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Perspectives

Recovery Strategies from the OR to Home

In This Issue

The annual incidence of spinal cord injury (SCI) is approximately 7,800 new cases each year. SCI primarily affects young adults, most frequently from motor vehicle accident. However, the percentage of persons older than 60 years of age with SCI is increasing. Pressure sores are the most common secondary condition among people with SCI along with respiratory complications, urinary tract infections, spasticity, and scoliosis. In their article Dr. Carey and Ms. Lasko describe the nursing management during the acute stages of SCI to help ensure survival through this critical period.

More than 56,000 Americans were diagnosed with bladder cancer in 2004 and about one-third of the cases are invasive. More than 12,000 Americans will die of bladder cancer this year and the expected prognosis for people with advanced bladder cancer that has spread to other organs is less than one year. For invasive bladder cancer, the surgeon may remove a portion or the entire bladder (cystectomy). Once the bladder is removed, surgeons must construct another way for urine to leave the body – a continent urinary diversion.

Ms. Sims in her article describes the several different types of continent urinary diversions and the nursing-care consideration to minimize postoperative complications.

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Acute Stages of Spinal-Cord Injuries

By Mary G. Carey (Adams) RN, PhD, and Madonna Lakso RN, CCRN

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In May 27, 1995, Christopher Reeve's headfirst tumble from a horse in Virginia resulted in severe damage to his second cervical spinal vertebra (C2), turning him into a quadriplegic. Thus, began his courageous, decade-long battle to reclaim his life. As an actor, he played Superman; as a man, he was a hero for people with spinal-cord injuries.

In the United States, 7,800 spinal-cord injuries (SCI) are reported annually. However, many feel that spinal-cord injuries are significantly under-reported, because they are not recorded in the following cases: people who die instantly, people with little or no remaining neurological deficit, and people who have neurological problems secondary to tumor that are not classified as SCI.

SCIs occur more often in the summer months, on Saturdays, and during daylight hours. Not surprisingly, motor vehicle accidents (48%) account for the majority of SCI, while falls (21%), violent crimes (15%), sports (14%; mostly diving accidents), and medical tumors (2%) account for the remainder. Men (82%) are much more likely to suffer from SCI. Regardless of gender; substance abuse and alcohol intoxication are substantial risk factors for SCI.[1]

Pathophysiology of a spinal-cord injury

Regardless of the mechanism, spinal-cord injuries have the following three common abnormalities that lead to tissue damage[2]:

- destruction from direct trauma
- compression by bone fragments or disk matter
- ischemia secondary to impingement of the spinal arteries

When synaptic connections are suddenly interrupted, the following events rapidly ensue:

1. The impact of force damages nerve cells.
2. There is a loss of normal blood flow, swelling of tissue, breakdown of cell structure, and loss of myelin sheathing.
3. The flow of ionic current is disrupted when the higher concentrated calcium ions on the exterior of the nerve cells leak interiorly and flood the neuron.

In the process of regaining ionic concentrations, calcium sets off a cascade of self-destructive cellular events. Enzymes that digest tissue (phospholipase) are released from the broken cell membrane. This results in the release of free radicals, which contribute to the imbalance by attacking nearby healthy cells. This activity triggers a process called lipid peroxidation. The oxygen breakdown of essential cell lipids leads to more swelling, as water enters tissue from the blood and cerebrospinal fluids. Cellular breakdown accelerates with the release of toxic substances that compromise blood flow. Injury promotes the release of neural substances, such as serotonin, catecholamines, and endorphins. Glutamate, normally the main excitatory transmitter, expresses its toxicity in large doses by overloading neuronal circuits.[3]

The most obvious symptom is paralysis due to swelling of the spinal cord. This paralysis may improve as swelling subsides, usually three or more weeks after the initial injury. Within a year, most

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Supported by an educational grant from Dale Medical Products Inc.

Bladder Cancer Surgery:
Postoperative Care of Patients with Continent Urinary Diversions

by Terran W. Sims, ACNP,MSN, RN

More than 56,000 Americans were diagnosed with bladder cancer in 2004.[1] While the majority of bladder cancers are superficial, i.e., they do not invade the bladder wall muscle, about one-third are invasive. Superficial tumors respond well to local therapy, but the recurrence rate can be as high as 30-70% and the risk of progression to invasive cancer during follow-up can be as high as 10-30%.[2] More than 12,000 Americans will die of bladder cancer this year and the expected prognosis for people with advanced bladder cancer that has spread to other organs is less than one year.[1,3]

Other indications for bladder surgery include[6]:

- neurogenic bladder that threatens kidney function
- congenital abnormalities, including bladder entrophy, epispadias, or cloacal exstrophy
- fibrosis
- cystitis arising from exposure to external beam radiation or interstitial radiation for cancers, such as pelvic or gynecological cancers.

During bladder surgery (cystectomy), the surgeon may remove a portion of the patient's bladder (partial cystectomy), section of bladder wall (segmental cystectomy), or the entire bladder (radical or total cystectomy). Once the bladder is removed, surgeons must construct another way for urine to leave the body – a continent urinary diversion.

There are several options for construction of a continent urinary diversion for urinary drainage. The surgeon and patient may choose a diversion that drains urine continuously to a pouch (ileal conduit) or a dry diversion with an ileocecal pouch that contains urine for later catheterization (Indiana, Florida, Miami, or Mainz pouch) or regular voiding (neobladder). Knowledge of each option is key to understanding nursing-care considerations in the postoperative period.

Continent urinary reservoirs

A variety of continent urinary reservoirs have been developed since 1950. Common ileocecal pouches, ileal pouches, and orthotopic bladders (i.e., neobladders) vary, depending on the type of bowel that is used for its creation and the flap or valve design.

The goal of any technique is to create[8]

- high-capacity, low-pressure pouch
- anti-refluxing approach with continent mechanism
- catheterizable stoma

The most common reservoirs are the Kock and ileocecal pouches. The Kock pouch uses >90 cm of ileum and small bowel to create a reservoir with a nipple valve.[4] While it provides the necessary components of any reservoir, the Kock pouch has mixed reviews for success. Experienced surgeons report success rates for daytime continence as high as 94%.[5] However, its use is limited, as other diversion options, which incorporate large bowel segments and report lower complication rates, have come into vogue.

The ileocecal pouch incorporates large bowel segments from the right colon and distal ileum. Several types exist, including the Miami, Florida, Mainz, and Indiana pouches.

The Indiana pouch was developed at the University of Indiana and incorporates an ileocecal valve as part of the continence mechanism.[6] This pouch is created with detubularized bowel. The surgeon transects the bowel to create a low-pressure but high-capacity reservoir. The ureters are implanted into the side of the reservoir. A nipple valve is constructed, then attached to the skin. A segment of bowel wall is used to form a stoma at the exit site. The ureters may be anastomosed in a refluxing or non-refluxing manner, based on surgical preference.

Another technique is the Mitrofanoff procedure, which uses the appendix to form a subepithelial anti-refluxing tunnel that leads to a continent catheterizable vesicostomy stoma.[7] This stoma can be placed at the umbilicus for a more cosmetic effect. The Mitrofanoff procedure is thought to alleviate the problem of maintaining continence in a surgically reconstructed bowel.

Both approaches are widely used today. Combining a reconstructed bowel reservoir with the Mitrofanoff procedure provides the best of both worlds, allowing for excellent continence, both daytime and nighttime.

The stoma of an ileocecal pouch is small and flush with the skin. Its location can be midline, at the umbilicus, or in the lower right abdominal quadrant.

The neobladder allows for a more anatomically natural urinary diversion, as it is anastomosed to the native urethra. This procedure goes by many names, including the Camey, Chimney, Hautmann or Hemi-Kock. A detubularized segment of intestine, usually ileum about 50- to 70-cm long, is used to construct a reservoir for urine storage. The ureters are implanted into the reservoir, which in turn is anastomosed to the native urethra. The external urethra is intact, so the patient is potentially continent. In most cases, patients experience daytime continence and have some risk of nighttime incontinence with large urine volumes. The Chimney modification uses an extra length of reservoir to reach the native urethra with less tension.[8,9]

Potential complications

The Kock and ileocecal pouches have potential complications that patients must consider preoperatively. Metabolic complications with the Kock pouch may arise from the segment of intestine that is used. These and other complications include metabolic acidosis, hypokalemia, hypomagnesia, and chronic renal insufficiency due to increasing blood urea nitrogen (BUN) and creatinine levels. Other issues are the formation of urinary calculus, ureteral reflux, and stoma incontinence. Based on these potential complications, many surgeons have chosen to use the large bowel procedure to construct an Indiana pouch or similar variation.

Complications of the ileocecal pouch include stoma incontinence, difficult catheterization, urinary calculus, leakage at the anastomosis, altered bowel resorption, pyelonephritis, bacteriuria, stomal stenosis, electrolyte abnormalities, and vitamin B12 deficiency, secondary to the use of terminal ileum. Pouch rupture is a rare complication, as the valve may leak, causing urinary incontinence before rupture. Long-term incontinence may develop as a secondary problem.

With the neobladder, potential complications include metabolic abnormalities, such as metabolic acidosis (which may resolve over time with adaptation), vitamin B12 deficiency (secondary to malabsorption with use of terminal ileum), urinary retention, incontinence, stenosis of the urethral anastomosis, fistula, or urinary calculi. Rupture of the neobladder is a rare complication, secondary to a poor sensation of fullness, coupled with poor bladder emptying.

Preoperative considerations for continent urinary diversions

Selection of the best diversion for each patient is crucial. Patients are encouraged to have a second choice of urinary diversion, if the first choice is not possible intraoperatively, secondary to contradictions. The most common reason

for not creating the selected diversion is cancer in the surgical margins, which prevents a curative operation and/or anatomical impossibilities due to the lack of sufficient bowel for creation of a pouch or neobladder.

The patient's motivation for self-care after surgery and over the long term is key to success; it should be assessed preoperatively. If the patient will require a caregiver, an ileal conduit may be the best choice for ease of care. Preoperative education will depend on which diversion is selected. The idea that the patient may awaken from surgery with a different diversion than the first choice must be emphasized, as intraoperative challenges may affect the final choice of surgical procedure.

Patients, family, and support-system members should be involved early to anticipate home care, until the patient can function independently with the diversion. Unrealistic expectations can lead to patient and caregiver frustration postoperatively.

Preoperative selection of the best stoma location should be performed, even if the patient believes that they have a good chance of a neobladder or cutaneous pouch. The pouch stoma can be located in an alternative area, even if a stoma site is marked for an ileal conduit. This selection can lead to the discussion of flexibility for surgical choice of a diversion, based on intraoperative findings.

The patient who selects a neobladder preoperatively should learn about clean intermittent catheterization (CIC) in anticipation that it may be needed until good bladder emptying habits are established. Learning CIC is useful, in case complications, such as anastomotic strictures or urinary retention, arise.

Bowel preparation is completed prior to surgery. Usually patients have a clear liquid diet for 1-3 days preoperatively and use laxatives (e.g., Fleets Phospho-Soda and bisacodyl tablets) for mechanical cleansing on the day before surgery. Patients may receive oral antibiotics, such as neomycin or erythromycin, for reduction of bowel flora.[8]

Postoperative care

Postoperative nursing care employs all general principles of surgical nursing, with special attention to the drains and catheters for continent urinary diversion. The general care of these patients includes a need for early ambulation and a focus on return of bowel function. While the length of hospitalization can range from 7-10 days, it depends on these two factors.

When bowel function has returned, as evidenced by the passing of flatus and small stools, the patient can be switched to oral pain medication and an advancing dietary regimen. Bowel function usually returns in 7 days, so parenteral hyperalimentation is not required.

Table 1. **Postoperative Issues**

Security of ureteral stents	Dislodgment requires immediate notification of the surgeon for evaluation
Output from surgical drains	An increase in JP or Penrose drainage may represent a urine leak or bleeding; the surgical team should be notified. A fluid sample should be sent to the laboratory for evaluation.
Malecot and Foley catheter	These devices should be patent and draining at all times. Decreased urine output should be investigated. Gentle irrigation of the Malecot catheter should restore drainage. If urine does not drain after irrigation and removal of mucous plugs, the surgical team should be notified. This problem could lead to undue tension on surgical anastomoses, secondary to obstruction. Dehydration could be the issue; assessment of fluid input and output should be assessed and recent serum lab markers evaluated for renal function.
Pain	Immediate postoperative pain can be managed effectively with an epidural and parenteral narcotics for breakthrough pain. After GI motility is established, oral pain medication can be used.
Cardiovascular and pulmonary issues	DVT prophylaxis should include heparin and compression stockings as well as early ambulation, which helps to prevent cardiovascular and pulmonary complications, such as PE, atelectasias, pleural effusions, and pneumonia.
Self-care and irrigation of catheters	The nursing staff should teach the patient/family caregiver to irrigate the Malecot and Foley catheters every 3-4 hours for consistent drainage and removal/flushing of mucous plugs. Home care is supportive, but it cannot provide complete care in every 24-hour period. Self-care and caregiver support should be taught early to prepare the patient for home care.

In selected cases when poor wound healing is anticipated, e.g., post-pelvic radiation, immediate postoperative hyperalimentation may be useful until bowel function returns and the patient shows signs of granulating tissue. A nasogastric tube is placed to provide gastric drainage and bowel decompression. Once the patient passes flatus, the nasogastric tube can be removed and the patient's diet can be slowly advanced, starting with ice chips and clear liquids.

Epidural catheters can be used for postoperative pain management, supplemented with parenteral narcotics for breakthrough pain. Once bowel function has returned, the epidural may be discontinued. The patient can switch to an oral regimen and may receive a stool softener to prevent constipation.

Early ambulation is key in moving the recovery process forward and preventing cardiovascular and pulmonary complications. It can be initiated as early as postoperative day one. The patient's drains and tubes will need to be supported during ambulation, but this necessity should not deter the staff or patient.

Preventing deep venous thrombosis (DVT) is key, based on length of surgery and immobilization. The use of subcutaneous heparin and compression stockings is standard for any abdominal surgery and continues throughout hospitalization with discontinuation at discharge. Patients with lower extremity edema may elect to continue to use support/compression stockings at home for several more days to assist in the mobilization of postoperative fluid. Incentive spirometry, coughing, deep breathing, and turning can help to prevent respiratory complications.

While postoperative care of a continent urinary diversion and new ileal conduit is similar, some special differences exist. Patients with an ileocecal pouch have abdominal drains and tubes to rid the body of serous sanguineous fluid and urine and to prevent tension on suture lines and internal anastomoses. Because many anastomoses are found in the internal reservoir, there is need for consistent irrigation and monitoring of fluid input and output. Continuous monitoring of fluid input and output volumes and ensuring that drains and tubes are free of kinks and obstructions are important nursing-care considerations.

An ileocutaneous pouch has ureteral stents, a Malecot catheter for irrigation and drainage, a Foley catheter through the stoma or, with the neobladder, through the urethra, to provide drainage immediately after surgery, and a left lower abdominal Jackson-Pratt or Penrose drain. The patient may have more than one drain, depending on the extent of pelvic surgery.

Stents are placed through stab wounds. They are temporary, yet so important. While in place, they drain the largest volume of urine. They can be connected to individual drainage bags or placed inside a urostomy pouch for urine collection and drainage. They are placed to allow for healing of the ureteral anastomosis and

Table 2. **Postoperative irrigation of continent urinary diversions**

Diversion with Malecot/Foley	Immediate postoperative care	Before discharge	Home regimen	After Foley removal
Ileocecal pouch Indiana pouch	Every 2-3 hours and with any decrease in urine output	Every 4 hours, day and night	Every 4 hours with option of every 5 hours at night after 1st clinic visit, postoperative week 3, and Foley removal	Self-catheterization every 2-3 hours and bedside drainage at night
Neobladder	Every 2-3 hours and with any decrease in urine output	Every 4 hours, day and night	Every 4 hours until 1st clinic visit, postoperative week 3, and Foley removal	Voiding every 2-3 hours day time and every 4 at night with PVR check, option of bedside drainage bag at night

prevention of hydronephrosis. Nurses should monitor them to ensure that they remain open until healing occurs. An urologist removes the stents prior to discharge.

The Malecot catheter, usually 22-24 French, is placed through an abdominal stab wound. This catheter is essential for continuous drainage of the pouch to prevent distention and tension on the anastomoses. This site for irrigation and drainage of urine prevents tension on suture lines and, later, provides an outlet while the patient learns self-catheterization. Keeping the pouch decompressed in the early postoperative period allows for improved healing and deceases the chance of a urine leak through the reservoir suture lines.

The pouch can accumulate mucous; irrigation and drainage tubes provide an outlet until the pouch is healed and watertight. A 16- to 20-French Foley catheter will drain any urine not voided by the Malecot catheter. Securing the Foley catheter to the leg with appropriate tension is important. The surgeon often secures it with a tube holder, such a Dale Foley Catheter Holder (See Figure 1), to ensure that no tugging, pulling, or changing of tension occurs in the early postoperative period.

An abdominal binder, such those with Velcro® closures (Dale Medical Products), can secure abdominal drains and tubes while the patient is ambulating. It can be removed while the patient lies in bed and put on before the patient arises to ensure that stents are not dislodged and to relieve tension on drains.

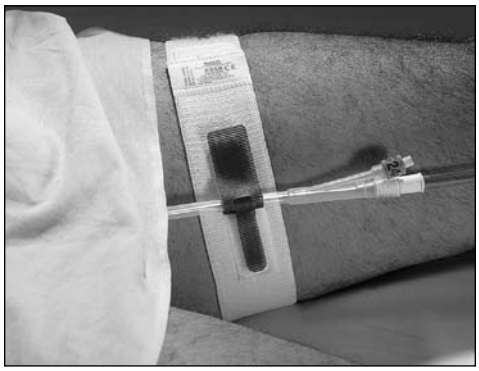

Figure 1. Foley Catheter Holder (Dale Medical Products)

Initially, every 2-3 hours, the nurse will verify consistent drainage of urine from the stents and Malecot catheter, then irrigate the catheter with 30-60 ml of sterile solution to prevent any obstruction by mucous. The urine and irrigation fluid may drain through the Malecot or Foley catheter.

The JP or Penrose drain removes serosanguineous fluid, which collects in the pelvis. An increase in JP drainage output or increasing pain or swelling in this area may signal a urine leak or internal bleeding. Inflammation and excoriation due to leakage will increase pain. These symptoms, along with increased drainage output and/or decreased urine output, are important to communicate to the surgical team for investigation.

It is not surprising that many patients feel overwhelmed postoperatively with tubes and drains. Patient and family education is important to build confidence, as postoperative recovery progresses. One goal is for the patient and family to learn the irrigation technique by day 4-5 and to practice it, with return demonstration and observation, throughout hospitalization. The intervals are lengthened to every 4 hours with consistent drainage (See Table 2). The patient is taught to irrigate more often if the urine volume decreases or stops.

After discharge, the patient will continue this regimen (even at night), until returning to the surgeon's office for the next stage of postoperative care: drain removal and x-rays to verify a watertight pouch. Once the stents and JP drain(s) are removed, the only drains for home care are the Malecot and Foley catheters. The exit sites of stents and drains may leak after initial removal, so protection of the skin is important until healing occurs; petroleum jelly-impregnated gauze or dry gauze can be placed over the exit sites.

Before discharge, the patient must be able to irrigate the pouch, manage the drains and Foley-catheter collection bags, and show a clear understanding of the proper care techniques. A lack of urine output is a medical emergency that must be immediately reported to the surgical team. This point cannot be stressed enough to patients, as a lack of urine output may be caused by an obstruction, which may cause tension and eventually rupture the sutures. Gentle irrigation may unblock an obstruction; if unsuccessful, the surgical team must be notified.

The neobladder differs from the ileocecal pouch in several ways that are worth noting. Postoperative drains and tubes are similar, but they are placed in different anatomical locations. Ureteral stents enter through stab wounds in the skin: a 22- to 24-French Malecot catheter in the suprapubic area, lower abdominal JP drains (left and right, depending on the extent of surgical resection), and a 16- to 20-French Foley catheter. The stents are connected to drainage bags or may be placed in urostomy drainage pouches for collection and monitoring of urine output.

Continuous drainage of the neobladder during the healing of anastomoses occurs and provides for a watertight reservoir. As with pouches, the stents are removed before discharge. The Malecot catheter remains in place for several weeks as a way to ensure consistent irrigation and drainage. A lack of urine drainage from either the Malecot or Foley catheter necessitates gentle in-and-out irrigation to dislodge any clots or mucous. If continuous drainage cannot be re-established, the surgical team must be notified to resolve the obstruction, which may create tension on new anastomoses.

Initially, the nurse irrigates the neobladder with 50-100 ml of sterile saline every 2-3 hours postoperatively, progressing to 4-hour intervals during recovery. At first, saline is input through one catheter and output through the other. Postoperative irrigation schedules are followed closely to ensure adequate drainage of urine and mucous.

If obstruction appears to be a problem, the Malecot catheter is clamped

Abdominal Binder (Dale Medical Products)

during irrigation, while the nurse gently instills 50 ml of saline through the Foley catheter to aspirate any mucous plugs. This procedure can be repeated, if neceesary.[8] It is vital to secure the Foley catheter to the patient's leg with a tube holder to maintain the proper tension, which is established by the surgical team during cystectomy.

Throughout hospitalization, the nursing staff needs to be in close contact with the surgical team to report any alteration in expected outcomes. Home-care nursing may be necessary and should be established by the discharge planning team prior to discharge for optimal home results.

Long-term considerations

This type of surgery has several potential long-term complications. Ureteral-anastomosis structure, neobladder-to-urethral stricture, and reservoir rupture are rare but must be discussed preoperatively. Metabolic complications are monitored by regular laboratory testing and addressed with medication. The formation of renal or urinary reservoir calculi is problematic and should be watched for. In patients with preoperative bladder cancer, physicians must monitor for tumor recurrence.

Incontinence as the result of a failed pouch or neobladder sphincter can be a frustrating outcome for patients and caregivers. Often this problem can be addressed surgically, but it must be carefully evaluated. If incontinence arises in patients with neobladder and an intact sphincter but poor emptying, then the regimen of CIC can be used to ensure decompression and slow return of reservoir tone.

Sexuality may be affected by cystectomy. For women, this surgery may alter sexual function, as the uterus and ovaries are usually removed, leading to symptoms of menopause, such as hot flashes or vaginal dryness. If part of the vagina is removed during surgery, sexual intercourse may be difficult. For men, surgery may damage the nerves that control erections, resulting in erectile dysfunction (impotence). Fortunately, many treatments are available to address this problem.

Skin issues can be rare but bothersome for patients with an ileocecal or Indiana pouch. Since the pouch may produce a small amount of mucous at the exit site, a small bandage or gauze dressing can be placed over the stoma to prevent leakage on clothing. Many patients use mineral oil to keep the stoma moist between catheterizations.

Patients and caregivers should be taught to recognize the signs and symptoms of urinary tract infection, a rare complication. Fever and flank pain may be signs of pyelonephritis or pouchitis. Abdominal pain may signal infection, which may or may not be localized to the urinary reservoir. If urine is needed for laboratory evaluation of infection, a double catheterization method can be used to secure an up-stream specimen for accurate culture and sensitivity evaluation. Treatment should be guided by laboratory results.

Conclusion

The decision for continent urinary diversion is complex. It requires multiple discussion sessions with patients and family support members before surgery. After surgery, postoperative hospital and home care is the key to a successful outcome. The patient must be taught how to irrigate the tubes and drains and should be able to return demonstrate this skill consistently before discharge. The idea of going home with a Malecot and Foley catheter must be consistently addressed, starting in the preoperative planning period.

It is important to emphasize that, by investing in proper care and maintaining consistent postoperative schedules, patients can achieve the life-long benefit of a well-healed urinary reservoir. The surgical team of the urologist, operative nurses, surgical inpatient nurses, enterostomal therapy (ET) or wound ostomy continence (WOC) nurse, and clinical staff, along with the patient's family support network all play important roles in helping the patient to achieve a successful outcome after cystectomy and continent urinary diversion.

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people experience an improvement in their initial level of injury of at least one or occasionally two spinal cord levels.

Diagnosis

Definitive diagnosis of spinal-cord injuries is made with a variety of imaging studies, including radiographic studies, standard X-ray (flexion and extension films), computerized tomography (CT), and magnetic resonance imaging (MRI). A thorough physical and patient history by a neurologist helps to determine the mechanism of injury. Because there is a 15% chance of finding a second vertebral injury, once the first injury is identified; maintaining strict stability of the vertebral column is of the utmost importance post-injury.

Spinal-cord injuries can be classified as either permanent or temporary, based the extent of damage and mechanism of injury.

- Tetraplegia (formerly known as quadriplegia) is injury to the cervical region, causing complete loss of motor function in all extremities.
- Paraplegia is injury to the lower thoracic lumbar or sacral region, causing incomplete to complete paralysis.

As defined recently in the International and American Spinal Injury Association (ASIA) Neurological Classification of Spinal Cord Injury, the term 'incomplete' has been specified to a greater extent and now indicates a person with preservation of motor or sensory function in the last sacral segment (S4-5). This definition addresses the patient who has an injury at a given level, some preserved sensation or motor function, but loss of function below that level. Spinal-cord injuries are further categorized to an ASIA Impairment Scale to describe the type of injury. Better-known classifications are[1]:

Central cord syndrome is more often associated with hyperextension of the neck and acceleration or deceleration of the cervical spine. Patients have greater motor strength in the upper limbs than in the lower limbs.

Brown-Sequard syndrome is ipsilateral (affecting the same side of the body) loss of posterior column sensation, contralateral pain, and temperature loss below the lesion.

Anterior cord syndrome is a complete loss of motor function below the level of the lesion and loss of light touch and sensation but preservation of the posterior column function.

Caudal equine lesion is due to a lumbar injury, fracture, or lumbosacral nerve root injury that compromises the bladder, bowel, and lower limbs.

Table 1. **Corresponding Level of Injury with a Physical Examination**[2]

Level of Spine	Sensation	Muscle
C2	Occipital	--
C3	Supraclavicular fossa	--
C4	Acromioclavicular joint	--
C5	Lateral antecubital fossa	Elbow flexors
C6	Thumb	Wrist extensors
C7	Middle finger	Elbow extensors
C8	Little finger	Finger flexors
C9	--	--
T1	Medial antecubital fossa	Small finger abductor
T2	Apex of axilla	--
T3	Third intercostal space	--
T4	Nipple line	--
T10	Umbilicus	--
L2	Mid-anterior thigh	Hip flexors
L5	Dorsum of foot	Long toe extensors
S1	Lateral heel	Ankle plantar flexors
S4-5	Perianal area	Rectal tone

Conus medullaris syndrome results from injury to the lumbar nerve roots and sacral cord. Sacral segments may show preserved reflexes.

Management

Ventilatory

As with all life-threatening injuries, care begins with the ABCs – airway, breathing, and circulation. With spinal-cord injuries, acute medical management often includes oral intubation with ventilatory support, which may be temporary or permanent. Tracheotomies are performed to provide a mechanism for long-term mechanical ventilation and can be done under local anesthesia. Surgeon determined, the surgical incision may be either vertical or horizontal but the general rule of thumb is the least amount of anatomical disturbance is best. To minimize trauma to the trachea, the tracheotomy is usually performed between the second and third tracheal ring. Once a tracheostomy tube is placed, it is secured with a tracheostomy tube holder to prevent accidental decannulation – a major complication of tracheostomy.

Cardiovascular

In the acute phase of spinal-cord injuries, the primary clinical strategy is to maintain hemodynamic stability and prepare for surgical intervention, if indicated.[4] A primary nursing responsibility includes diligent monitoring of the patient's vital signs, including but not limited to: heart rate and rhythm, blood pressure (preferably arterial waveform), respiratory waveform, and oxygenation saturation. Importantly, continuous monitoring should be maintained. If transportation outside of the intensive care unit is necessary (e.g., for a CT scan), then a transport monitor is required. Pharmacologically, intravenous phenylephrine and epinephrine are often used to maintain vasomotor tone, which may be compromised by severe vasodilation due to neurogenic shock.

Nutrition

Serious nutritional challenges accompany spinal-cord injuries. Specifically, patients go through an initial period of decreased metabolic demand with accompanying nitrogen excretion, which creates a negative nitrogen balance. Thus, studies have reported that, within four weeks, patients with SCI may lose up to 10-20% of their body weight.[5] Thus, it is important to initiate enteral feeding early to reduce the incidence of respiratory, wound, and urinary tract infections, which lead to prolonged ventilation, antibiotic treatment, longer lengths of stay, and delayed recovery.

Bowel and bladder

The spinal cord transmits electrical impulses between the brain and rest of the body to control movement, posture, and respiration ("C3, 4, and 5 keep the diaphragm alive") heart rate, heat regulation, circulation, and bowel, bladder, and sexual function ("S2, 3, and 4, urine, feces hit the floor!").[6] In the acute phases of SCI, the bladder may be distended and loss of peristalsis (ileus) may occur. Thus, bowel and bladder incontinence should be expected. Bladder management may include the use of a Foley catheter. To minimize catheter movement, a commercially available Foley catheter holder may be used to secure the device. Holders can prevent meatal irritation, which is a causal factor in nosocomial infections, such as urinary tract infections, and may minimize skin breakdown.

With stabilization, aggressive bowel and bladder rehabilitation may enable the patient to effectively manage their elimination pattern.

Other considerations

Although controversial, the use of methylprednisolone within 12 hours post-injury has been said to decrease spinal-cord edema and may lessen the severity of SCI.[7] Bracken and colleagues[8] reported that methylprednisolone when given as a bolus of 30 mg per kilogram of body weight, followed by infusion at 5.4 mg per kilogram per hour for 23 hours in patients with acute spinal-cord injury, neurologic recovery improves when given in the first eight hours. It is contraindicated in acute penetrating spinal injuries.

Complications

Spinal shock

A state of transient physiological reflex depression, spinal shock is associated with an initial increase in blood pressure (related to catecholamine release), which is quickly followed by hypotension. Spinal shock is due to the lack of blood perfusion at and below the level of injury. Because loss of all sensorimotor function occurs during this phenomenon, flaccid paralysis, including bowel and bladder, occurs and sustained priapism may develop. Spinal shock tends to last a few hours to days, until reflex arcs below the level of injury recover.[2]

Neurogenic shock

A further complication of spinal-cord injury is neurogenic shock, which is manifested by the triad of hypotension, bradycardia, and hypothermia. Shock tends to occur more commonly in injuries above T6 (the 6th thoracic spine), secondary to disruption of the sympathetic outflow from T1-L2 (the 1st thoracic to the 2nd lumbar spine) and unopposed vagal tone, leading to decreased vascular resistance with associated vascular dilation. Treatment may require the use of potent vasoconstrictors (e.g., phenylephrine) to assure an adequate arterial blood pressure in order to maintain perfusion.[2] Of note, neurogenic shock can be differentiated from hypovolemic shock, which manifests itself by tachycardia.

Conclusion

Overall, 85% of SCI patients who survive the first 24 hours are still alive 10 years later, compared with 98% of the non-SCI population of similar age and sex. Today, the most common cause of death in SCI patients is respiratory ailment, whereas, in the past, it was renal failure. As in the general population, an increasing number of people with SCI are dying of unrelated causes, such as cancer or cardiovascular disease.[4] Mortality rates are significantly higher during the first year after injury than during subsequent years.

Significant improvements have been made in post-SCI quality of life. For example, with C6 level injury, it is possible, with practice, for an individual to drive an automatic-transmission car with hand controls or a manually operated computer. For those with high cervical injuries, voice-recognition software is very useful in improving quality of life.

Future directions include pharmacological agents and stem cell research.[3] Spinal-cord injury affects everyone in the injured person's life, including spouse, immediate family, and friends. It may cause loss of financial security and independence. Much has been done to improve survival outcome and quality of life. Job retraining, mechanisms to maintain independent mobility, and advances in medicine have improved the survival rate by as much as 10 years. Importantly, healthcare professionals can help to improve survival rates by continuing their education about spinal-cord injuries.

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1. National Spinal Cord Injury Association. Spinal Cord Statistics. 1995.

Continued

Case Study: Acute phase of SCI

Ron, a 20-year-old, was brought to Emergency after he was found with a single gunshot wound to the head, inferior to the left ear, with no exit wound. According to the police report, Ron was shot "execution style", i.e., at close range with the intention to kill. He was initially found with pulseless electrical activity (PEA). As per the Advanced Cardiac Life Support (ACLS) protocol, he was intubated and resuscitated at the scene. Ron arrived hemodynamically stable, although unresponsive, with minimal effort to breathe and pupils reactive bilaterally. On admission, Ron's CT of the head showed that the bullet had entered beneath the left ear, passing posteriorly across cervical cord segments II, III, and IV, completely transecting the spinal cord. The bullet was lodged in the right upper chest with no pneumothorax and initially no injury to the trachea or esophagus. A steroid protocol was initiated and aggressive fluid resuscitation (including blood transfusions) was started, given his poor prognosis. With emergency care, including intubation, fluid recitation, and surgical repair, Ron survived.

Ron's first few trauma intensive care unit (TICU) days were tenuous. He remained in critical condition, hemodynamically labile, despite the infusion of vasopressors, sedation, and neuromuscular blockades. He developed acute respiratory distress syndrome (ARDS), requiring bronchoscopies and was aggressively resuscitated from multiple profound bradycardia episodes (Figure 1) secondary to periods of hypoxia (oxygenation saturation less than 90%). Two days after Ron's admission, he received a tracheostomy and, a week later, a percutaneous endoscopic gastrostomy (PEG) tube replaced the nasogastric (NG) tube. Ron's nutrition included 240 ml of TraumaCal every 4 hours.

Ron remained in the TICU for about two months. He had multiple infectious bouts and nurses were unable to wean him from mechanical ventilation. Given that he was unable to show signs of spontaneous respiration, despite PCO_2 levels of up to 60 mm Hg, Ron remained on the ventilator with settings of 40% oxygenation, ventilation mode of pressure-regulated volume control (PRVC), tidal volume (TV) of 500 ml, and positive end expiratory pressure (PEEP) of 5. He continued to require frequent pulmonary toileting to prevent desaturation and aggressive suctioning. The TICU team maintained Ron on ranitidine 150 mg daily for stress ulcer prophylaxis, Lovenox (30 mg subcutaneously), along with sequential compression devices (SCDs) and thrombolytic embolic decompression (TED) stockings for thrombolytic prophylaxis.

Specifically, Ron's consultations included:

1. Cardiology for evaluation of pacemaker therapy for the bradycardic episodes. Given that the episodes were due to hypoxic spells, Ron did not receive a pacemaker.
2. Psychiatry to evaluate Ron's depression, as expressed by tears and withdrawal from staff. Psychiatry prescribed antidepressants (Sertraline 50 mg) and spiritual care by the hospital's priest.
3. Orthopedics continued to manage Ron's cervical spine, recommending that the cervical collar remain in place for an additional month.
4. The wound care nurse was consulted about Ron's skin condition, because not unexpectedly given Ron's initial acuity; he had a stage I to II sacral decubitus. Duoderm application, Foley catheter, and a Flexicare bed were recommended for decubitus prophylaxis.
5. Despite the fact Ron no grown fungal elements on any cultures, Infectious Disease recommended Diflucan (400 mg daily) to treat his continued febrile spikes of unknown origin, which persisted throughout the first month.

With the classification of a complete spinal-cord injury, Ron was diagnosed as a high-leveled tetraplegic. His TICU course was primarily aimed at establishing respiratory stability, as the loss of his diaphragmatic control caused him to be ventilatory-dependent. Eventually, after nearly three months, Ron was transferred to rehabilitation for spinal cord-injured patients, where he continues to regain respiratory and physiological stability.

Figure 1. Bradycardic episode. Profound bradycardia with one premature ventricular contraction (PVC) and sustained asystole.

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This continuing nursing education activity was approved by the Vermont State Nurses Association Inc. (VSNA) an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation.

After reading this article, the learner should be able to:

1. Identify the classification system of spinal cord injuries
2. Explain the initial management of spinal cord injuries
3. List two of the acute complications related to spinal cord injuries
4. Describe the differences between continent and incontinent urinary diversions
5. Identify postoperative complications of continent diversions and the nursing care to prevent them

Instructions

1. Read both articles.
2. Complete the post-test on page 8. (You may make copies of the answer form).
3. Complete the participant evaluation.
4. Mail or fax the complete answer and evaluation forms to address on back page.
5. To earn 1.9 contact hours of continuing education, you must achieve a score of 70% or more. If you do not pass the test you may take it one more time.
6. Your results will be sent within four weeks after form is received.
7. The fee has been waived through an educational grant from Dale Medical Products Inc.
8. Answer forms must be postmarked by December 15, 2007.

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1. **Methylprednisone is contraindicated in the patient with:**
   a. Patient with injury to the spinal cord
   b. Patient with stable lumbar fracture who is neurologically intact
   c. Patient with an unstable thoracic fracture
   d. None of the above
2. **Maintaining strict cervical stability post-injury with an unstable C3 fracture is extremely important in order to:**
   a. Maintain alignment of the lumbar spine
   b. Correct cervical fracture
   c. Prevent further injury to an already unstable fracture
   d. None of the above
3. **Life expectancy of a patient post SCI has improved due to:**
   a. Early improved surgical interventions
   b. Better pharmacological therapies available
   c. Increased expertise of nursing and medical staff
   d. All of the above
4. **Neurogenic shock can be differentiated from hypovolemic shock which manifest itself by tachycardia.**
   a. True
   b. False
5. **Neurogenic shock is manifested by the triad of:**
   a. Hypotension, tachycardia, hypothermia
   b. Hypotension, bradycardia, hypothermia
   c. Hypertension, tachycardia, hypothermia
   d. None of the above
6. **Each year what percent of the spinal cord injured are re-admitted to the hospital?**
   a. Less than 10%
   b. 10-20%
   c. 30-50%
   d. More than 77%
7. **At what spinal level was Christopher Reeve's injury?**
   a. C1
   b. C2
   c. C4
   d. L1
8. **Cystectomy and urinary diversion can be necessary when bladder cancer is:**
   a. Papillary
   b. Fulgurated and lasered
   c. Invasive
   d. Recurrent
9. **A patient has an Indiana pouch and calls the clinic post week 2 with abdominal pain and no urine output for 2 hours. What should the clinic nurse instruct the patient to do?**
   a. Wait 1 hour and call back if not output
   b. Increase fluids and call back in 2 hours
   c. Gently irrigate the Malecot and Foley catheter to identify mucous plug obstruction
   d. The pouch is not yet functioning, following surgery
10. **Early ambulation is stressed after surgery because:**
    a. The leg bag needs to be tried before discharge
    b. Reduces postoperative pain
    c. Promotes wound healing
    d. Prevents postop pulmonary complications
11. **The patient choosing continent diversion should understand:**
    a. Home health nursing will be key in all home care after surgery
    b. It will work with no need for self care after surgery
    c. Self care will be key in success
    d. It is a good choice for another care giver to assist with
12. **Patients may prefer neobladder over the Indiana pouch because:**
    a. It offer normal micturition
    b. It is a shorter surgery and easier to withstand
    c. It functions with no self care post operatively
    d. Reduces chance of recurrent cancer
13. **The Ileal conduit maybe chosen for patient verus the continent diversion because:**
    a. It is the gold standard for all patients
    b. Patients cannot learn sterile catheterizations
    c. It prevents cancer recurrence
    d. It is the shorter surgery with ease of construction and fewer complications
14. **Patients with orthotopic neobladder should be taught clean intermittent catheterization (CIC) because:**
    a. They will perform CIC for months following surgery
    b. It is not taught because they will not need it
    c. It may be needed in cases of poor bladder emptying
    d. It is an integral aspect of neobladder care
15. **The patient with a neobladder asks the nurse when the Foley catheter can be removed. She answers:**
    a. In 1 week when he can void spontaneously
    b. When urine is normal color and character
    c. Postop week 3 when cystogram shows watertight healing of the pouch
    d. Before he leaves the surgical unit since he is ready to catheterize
16. **Post operatively the urinary stents in the indiana pouch become dislodged but the nurse knows:**
    a. This is not a problem because she was going to remove them anyway
    b. She can simply push them back in the exit site and re-tape
    c. The surgeon should be notified
    d. These are not connected to the actual urine in the pouch so unimportant

Participant's Evaluation

What is the highest degree you have earned (circle one) ? 1. Diploma 2. Associate 3. Bachelor's 4. Master's 5. Doctorate

Indicate to what degree you met the objectives for this program: Using 1 = Strongly disagree to 6 = strongly agree rating scale, please circle the number that best reflects the extent of your agreement to each statement.

	Strongly Disagree					Strongly Agree
1. Identify the classification system of spinal-cord injuries	1	2	3	4	5	6
2. Explain the initial management of spinal-cord injuries	1	2	3	4	5	6
3. List two of the acute complications related to spinal cord injuries.	1	2	3	4	5	6
4. Describe the differences between continent and incontinent urinary diversions	1	2	3	4	5	6
5. Identify postoperative complications of continent diversions and the nursing care to prevent them	1	2	3	4	5	6

Name & Credentials _____
Position/Title _____
Address _____
City _____ State _____ Zip _____
Phone _____ Fax _____
email address _____

Mark your answers with an X in the box next to the correct answer

	A	B	C	D		A	B	C	D
1	☐	☐	☐	☐	9	☐	☐	☐	☐
2	☐	☐	☐	☐	10	☐	☐	☐	☐
3	☐	☐	☐	☐	11	☐	☐	☐	☐
4	☐	☐	☐	☐	12	☐	☐	☐	☐
5	☐	☐	☐	☐	13	☐	☐	☐	☐
6	☐	☐	☐	☐	14	☐	☐	☐	☐
7	☐	☐	☐	☐	15	☐	☐	☐	☐
8	☐	☐	☐	☐	16	☐	☐	☐	☐

How long did it take you to complete this home-study program? _____

What other areas would you like to cover through home study?

_____

_____

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