sedation with local or regional techniques (e.g., midazolam 1–2 mg, fentanyl 25–50 mcg iv prn anxiety or discomfort).

General anesthesia:

Induction	Standard induction (see p. B-2). Consider use of LMA.	
Maintenance	Standard maintenance (see p. B-2). Muscle relaxation usually not imperative. Deeper levels of anesthesia are usually required to obtund autonomic reflexes (e.g., HTN, taryngospasm) resulting from intense surgical stimulation that may occur during these procedures.	
Emergence	No specific considerations	
Blood and fluid requirements	Minimal blood loss IV:18 ga × 1 NS/LR @ 2 mL/kg/h	
Monitoring	Standard monitors (see p. B-1).	
Positioning	and pad pressure points. eyes.	***NB:** peroneal nerve compression at lateral fibular head → foot drop.

Postoperative

Complications	Peroneal nerve injury 2° lithotomy position	Peroneal nerve injury manifested by foot drop and loss of sensation on dorsum of foot. Seek neurology consultation.

Pain management	Ketorolac 30 mg im or iv in adults ± morphine 2–4 mg iv or fentanyl 25-50 mcg iv prn	Following orchiopexy, high incidence of postop pain, which may be reduced by ilioinguinal/iliohypogastric nerve blocks.

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References

1. Hannallah RS, Broadman LM, Belman AB, et al: Comparison of caudal and ilioinguinal/iliohypogastric nerve blocks for control of post-orchiopexy pain in pediatric ambulatory surgery. *Anesthesiology* 1987; 66(6):832–4.

2. Rozanski T, Bloom DA, Colodny A: Surgery of the scrotum and testis in childhood. In *Campbell's Urology,* Vol 2, 7th edition. WB Saunders, Philadelphia: 1998, 2193–209.

Perineal Operations

Surgical Considerations

Urethroplasty: Urethral strictures that do not respond to transurethral dilation and incision are corrected with urethroplasty. A transverse or longitudinal perineal incision is made and carried down to the urethra, which is dissected free from surrounding tissues. The strictured area is excised and end-to-end anastomosis is performed over a catheter. Repair of a long urethral stricture may require placement of a patch from the scrotum, foreskin, or buccal mucosa.

Variant procedure: Transurethral incision and dilation, which is associated with a 30–50% recurrence rate.

Usual preop diagnosis: Urethral stricture, usually posttraumatic

Urethrectomy: Partial or total urethrectomy is done through a longitudinal perineal incision. The urethra is dissected free of surrounding tissues and followed proximally and distally from the membranous urethra to the external urethral meatus. In total urethrectomy, a tubularized skin graft is interposed between membranous urethra and perineal skin.

Usual preop diagnosis: Urethral carcinoma

Insertion of artificial urinary sphincter, performed for incontinence, consists of a perineal incision, through which a cuff is inserted around the bulbar urethra. A suprapubic incision is made to place the reservoir and pump, which inflates and deflates the cuff.

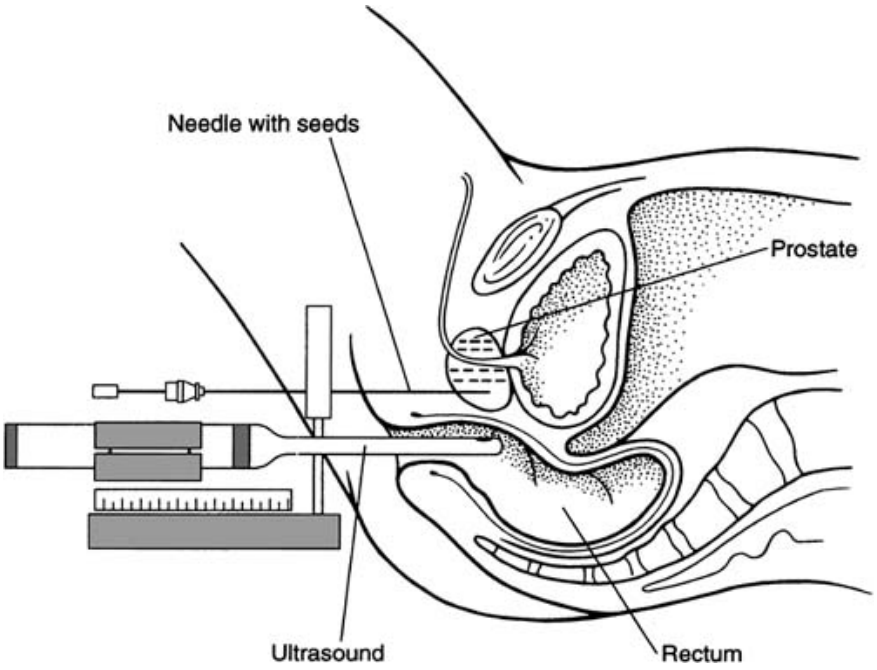

Figure 9-20. Transperineal brachytherapy of prostate gland.

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Usual preop diagnosis: Urinary incontinence

Transperineal prostate seed implantation (brachytherapy): High doses of radiation can be delivered to the prostate by implanting radioactive seeds directly into the prostate gland. Using a transrectal ultrasound probe, radioactive seeds (iodine 125 or palladium 103) are implanted into the prostate (Fig. 9-20). The patient is placed in lithotomy position, and a rectal ultrasound probe, with a perineal grid attached, is introduced to image the prostate. Radioactive seeds are then placed transperineally using preloaded needles. Preop dosing calculations determine the number and location of the seeds. This procedure is done by a combined team of radiation oncologists and urologists. No special radiation precautions are necessary for the OR team.

Usual preop diagnosis: Prostate cancer

Summary of Procedures

	Urethroplasty	Urethrectomy	Insertion of Sphincter	Brachytherapy
Position	Lithotomy			
Incision	Perineal (Fig 9-6)		and scrotal (Fig. 9-19, inset)	None
Antibiotics	Gentamicin 80 mg im/iv			
Surgical time	3 h	2 h	3 h	2 h
EBL	100 mL	300 mL	Minimal	
Postop care	PACU → home			PACU, outpatient
Mortality	< 1%			
Morbidity	Wound infection: 2%		Erosion of the urethra: 10% Extrusion of sphincter: 2%	Urinary retention
Pain score	3	3	4	3

Patient Population Characteristics

Age range	All ages	Adults	Older adults	50–80 yr
Incidence	< 1% of urologic procedures		2% of radical prostatectomy	10% of prostate cancer
Etiology	Traumatic strictures	Unknown	Radical prostatectomy (2%); incontinence	Aging

Anesthetic Considerations

Preoperative

This is a generally healthy patient population; preop considerations should be based on H&P.

Laboratory	Tests as indicated from H&P.
Premedication	Sedation prn anxiety in adults (e.g., lorazepam 1–2 mg po 1–2 h prior to surgery; midazolam 1–2 mg iv in preop area).

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Intraoperative

Anesthetic technique: Spinal or GA are acceptable, with choice dependent on length of procedure, position, patient age, coexisting disease, and patient preference. A sacral sensory level (saddle block) is usually sufficient. Lumbar *(Print pagebreak 898)* epidural anesthesia may be less reliable at providing sacral anesthesia, and offers no advantages over the above techniques for shorter procedures, although caudal anesthesia may be an acceptable alternative.

Regional anesthesia:

Spinal	0.75% bupivacaine 10 mg in 7.5% dextrose: hyperbaric tetracaine 10 mg (with epinephrine [200 mcg] for longer procedures)
Caudal	0.5% bupivacaine with epinephrine 5 mcg/mL 15–20 mL. Supplemental iv sedation.

General anesthesia:

Induction	Standard induction (see p. B-2). Consider use of LMA.	
Maintenance	Standard maintenance (see p. B-2); muscle relaxation usually not required. Deeper levels of anesthesia are usually required to obtund autonomic reflexes (e.g., HTN, laryngospasm) resulting from intense surgical stimulation that may occur during these procedures.	
Emergence	No specific considerations	
Blood and fluid requirements	Minimal blood loss IV:18 ga × 1 NS/LR @ 2 mL/kg/h	
Monitoring	Standard monitors (see p. B-1)	
Positioning	and pad pressure points. eyes.	Patients with arthritis or other musculoskeletal disorders may not tolerate the exaggerated lithotomy position, thus precluding the use of a regional technique. ***NB:** In lithotomy position, peroneal nerve compression at lateral fibular head → foot drop.
Complications	Anticipate ↓ BP on return from lithotomy position.	Rx: volume (200–500 mL NS/LR) or ephedrine (5 mg iv) may be necessary.

Postoperative

Complications	Peroneal nerve injury 2° lithotomy position	Peroneal nerve injury manifested as foot drop with loss of sensation over dorsum of foot. Seek neurology consultation.
Pain management	Mild-to-moderate pain	Rx: morphine 0.05–0.1 mg/kg iv prn

Vaginal Operations

Surgical Considerations

Description: Vaginal operations are performed by both urologists and gynecologists. They include the following:

Repair of vesicovaginal fistulas: The vaginal approach is usually recommended for small and distally located vesicovaginal fistulas; otherwise, a transabdominal repair is performed (see Open Bladder Operations, p. 883). An incision *(Print pagebreak 899)* is made in the anterior vaginal wall around the fistula, which is excised. Bladder and vaginal walls are separated and closed with interposition of tissues or flaps to separate the incisions and prevent recurrence. A Foley catheter is left indwelling.

Variant approach: Transabdominal repair of vesicovaginal fistula (see Open Bladder Operations, p. 883).

Usual preop diagnosis: Vesicovaginal fistula

Operations to correct stress urinary incontinence: Many procedures have been designed to correct female urinary incontinence. They fall into two basic groups: (a) operations to correct hypermobility of the urethra, and (b) operations to correct nonfunctioning urethra. The operation most commonly used by urologists to correct hypermobility is the **Stamey procedure** (Fig. 9-21), or **vesical neck suspension.** The operation is performed through two small suprapubic incisions, one on each side of the midline, and an anterior vaginal incision. A nylon suture is placed in a loop from either side of the bladder neck and not around it. Cystoscopy is used to ensure proper placement and to prevent the suture from transversing the bladder. When the sutures are pulled up and tied over the anterior rectus sheath, they pull the bladder neck up to its original position behind the symphysis pubis and restore the acute posterior ureterovesical angle. A variant of this procedure is the **Raz bladder neck suspension,** where bolsters are not used.

Operations to correct a nonfunctioning urethra include **submucosal collagen injection** at the bladder neck or construction of a **sling.** Rectus fascia, fascia lata of the thigh or the vaginal wall can be used to construct a sling around the urethra. All these techniques involve a combined suprapubic and vaginal approach.

Sling operations are the most common procedures done for correction of stress incontinence. These procedures can be done vaginally or open via a suprapubic incision. A variety of materials, both natural and synthetic, have been used. Many modifications have been made with reference to the placement of anchorage of the sling; therefore, there are a large number of procedures with different names utilizing the same principle. Most slings are placed midurethra.

Variant approach: The **Marshall-Marchetti-Krantz operation,** which is performed retropubically, sutures the anterior portion of the urethra, bladder neck, and bladder to the pubic bone. Other modifications include laparoscopic suspensions and ligament surgery. Some patients have cystoceles and rectoceles, which can be repaired at the same time as the vaginal sling surgery.

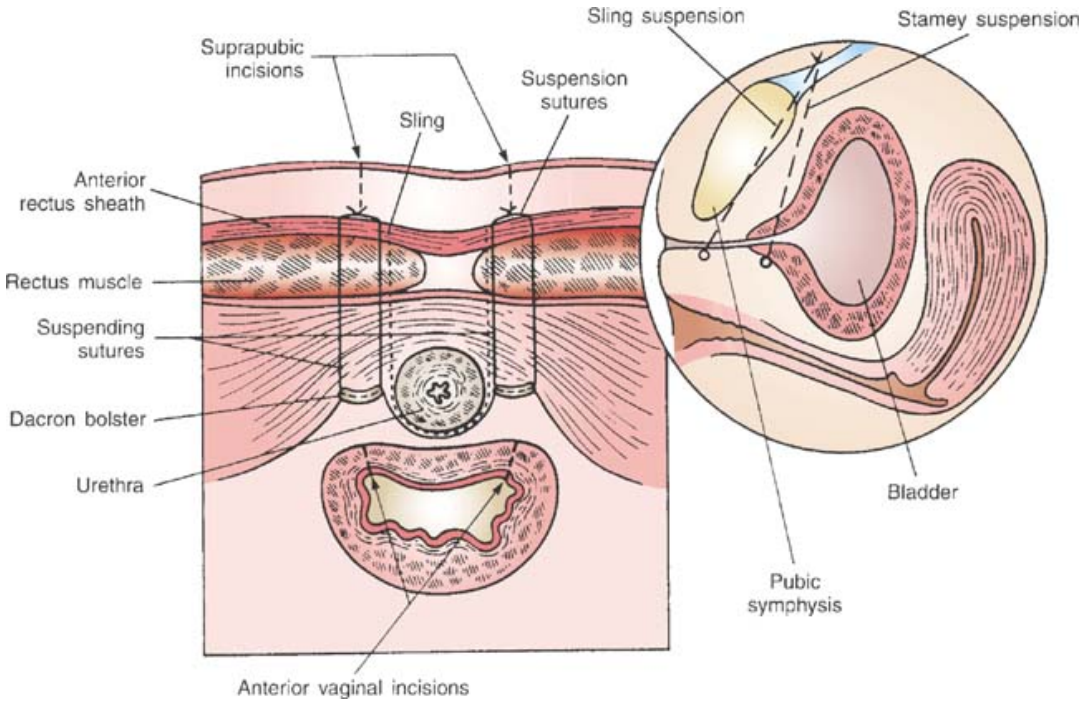

Figure 9-21. Stamey and sling procedures, sectional view; inset shows lateral view.

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Usual preop diagnosis: Stress urinary incontinence

Excision of urethral diverticulum: Urethral diverticula are extremely rare and need excision only if they are the cause of recurrent UTIs. An incision is made in the anterior vaginal wall over the urethral diverticulum, which is dissected all around until it is attached only by its neck. It is excised and the neck closed. A Foley catheter is left indwelling, and the vaginal incision is closed.

Usual preop diagnosis: Recurrent UTI 2° infected urethral diverticulum

Repair of cystocele and rectocele: Some patients with urinary incontinence also present with prolapse of the bladder or rectum into the vagina. These can be repaired at the same time as incontinence surgery. A vaginal incision (anterior for cystocele, posterior for rectocele) is made and dissected laterally to free the bladder or rectum from the vagina. The defect is repaired and the redundant

vaginal wall excised.

Usual preop diagnosis: Incontinence with pelvic prolapse, cystocele, or rectocele

Summary of Procedures

	Repair of Vesicovaginal Fistula	Correction of Stress Incontinence	Excision of Urethral Diverticulum
Position	Lithotomy		
Incision	Anterior vaginal	Anterior vaginal; suprapubic	Anterior vaginal
Special instrumentation	None	Cystoscope	None
Antibiotics	Gentamicin 80 mg iv, slowly		
Surgical time	2 h	1 h	
EBL	200 mL	500 mL	200 mL
Postop care	PACU → room		
Mortality	< 1%		
Morbidity	Infection: 2% Recurrence: 2%	10% Urinary retention: 20%	
Pain score	3	5	3

Patient Population Characteristics

Age range	20–80 yr		
Incidence	< 1% of urologic procedures	5% of urologic procedures	< 1% of urologic procedures
Etiology	Traumatic delivery; iatrogenic following hysterectomy (< 1%)	Childbirth	Congenital (extremely rare)

Anesthetic Considerations

Preoperative

This is a generally healthy patient population. Preop considerations should be based on H&P.

Laboratory	Tests as indicated from H&P.
Premedication	Standard premedication (see p. B-1).

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Intraoperative

Anesthetic technique: Spinal, continuous lumbar epidural, or GA are acceptable, with choice dependent on age, coexisting disease, and patient preference. A block level of T9-T10 is recommended for operations involving the bladder, whereas somewhat higher levels of anesthesia may be necessary if a suprapubic incision is made. Epidural anesthesia may be less reliable than spinal in providing sacral anesthesia.

Regional anesthesia:

Spinal	0.75% bupivacaine 10–12 mg (1.6 mL)

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Epidural	2% lidocaine with epinephrine 5 mcg/mL, 15–20 mL. Supplemental iv sedation.	
General anesthesia:		
Induction	Standard induction (see p. B-2).	
Maintenance	Standard maintenance (see p. B-2). Muscle relaxation not imperative.	
Emergence	No specific considerations	
Blood and fluid requirements	Minimal blood loss IV: 18 ga × 1 NS/LR @ 2–4 mL/kg/h	
Monitoring	Standard monitors (see p. B-1).	
Positioning	and pad pressure points. eyes.	***NB:** In lithotomy position, peroneal nerve compression at lateral fibular head → foot drop.
Complications	Anticipate ↓ BP when returning from lithotomy.	Rx: volume (200–500 mL NS/LR) or ephedrine (5 mg iv) may be necessary.
	Bladder perforation	Bladder perforation may present as shoulder pain in the awake patient, but may go unnoticed in the patient under GA. Sx include unexplained HTN, tachycardia, ↓ BP (rare).

Postoperative

Complications	Peroneal nerve injury 2° lithotomy position Bladder perforation (see above).	Peroneal nerve injury is manifested as foot drop with loss of sensation on dorsum of foot. Seek neurology consultation.
Pain management	Consider ketorolac 30 mg iv/im in adults; supplement with morphine 0.05–0.1 mg/kg iv prn.	

Suggested Readings

1. Leach GE, Trockman BA: Surgery for vesicovaginal and urethrovaginal fistula and urethral diverticulum. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

2. Raz S, Stothers L, Chopra A: Vaginal reconstructive surgery for incontinence and prolapse. In *Campbell-Walsh Urology*, 9th edition. WB Saunders, Philadelphia: 2006.

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Special Considerations for Robotic-Assisted Laparoscopic Procedures

Anesthetic Considerations

The anesthestic considerations for the majority of laparoscopic and robotic procedures on the urologic system are similar, and are thus summarized in this section rather than repeated for each individual procedure.

Intraoperative

Anesthetic technique: In general, since laparoscopic surgery involves insufflation of the abdomen with CO_2, and may also require steep Trendelenburg position, GA with tracheal intubation and controlled ventilation is the technique of choice.

General anesthesia:

Induction	Standard induction (see p. B-1)	
Maintenance	Standard Maintenance (see p. B-2). Muscle relaxation advised.	
Emergence	Ensure airway patency (subcutaneous emphysema → airway compromise)	
Blood and fluid requirements	IV: 16–18 ga x 1 LR/NS @ 2–6 mL/kg/hr warm fluid, humidify gasses	Blood loss may be difficult to estimate. In general, less than for open procedures.
Monitoring	Standard monitors (see p. B-1) ± arterial line ± CVP	Consider invasive monitors for nephrectomy, prostatectomy
Positioning	and pad pressure points.	Prolonged duration of robotic procedures in lithotomy position of special concern (peroneal nerve injury).
Complications	CO_2 insufflation	→↑ intra-abdominal pressure → ↓ venous return, ↓ BP; also ↑ airway pressure, ↑ PCO_2/$ETCO_2$ * **NB:** right mainstem intubation can occur because of shift of diaphragm cephalad.
	Retroperitoneal gas insufflation	→ subcutaneous emphysema (can track to head and neck → airway compromise), pneumothorax.
	VAE	Gas embolism via prostatic venous sinuses reported

Postoperative

Complications	Peroneal nerve injury (foot drop) Upper airway obstruction	Other pressure point injuries may occur 2° subcutaneous emphysema tracking up to the head and neck
Pain management	Consider ketorolac 30 mg iv/im in adults	Pain less than for open procedures. Supplement with morphine 0.05–0.1 mg/kg iv prn, followed by PCA.
Tests	Hct	If excessive blood loss

Suggested Readings

1. Conacher ID, Soomro NA Rix D: Anaesthesia for laparoscopic urological surgery. *Br J Anaesth* 2004; 93(6): 859–64.

2. Nelson JB: Debate: open radical prostatectomy vs. laparoscopic vs. robotic. *Urol Oncol* 2007; 25(6): 490–3.

3. Zorn KC, Gofrit ON, Orvieto MA, et al: Da Vinci robot error and failure rates: single institution experience on a single three-arm robot unit of more than 700 consecutive robot-assisted laparoscopic radical prostatectomies. *J Endourol* 2007; 21(11):1341–4.

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