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Anesthetic Implications of Robotic-Assisted Radical Prostatectomy in a Patient with Immune Thrombocytopenia: a Case Report

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ABSTRACT

We report the first case of a robotic–assisted radical prostatectomy (RARP) operation at Songklanagarind Hospital. The patient was diagnosed with prostatic adenocarcinoma. He also had underlying immune thrombocytopenia (ITP) and suspected previous pulmonary tuberculosis. General anesthesia with an endotracheal tube was the choice of anesthesia. This article discusses specific considerations regarding robotic surgery and the patient's condition. The operation was successful; it took about 160 minutes longer, incurred 200 ml more of blood loss, but it led to an equal length of hospital stay compared to the data from another tertiary hospital in Thailand. A minor complication was a pressure sore on the patient's shoulder, conceivably due to the shoulder braces.

Keywords: anesthesia in robotic surgery; case report; da Vinci Xi; immune thrombocytopenia; prostatic adenocarcinoma; robotic–assisted radical prostatectomy

INTRODUCTION

Prostatic adenocarcinoma was the second most frequent and the fifth leading cause of cancer deaths among men in 2020.[1] Radical prostatectomy, a complex and delicate procedure deep inside the pelvis, is the most common operative initial treatment. Operation includes the removal of the prostate gland, seminal vesicles, ampullae, and surrounding tissues. The neurovascular bundle sparing technique preserves erectile function and urinary continence; thus, it leads to better postoperative outcomes. Robotic technology facilitates this technique, reduces blood transfusion, and promotes faster recovery. Therefore, robotic-assisted radical prostatectomy (RARP) has gained popularity.[2] The latest robot system is the da Vinci Xi, with a distinctive docking process and working position.

Meanwhile, anesthetic management in RARP possesses some unique perioperative concerns. A consensus guidance from anesthesiologists, gynecologists, urologists, and a clinical epidemiologist has identified nine core contents: patient position, ventilation strategies, hemodynamic variations, neuromuscular block, prevention of acute kidney injury, monitoring of anesthesia depth, postoperative delirium and cognitive dysfunction, postoperative nausea and vomiting, and pain management.[3] Herein, we present the first case of an RARP operation using the da Vinci Xi robot at Songklanagarind Hospital. This case study (REC.64-576-8-1) was approved by the Human Research Ethics Committee, Faculty of Medicine, Prince of Songkla University on December 13, 2021.

CASE REPORT

A 68-year-old male presented with microscopic hematuria and a prostate-specific antigen (PSA) level of 11.3 ng/mL. His magnetic resonance imaging (MRI) revealed a 4.5x3.5x5.5 cm prostate (volume of 45.4 ml) with a 2x2.2 cm, ill-defined, T2-hypointense mass/lesion with DWI restriction, involving the left-sided central gland and the mid-peripheral zone of the prostatic midgland; it was classified as a PIRADS 5 lesion. No extracapsular extension or lymphadenopathy was detected. Both the computed tomography (CT) of the chest and the bone scan were negative for malignancy. The transrectal ultrasound-guided prostatic (TRUS) biopsy revealed a Gleason score of 7 (3+4) adenocarcinoma in 2 out of 6 specimens.

The patient had had underlying immune thrombocytopenia (ITP) for two years prior to presentation. He had taken prednisolone in the dose of 15 mg/day, which was tapered off ten months before admission. He denied having a history of previous surgery or anesthesia. During the preoperative visit, the patient did not show any signs or symptoms of Cushing's syndrome. He had senile purpura on both upper extremities. The blood workup revealed a platelet count of 98,000 /μL with giant platelets; otherwise normal. The chest film displayed minimal reticular opacity at the right apical lung. On the subsequent CT imaging, the opacity was interpreted as a few calcified granulomas. The sputum acid-fast stain test for three days was negative.

Problems list

1. Prostatic adenocarcinoma

2. Immune thrombocytopenia

3. Previous pulmonary tuberculosis

4. Elderly age

The patient did not take any premedication. The blood component preparation comprised two doses of platelet concentrates, packed red cells, and fresh frozen plasma. The preoperative patient education included breathing exercises and the use of a numerical pain rating scale (NPRS). In addition, surgeons discussed the procedures with the anesthesiologic team and operating room nurses. The planned choice of anesthesia was general anesthesia with an endotracheal tube.

Apart from the standard monitoring, we placed an arterial line in the left radial artery for continuous blood pressure monitoring. Six units of platelet concentrates were transfused before anesthetic induction with fentanyl 1.1

mcg/kg, propofol 1.7 mg/kg, and cisatracurium 0.15 mg/kg. The endotracheal intubation with a glidescope blade went without any difficulty. The maintenance anesthetics were desflurane at a dose of 1 minimal alveolar concentration (MAC), cisatracurium infusion at 1.5 mcg/kg/min, fentanyl at 1.0 mcg/kg/hr, and xylocaine infusion at 1 mg/kg/hr.

Another intravenous catheter in the forearm was a backup drug administration route. Two assistants simultaneously moved the patient's lower extremities into the lithotomy position to prevent excessive hip flexion, knee extension, and lumbar spine torsion. We padded both peroneal nerve areas, tucked both arms, and applied shoulder braces with cushions at both acromioclavicular joints. Intermittent pneumatic compression (IPC) was also performed throughout the surgery. The body temperature control strategy included warming mattresses, a forced-

air warmer, and an S-line fluid warmer. The operating table was adjusted to the 27-degree head-down position (Figure 1). The ventilator mode was pressure-controlled with time cycling to maintain a tidal volume of 7–8 ml/kg and an end-tidal CO_2 of 35–40 mmHg. Physiologic positive end-expiratory pressure (PEEP) was applied, resulting in a plateau pressure of 23–25 cmH_2O.

The operation started with the camera port insertion, and the intraperitoneal pressure was no more than 15 mmHg. The robot docking process began with the instrument port placement: 10-mm ports at the right paraumbilical and right upper quadrant area and four 5-mm ports along the umbilical line (Figure 2). During intraperitoneal inflation, bradycardia at 50 bpm occurred, but it resolved without the administration of any vagolytic agents. The operation took six hours; the patient's blood pressure
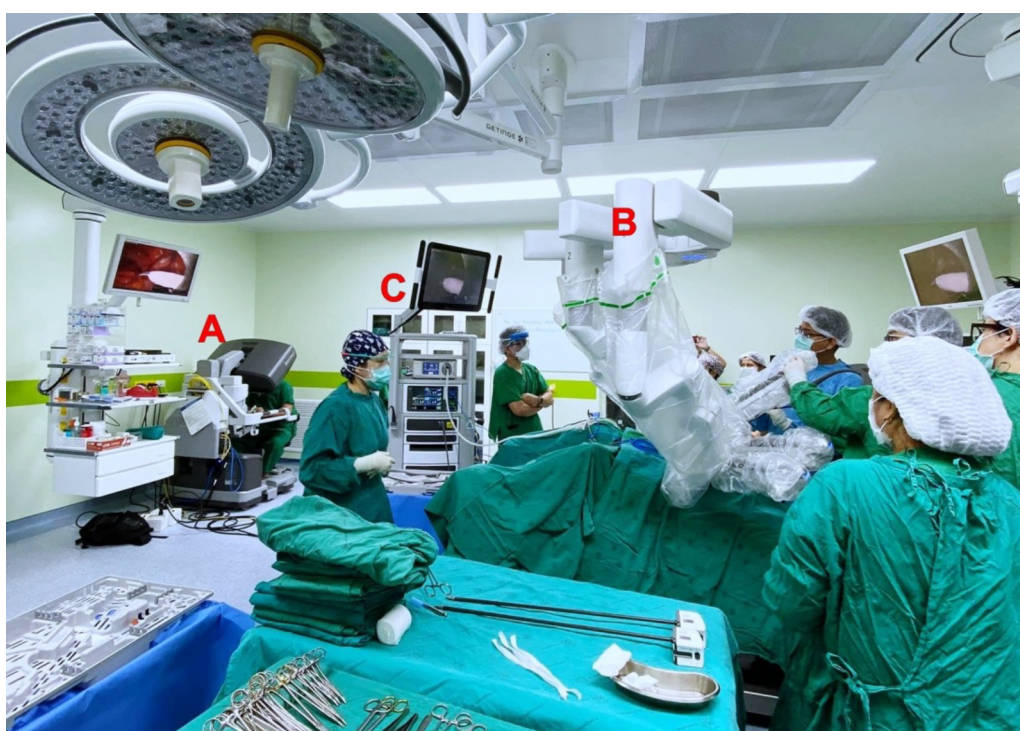

Figure 1 The da Vinci Robotic Surgical System; A. Surgical consoles; B. Patient-side cart with mounted surgical arms; C. Optical tower

Figure 2 Operating surgeon at surgical console (left); Surgical field (right)

remained within 20% of his baseline. The estimated blood loss was 500 ml. The total intravenous fluids comprised 1,850 ml of lactated Ringer's solution, and six units of concentrated platelets before the skin incision and another six units during the procedure. The intraoperative findings were an enlarged prostate weighing 40 grams, normal bilateral lymph nodes, and successful cavernous nerves preservation. Furosemide 20 mg administration followed the vesicourethral anastomosis, and urine output was 8 ml/kg/hr. There was no intraoperative complication.

Additional to intravenous fentanyl and xylocaine, perioperative analgesia involved the local injection of 1% xylocaine and intravenous paracetamol of 1,000 mg. A reversal, neostigmine 0.04 mg/kg, was administrated one hour after cisatracurium cessation. After that, the patient gained consciousness, respiratory function, and motor power before extubation. The recovery room examination revealed a 3x3 cm grade-2 pressure ulcer at the right shoulder.

At the surgical ward, six units of platelet concentrates and 500 ml of fresh frozen plasma were transfused. The postoperative pain control included paracetamol 500 mg every 6 hours for three days, then as needed, and morphine 3–6 mg/day. As a result, the average NPRS was 1–2. The prescribed medications included ciprofloxacin, omeprazole, zinc supplement, and mixt carminative. The patient began sipping some liquid diet on postoperative day two and was placed on a regular diet on postoperative day four. The Jackson Pratt drain removal happened on the day of discharge (postoperative day six), but Foley's catheter remained indwelled for 14 days. The pathologic findings indicated prostate adenocarcinoma, a Gleason score 7 (3+4) mass with all margins free of malignancy. The immunologic staining was positive for SMA and desmin in the spindle cell component but negative for CD 68.

DISCUSSION

RARP has gained popularity among urologists. Our patient was the first successful operation of this kind at Songklanagarind Hospital.

A preoperative concern was exogenous steroid use due to ITP treatment. However, our patient was at a low risk for adrenal crisis, as he had discontinued the low-dose prednisolone therapy long before the time of operation. According to the current knowledge, the level of the hypothalamic-pituitary-adrenal axis suppression and the duration required for it to return to normal was unknown.[4] Hence, we avoided unnecessary steroid supplementation, and no sign of adrenal insufficiency was observed.

Specific intraoperative considerations involved patient inaccessibility during robot docking and the arm-tuck position. We secured intravenous and arterial lines with extra extensions before robot docking. Apart from standard monitoring, blood pressure was assessed via an arterial line because the repetitive use of pressure cuff measurement increases the risk of skin bleeding, especially in thrombocytopenic patients. Also, pressure cuffing on the upper arm increases the risk of radial neuropathy. The other methods followed to prevent peripheral neuropathy were in accordance with the practice advisory for the prevention of perioperative peripheral neuropathies 2018 recommendations. We used shoulder braces to prevent patient displacement. Our patient did not have a postoperative brachial plexus injury; nevertheless, despite caution, he developed a pressure injury (PI) in this area. This complication emphasizes the geriatric skin fragility and the need for the of use of patient restrain straps.

The use of a neuromuscular blocking agent is indispensable in this procedure; its insufficiency may lead to significant injury. Deep blockade improves the surgical working space and facilitates mechanical ventilation.[5] Nevertheless, residual muscle relaxants are harmful, especially in patients with unhealthy lungs. We infused cisatracurium via a three-way stop cock with a short extension from the patient side to facilitate a rapid dose adjustment. An acceleromyograph at the end of the operation showed a positive response to the train-of-four stimulations with fading. We, consequently, administered a reversal agent.

RARP effects hemodynamic change in several ways. Sympathetic stimulation from hypercapnia accelerates heart rate and contractility. Meanwhile, rapid peritoneal stretching stimulates vagal tone, increases intrathoracic pressure, and decreases venous return.[6] Personalized or goal-directed fluid therapy (GDFT) should be adopted. However, fluid responsiveness via the heart-lung interaction could be a false positive due to pneumoperitoneum. In such a case, pulse pressure variation is particularly low, suggesting adequate hydration.

To our knowledge, there is no solid evidence supporting colloid and diuretics usage in RARP. Nevertheless, we transfused platelet concentrates to enhance primary hemostasis because our patient had a subordinate platelet count. After some degree of blood loss, fresh frozen plasma may also be an option in order to restore intravascular volume while avoiding tissue edema. Furosemide, which promotes urinary excretion, can accentuate an early surgical complication if present.

The pulmonary system can incur some effects from RARP. Uncorrected hypercapnia from gas insufflation can lead to respiratory acidosis, pulmonary vasoconstriction, and dead space ventilation. End-tidal carbon dioxide monitoring can detect this problem; therefore, routine arterial blood gas analysis is undue. High intraperitoneal pressure worsens atelectasis, functional residual capacity, and lung compliance. In addition, steep Trendelenburg positioning increases airway pressure and glottic edema; carinal cephalad migration may also occur and lead to endobronchial intubation.

The confirmation of the tracheal tube positioning is performed after pneumoperitoneum in the steep Trendelenburg positioning. We employed pressure-controlled ventilation to ensure a lower peak airway pressure and better dynamic compliance, aiming for a

plateau pressure of less than 30 cmH$_2$O.[7] The inspired oxygen fraction to maintain the saturation above 94% was sufficient; excessive oxygen increases the risk of hyperoxic acute lung injury. We periodically performed sustained-inflation lung recruitment to reduce atelectasis and other potential pulmonary complications. Postoperative breathing exercises are essential, especially for the elderly with previous lung disease.

Another physiologic change from RARP is increased intracranial pressure. High cerebral perfusion can predispose the occurrence of postoperative delirium and cognitive dysfunction (POCD). Besides, the head-down position raises intraocular pressure; this may complicate any undiagnosed ocular disease. In light of all the points discussed above, the duration of the steep Trendelenburg positioning and the intraperitoneal pressure should be as limited as possible. Our patient kept at a 23-27 degree position for 5 hours. There were no serious cardiovascular, pulmonary, or neurologic complications.

Another significant risk in prolonged operations is deep venous thrombosis (DVT). The Caprini scoring system, validated in over 250,000 patients worldwide, provides an efficient method for risk stratification. Our patient had a score of 4, suggesting a moderate risk. We preferred the IPC to anticoagulants for DVT prophylaxis; the latter is associated with a higher bleeding tendency in ITP patients compared to the former.

Regarding pain control, the robotic approach decreases incision size and accelerates postoperative recovery, thereby leading to a lower postoperative opioid consumption. Some researchers have suggested the use of non-steroidal anti-inflammatory drugs (NSAIDs) to optimize pain control.[8] Our patient did not receive any NSAIDs intraoperatively due to uncertainties regarding his renal function. Adequate pain control improves outcomes and reduces the risk of postoperative delirium and cognitive dysfunction.

Lastly, the elderly are at risk for PIs, which can lead to poor clinical outcomes.[9] Our patient demonstrated a small PI at his shoulder. Zinc level examination and appropriate supplementation when warranted, along with added intake of calories, protein, and trace elements, could improve healing time. Additionally, thrombocytopenic patients might be at risk for bleeding and stress-related mucosal disease (SRMD). Accordingly, our patient received a proton-pump inhibitor.

The pathologic study findings showed a negative surgical margin, indicating a non-inferior oncologic outcome to those reported by other studies.[2] Compared to a tertiary hospital in Thailand with an experience of nearly 700 cases, our first operation took 160 minutes longer and incurred 200 ml more of blood loss; however, the length of hospital stay was equal.[10] More, we remain confident that more experience will enhance our team's surgical performance related to this procedure and help reach the learning curve plateau.

CONCLUSION

In this case study, we discussed the first RARP case at Songklanagarind Hospital. Firstly, steep Trendelenburg positioning and pneumoperitoneum effect physiologic changes in the cardiovascular, pulmonary, and neurologic systems. Our recommendations to avoid the occurrence of relevant complications consist of the employment of GDFT, a protective ventilation strategy, and the limitation of the head-down position as much as possible. Secondly, the cautious application of padding can decrease the risk of PIs and peripheral neuropathy. Furthermore, patient strapping should replace shoulder braces in order to prevent brachial plexus injury and PI. Thirdly, the neuromuscular blockade prevents patient injury and facilitates the laparoscopic procedure.

Underlying ITP and advanced age increase the risk of bleeding, adrenal crisis, SRMD, PIs, pulmonary complications, and POCD. Pain education and breathing

exercises during the preoperative visit led to efficacious postoperative care in all cases. Steroid supplements might not be necessary for those with a low risk of adrenal crisis. Vigilant positioning, the prompt transfusion of blood components when warranted, adequate pain control, and the administration of additional medication as necessary can help minimize the occurrence of unwanted sequelae.

CONSENT

Written informed consent was obtained from the patient.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare related to this case report.

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