Cystoprostatectomy: Anesthetic Management of Patient with Multiple Co-Morbidities

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Citation

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Abstract

This article discusses the anesthetic management of a patient with bladder cancer undergoing a radical cystoprostatectomy, bilateral pelvic lymphadenectomy, diversional urinary ileal conduit and repair of an abdominal wall hernia. The patient had multiple comorbidities including chronic cardiovascular, respiratory, and metabolic conditions. The article discusses the complex anesthesia management of a patient with multiple co-morbidities undergoing this procedure.

INTRODUCTION

In North America, South America, Europe and Asia, 90% of bladder cancers are transitional (urothelial) cell carcinoma (TCC).[1] Three phenotypes exist in urothelial cancer. The first is low-grade, non-muscle proliferative lesions, the second is highly proliferative muscle invading tumors, and the third is cancer in situ (CIS).[1] Treatment varies according to the stage of the cancer, yet approximately 50% of these patients require a radical cystectomy or a combination of radiation therapy and systemic chemotherapy.[1] Invasive bladder cancers are graded on a scale indicating spread of tumor, involvement of lymph nodes, and occurrence of metastasis (TNM). Tumors which have involvement of muscle (T3), fat, and structures outside bladder (T4) are treated first with a transurethral resection of bladder tumor (TURBT), and then radical cystectomy (possible prostatectomy) followed by neoadjuvant chemotherapy.[1,2] Radical cystoprostatectomy (RCP) is the standard and effective treatment method for patients with invasive or superficial recurrent bladder cancer who are in a high progression risk group.[3] Patients in the high progression risk group, including those with CIS and muscle invading tumors, have the biggest risk of cancer progression, and also are in the highest risk group for death.[1] Currently, the ileal conduit, which is the use of the small intestine anastomosed to the ureters to transfer urine to an incontinent stoma, is the most common type of urinary diversion used in these patients.[3]

CASE REPORT

The patient was a male in his early 70's who presented to the emergency department months earlier with hematuria. He was scheduled for a TURBT with cystoscopy, and was subsequently diagnosed with T4 high-grade urothelial carcinoma of the bladder with invasion of the tumor into the prostatic stroma. The patient had completed 4 cycles of neoadjuvant chemotherapy with gemcitabine and cisplatin after which surgical treatment was recommended. The surgical procedures planned were a radical cystoprostatectomy, bilateral pelvic lymphadenectomy, diversional urinary ileal conduit, and repair of abdominal wall hernia. This complex surgical procedure was scheduled to take 8 hours, involving both the urology and plastic surgery services.

Past Medical History

The patient's past medical history includes chronic obstructive lung disease (COPD), heart failure (HF), coronary artery disease (CAD), diabetes mellitus (DM), hypertension (HTN), and obstructive sleep apnea (OSA). The surgical history was significant for quadruple coronary artery bypass graft (CABG), thoracic aortic aneurysm repair, left leg fracture repair, left inguinal herniorrhaphy, and cystoscopy with TURBT. The patient also had a history of postoperative emergence delirium. Allergies included atorvastatin. Current medications included as needed use of fluticasone/propionate, albuterol, alprazolam, and acetaminophen/hydrocodone. Scheduled medications included daily oral doses of carvedilol 25 milligrams (mg), tamsulosin hydrochloride 0.4 mg, furosemide 40 mg, glimepiride 4 mg, magnesium oxide 500 mg, metformin 1000 mg, trazodone 50 mg, and subcutaneous insulin

detemir.

Review of Systems

Review of systems had pertinent positives included respiratory complaints of occasional wheezing, as well as a history of emergence delirium and sleep disturbances. All other systems were reviewed and were reported negative.

Physical Examination

Relevant findings of the physical examination can be found in Table 1.

Table 1

General Examination

General Appearance	Morbidly obese man in no acute distress.
Vital Signs	Temperature - 37 degrees Centigrade Blood pressure - 130/72 mmHg Pulse - 82 beats per minute Respirations - 16 breaths per minute Weight - 110.0 kilograms (kg) Height - 167.0 centimeters (cm) Body mass index - 39.44
Head, Eyes, Ears, Nose, Throat	Pupils equal, round and reactive. Conjunctivae pink. Oropharynx clear with moist mucous membranes.
Neck	Supple, no bruits, no lymphadenopathy. Airway Mallampati score 3. Dentation intact, small mouth, short neck with increased neck circumference.
Heart	Distant heart sounds, S1 and S2, no murmurs.
Lungs	Bilaterally clear to auscultation; decreased breath sounds at bases. Appears short of breath when lying flat.
Abdomen	Obese, nontender, no guarding or rebound. Weakness in ventral abdominal wall.
Extremities	Bilateral pitting edema 2+ at calf. Pulses 2+.
Neurological	Reflexes intact, alert and oriented to person, place, and time.
Skin	Warm and dry to touch.

Diagnostic Testing

Results of pre and post-operative laboratory testing are found in Table 2. Preoperative testing for this patient included laboratory work, an echocardiogram (ECG), and cardiac catheterization. Hypomagnemia was treated pre-operatively with magnesium oxide 500 mg twice a day by mouth for 2 weeks. There was an intraoperative plan to treat hypomagnesemia or related hypokalemia if indicated by ECG changes such as QT prolongation, QRS widening, or T wave flattening. A decreased hematocrit of 31.3% was noted, and the patient was cross-matched for 4 units of packed red blood cells. The patients HgA1C was noted to be at acceptable range demonstrating an effective average blood glucose control over the last 6-12 weeks.6

The patient had an echocardiogram completed preoperatively due to history of CAD, CABG, HTN, DM, and HF. The results of the echocardiogram showed normal left ventricular systolic function with ejection fraction of 55-60% with no pericardial effusion.

Table 2

Laboratory/ Diagnostic Review

Test	Pre-Operative Values	Post Procedure Values	Normal Values
Complete Blood Count			
White blood cells (WBC)	7.1 K/uL	9.1 K/uL	4.0- 11.0 K/uL
Red blood cells (RBC)	3.33 M/uL *	2.90 M/uL *	4.5-6.0 M/uL
Hemoglobin	10.4 g/dL *	8.6 g/dL *	14-18 g/dL
Hematocrit	31.3 % *	25.7% *	40.0-54.0
Platelet count	172 K/uL *	128 K/uL *	140-440 K/uL
Urinalysis			
Hemoglobin, urine qualitative	Large *	Large *	Negative
RBC per high power field (HPF)	10 *		0-2
WBC per HPF	3 *		0-2
Coagulation Studies			
Protime	13.6 seconds		12.7-15.0 seconds
International Normalized Ratio (INR)	1.04		
Activated Partial Thromboplastin Time (APTT)	30.9 seconds		24.7-35.9 seconds
Glycohemoglobin A1C			
	6.0 %		4.5- 6.2%
Chemistry Panel			
Glucose	127 mg/dL *	183 mg/dL *	70- 110 mg/dL
Carbon dioxide	31 mEq/L *	35 mEq/L *	23-30 mEq/L
Blood urea nitrogen	27 mg/dL *		8-20 mg/dL
Creatinine	1.54 mg/dl *	1.38 mg/dl	0.7-1.30 mg/dl
Magnesium	1.4 mg/dL *	2.0 mg/dL	1.8-2.9 mg/dL
Lipid Panel			
Cholesterol	174 mg/dL		< 185 mg/dL
High density lipoprotein	33 L *		> 40 L
Triglycerides	222 mg/dL*		< 150 mg/dL
Thyroid Function Tests			
Thyroid stimulating hormone	3.10 uIU/ml		0.27- 4.20 uIU/ml
T4 (thyroxine), free	1.02 ng/dL		0.93- 1.70 ng/dl
B-Type Natriuretic Peptide		178 pg/ml *	0-100 pg/ml

*Abnormal values

Abbreviations: < = less than; > = greater than; K/uL = thousands per microliter; M/uL = millions per microliter; g/dL = grams per deciliter; mg/dL = milligrams per deciliter; ng/dL = nanograms per deciliter; uIU/ml = micro international unit per milliliter ; L = liter; mEq/L = milliequivalents per liter; pg/ml = picograms per milliliter

Cardiac catheterization (see Table 3) showed that all grafts are patent and systolic function is normal. Although the patient had a history of compensated HF, CABG, DM, and low functional capacity, he was cleared by cardiology to continue with surgery. Caution needed to be taken to maintain cardiac perfusion pressure and maintain fluid balance. The use of an arterial line with cardiac output monitoring was planned. Of note, the patient has not been on aspirin for several years and has intolerance to statin (atorvastatin) therapy. As noted in the laboratory results, the high density lipoprotein (HDL) was slightly low and triglycerides were slightly elevated, further contributing to his ongoing risk of heart disease and stroke. Cardiology planned to attempt placement on a statin again after surgery.

Table 3

Cardiac Catheterization Results

Native Vessels	Stenosis
Left main coronary artery	50%
Left anterior descending proximal	70 %
Left anterior descending mid	85-90%
Left circumflex	95%
Right coronary artery	Diffuse disease in proximal and mid segment
Grafts	
Right posterior descending artery	Patent
First obtuse marginal	Patent
Third obtuse marginal	Patent
Skip graft	Patent

SURGICAL RISK FACTORS

The anesthetic issues for this patient were complex. Consideration had to be taken for multiple co-morbidities including a history of compromised cardiac function, HTN, DM, COPD, potential airway issues, and the history of emergence delirium. The patient had no recent active cardiac exacerbations that increased his perioperative risk. However, he did have a history of compensated HF with known CAD, status post bypass as well as DM and low functional capacity.

In patients with chronic HF, renal disease and hypertension, hypervolemia can be the stimulus for acute decompensated HF. Optimal assessment of fluid status and management of both hemodynamic and clinical congestion are imperative during surgery. The ability to measure urine output is removed early on in this surgery due to surgical transection of the ureters. The ability to assess volume status is maintained through the use of an intraarterial catheter allowing measurement of stroke volume variation (SVV), cardiac output (CO) and cardiac index (CI).

The patient was over a decade postoperative from his CABG, and cardiac catheterization results showed all grafts were patent, thus reducing his risk of a cardiovascular event. However, the patient was intolerant of both aspirin and statin therapy, which put him at an increased risk for thrombosis associated with the stress response to surgery. Stress induces sympathetic activation, which promotes shear stress on arterial plaques, enhanced vascular reactivity, reduced fibrinolytic activity, platelet activation, and hypercoagulability.[4] Patients with pre-existing organ dysfunction such as ischemic heart disease, COPD and renal insufficiency are more likely to develop acute coronary syndrome, HF, pneumonia or respiratory failure following major surgical interventions.[7]

Hypertension is a well-known factor for increased cardiovascular risk during surgery. Sympathetic activation may be more pronounced in the hypertensive patient during anesthesia. A history of hypertension placed this patient at increased risk for diastolic dysfunction and/or systolic dysfunction, HF, renal impairment, and cerebrovascular and coronary occlusive events.[5]

Anesthesia and surgical stress also cause a metabolic stress response that has the potential to overwhelm homeostatic mechanisms in patients with diabetes. The stress response includes release of the catabolic hormones epinephrine, norepinephrine, cortisol, glucagon, and growth hormone, as well as an inhibition of insulin secretion.[6] Blood glucose levels are optimally maintained intraoperatively with use of intravenous (IV) infusion of insulin, glucose, and potassium as required. Intraoperative blood glucose levels should be maintained between 120–180 mg/dl in an effort to decrease deep wound infection and neurologic, renal, and cardiac complications following surgery.[6] The measurement of glycosylated hemoglobin (HbA1c) is primarily used to identify the average plasma glucose concentration over prolonged periods of time; glycemic control is considered suboptimal if the HbA1c is greater than 8%.[6]

Volatile anesthetic agents, opiates, and muscle relaxants as well as mechanical ventilation are known to interfere with the respiratory system. The synergistic effects of the supine position, prolonged anesthesia, and an abdominal incision produce an immediate decline in lung volumes leading to atelectasis formation in dependent parts of the lung. Other mechanisms deleterious to the surgical patient with COPD include upper airway instrumentation, inhalation agents, residual neuromuscular blockade, depressed hypoxic ventilatory drive, altered immune defenses, decreased gas exchange capacity, decreased mucociliary clearance and increased permeability of the alveolar-capillary barrier. These mechanisms can lead to reflex bronchoconstriction, thereby promoting the expiratory collapse of the peripheral airways with incomplete lung alveolar emptying. The related lung hyperinflation with intrinsic positive end-expiratory pressure (PEEP) decreases systemic venous return, restricts cardiac filling and can lead to compromised cardiac function.[7]

Emergence delirium is a well-documented occurrence that can cause undue stress to the already complex surgical patient. Emergence delirium can have serious consequences for the surgical patient such as injury to self and others, increased pain and bleeding, self-extubation, and removal of catheters requiring physical or chemical restraint. Emergence delirium can place increased

physiological stress on an already compromised heart potentially leading to myocardial events.8

PLAN

A general anesthetic with the placement of an endotracheal tube (ETT) was chosen for this patient. He has an acceptable preoperative left ventricular (LV) ejection fraction of 55-60%, with mild left ventricular hypertrophy. Due to cardiac, renal and respiratory considerations, an arterial line for invasive hemodynamic monitoring was planned. The arterial line was used in an effort to monitor continuous blood pressure, volume status, and respiratory status through arterial blood gas (ABG) values. However, due to the failure of arterial cannulation, noninvasive advanced hemodynamic monitoring was applied prior to induction with use of the Nexfin Continuous Hemodynamic Monitoring System (Edwards Lifesciences, Irvine, USA). The Nexfin system provides noninvasive beat-to-beat, continuous cardiac output and blood pressure monitoring. The Nexfin monitor also provides stroke volume (SV), stroke volume variation (SVV) and cardiac output (CO) values. Stroke volume variation is suggested to be a reliable predictor of hypovolemia and fluid responsiveness in surgery. Evidence suggests that static variables such as central venous pressure (CVP), pulmonary capillary wedge pressure (PCWP), heart rate, and blood pressure do not adequately reflect response to a fluid challenge.9 As an alternative to these, measurements assessment of SVV has been used as a dynamic index to guide fluid therapy in patients receiving mechanical ventilation.9 When SV varies, the changes in systolic arterial pressure and pulse pressure variation (PPV) can be observed. SVV and PPV are pronounced during hypovolemia, and the variation decreases as intravascular volume is restored.9

The Nexfin system is a noninvasive monitoring system and does not allow for collection of arterial blood for blood gases and intraoperative hemoglobin monitoring. Fingerstick and venous blood draws were used for necessary labwork. Failure of arterial cannulation was less than ideal because ABGs were not available. In the future, with a difficult arterial stick, the use of an ultrasound would be indicated to assist with obtaining arterial access.

The patient had a preoperative Mallampati score of 3, a short thyromental distance (less than 5 cm) and an increased neck circumference. A potentially difficult airway was anticipated and planned for. Anesthesia induction was achieved with IV etomidate 20 mg, chosen for its decreased cardiodepressive effects, IV sufentanil 30 micrograms (mcg) and IV

cisatracurium 16 mg. The initial attempt to secure the ETT with the use of a Miller blade was unsuccessful. The equipment was changed to use the regular size Airtraq Optical Laryngoscope (Prodol Ltd., Vizcaya, Spain). Tracheal intubation was then easily achieved with an 8 millimeter (mm) ETT.

Albuterol aerosol puffs were given at this time due to the history of COPD and a noted increased peak airway pressures of 40 cm water (H_2O). Terbutaline (beta-2 agonist) 0.25 mg subcutaneously (SQ) was given once for its bronchodilator effects. Intraoperative ventilator settings were set to the following; tidal volume of 600 ml, inspiratory to expiratory ratio (I:E ratio) of 1:3, and volume/pressure mode. The heart rate was controlled using the cardioselective beta-1 receptor blocker esmolol, in doses of 20 mg IV. Anesthetic maintenance was facilitated with desflurane 2.5-5.8% exhaled and an air to oxygen (O_2) ratio of 50%. An IV sufentanil drip was maintained at 0.2 mcg/kg/hour. Muscle relaxation was used to improve surgical exposure with an IV cisatracurium drip at 0.8 mcg/kg/min which was later reversed with a dose of neostigmine 5 mg IV and glycopyrrolate 0.8 mg IV. Cefazolin 2 grams IV was administered for antibiotic prophylaxis and repeated every 4 hours. Enoxaparin 30 mg SQ was administered pre-incision due to the patient's cardiac history and increased risk of acute thrombus-related problems.4

Intraoperative fluids were monitored closely with use of the Nexfin cardiac output monitor, titrating to SVV and CO. Fluid included a total of 6 liters (L) of crystalloid (Plasmalyte), 3.5 L of colloid (albumin), and 1.3 L of packed red blood cells. Estimated blood loss for the entire procedure was 800 ml. The hemoglobin was monitored by fingerstick, which was maintained between 8.0-10.3 g/dL. The blood pressure goal was to maintain a mean arterial pressure (MAP) of 80 mmHg. Small doses of ephedrine (5 mg) and phenylephrine (100 mcg) were used as needed to maintain a goal MAP. The urine output goal was to maintain 50 ml per hour, which was monitored by a Foley catheter prior to opening of the bladder. Dexmedetomidine was used at a low dose of 0.1 mcg/kg/hr to decrease cardiovascular lability related to hypertension and to attempt to decrease the potential for emergence delirium.10 Blood sugar was monitored with fingersticks and maintained between 120-180 mg/dL with regular insulin IV. Total anesthetic time was 11 hours and 17 minutes. Prior to the end of surgery, acetaminophen 1gram IV and albuterol 5 aerosol

puffs were administered.

Following surgical closure from the abdominal incision, anesthesia was terminated; hydromorphone 2 mg IV was titrated to a respiratory rate of 10 breaths per minute. The patient was repositioned in a head up position, and alveolar recruitment measures were given prior to extubation in an effort to reverse atelectasis and open collapsed alveoli. Endotracheal extubation occurred when the patient was fully awake and spontaneously breathing at a rate of 10 breaths per minute with a tidal volume of 500 ml. He was recovered in the post anesthesia recovery unit without sequelae and with adequate pain control.

EVALUATION OF PLAN

The plan for this patient was appropriate, addressing all comorbidities and areas of concern, although some modifications of the plan were required. Blood pressure was maintained at the desired MAP with no adverse cardiac events/ECG changes noted. Intraoperative hemoglobin was maintained at greater than 10 g/dL to maintain O2 carrying capacity of blood and avoid cardiac stress. Potential difficult airway issues were anticipated. A change in plan from using a Miller blade to the Airtraq was made and used accordingly for smooth intubation. Arterial line access was attempted multiple times unsuccessfully. A change in plan was made to use the Nexfin cardiac monitor to evaluate CO and SVV. Ideally, the use of Doppler ultrasound should be planned if having difficulty obtaining arterial access. The patient's COPD was managed with beta-2 selective agonists, ventilator settings, and fluid control. Blood sugar was monitored through fingersticks and controlled as planned. On completion of surgery, the patient was extubated uneventfully in the operating room. The patient emerged with adequate pain control, appropriate respiratory parameters, and did not exhibit emergence delirium.

DISCUSSION AND CONCLUSION

Bladder cancer is the fifth most common malignancy in the United States (US).[11] Surgical treatment with a radical cystectomy remains the standard of care in the US for the primary treatment of muscle invasive urothelial bladder cancer in patients who are medically operable.[1] Men with severe comorbid conditions such as moderate-to-severe COPD, diabetes mellitus, heart failure, stroke, myocardial infarction, liver disease, and peripheral vascular disease are found to be surgically treated for their prostate cancer at the same rate as men without comorbidities.[11] Anesthesia care for men with multiple co-morbidities requiring prostate surgery can be complex and requires consideration for a wide range of variables.

Preoperative tests should include laboratory testing to assess renal, liver, electrolytes, and hematological function. Efforts must be made to optimize the patient's medical status prior to surgery. If warranted, a preoperative echocardiogram, stress test, and electrocardiogram should be completed. Intraoperatively, the ability to monitor fluid management is challenging due to the inability to monitor urine output. Obtaining an arterial line with cardiac output monitoring is paramount.

The 10-year survival rate for men having a cystoprostatectomy depends on the type of co-morbidities they have. Those with diabetes with organ damage have a 50% 10 year survival rate; the survival rate is 51% for those with comorbid peripheral vascular disease and 35% for men with moderate to severe COPD.[11] In order to have a successful outcome, early optimization of the patient's health status and a comprehensive intraoperative anesthesia plan are vital.

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