Radical prostatectomy is one of the most common treatment options currently recommended for clinically localized prostate cancer. Evaluation of intraoperative and postoperative complications is important in evaluation of relative morbidity of this treatment option. Furthermore, investigation of complications of surgical treatment in correlation with not only surgical technique, but comorbidity, ASA stage and anesthetic technique enables improvements in complete perioperative treatment and decrease of incidence of complications resulting from the procedure.

Improvement of anesthetic techniques and use of new anesthetic agents contributes to better outcome of surgical treatment. For radical surgery, combined epidural analgesia and general anesthesia reduces postoperative complications and mortality. Benefits can be conferred most likely by altered coagulation activation in surgery, increased blood flow, reduction of operative stress response.

Modalities for reduction of intraoperative blood loss during radical prostatectomy are normovolemic haemodilution, preoperative donation of blood for autologus transfusion and use of erythropoietin for increasing red cell mass.

Key words: prostate cancer, radical retropubic prostatectomy, anesthesia

INTRODUCTION

Operative risk stratification that determines anesthetic technique, extent of postoperative monitoring and intensive care, is based on evaluation of three main factors: patient’s age, presence of comorbidities and type of surgery. As it was introduced, radical prostatectomy was at first associated with substantial potential perioperative morbidity and mortality. Today it offers the best long-term cancer control of all current treatment options for prostate cancer. Radical prostatectomy is mostly recommended for men with low-risk disease, defined as PSA ng/mL and Gleason grade =6, men aged 65 years and younger, and in good health1,2. As pelvic operation, with transection of the dorsal venous complex and staging of pelvic lymph nodes, radical prostatectomy is considered to be an operation of intermediate risk for intraoperative complications.

Regarding patient’s age, association between age and comorbidities is imperfect, as many older men have few or even no comorbid conditions. Nevertheless, as we age, chronic conditions become more common. And increasing comorbidity has been shown to increase the risk of a variety of adverse postoperative outcomes3. Particularly cardiac condition (such as coronary artery disease, congestive heart failure, valvular heart disease and severe arrhythmia) and diabetes mellitus are associated with increased incidence of perioperative complications. In surgical patients presented with an American Society of Anesthesiologists (ASA)3 physical status classification score of 1 and 2 (healthy persons or mild systemic disease) risk of perioperative mortality is 0,4%, while in patients presented with score 3 (severe systemic disease) it is 1-3%4 and in those with score 4 (severe systemic disease that is constant threat to life), risk increases up to79/4.

Choice of anesthesia for each patient is based on preoperative evaluation parameters and type of surgery. The key factors in preventing patient’s injury from anesthesia are vigilance, up-to-date knowledge, and adequate monitoring. For radical prostatectomy, as for all radical and extensive operations, improvement of anesthetic techniques, particularly combined epidural analgesia and general anesthesia, as well as development of novel anesthetic agents, contributes to better outcome and decrease of perioperative morbidity. Risk of intraoperative blood loss is minimized with improvement of surgical technique, and by implementation of current guidelines in transfusion therapy, such as preoperative autologous blood donation, and use of erythropoietin preoperatively for increasing red cell mass. Sill, evaluation of perioperative complications for
radical prostatectomy is one of main topics in urology, despite significant decrease of complications rate in past decades.

**PATIENT’S POSITIONING**

Radical retropubic prostatectomy is performed via a midline lower abdominal incision with the patient in supine position. Slight hyperextension is provided by elevation of kidney rest under the lumbar spine, or by braking the table at the midline, for extension of the distance between the symphysis pubis and the umbilicus. The table is then placed in the Trendelenburg position until the patient’s legs are parallel to the floor (Fig. 1). This position provides direct intraoperative visualization of pelvic structures, particularly pelvic plexus, and a staging pelvic lymphadenectomy can be performed through the same incision. For radical perineal prostatectomy patient is in exaggerated lithotomy position combined with slight flexion of the trunk and a Trendelenburg tilt (Fig. 2). Advocates for perineal approach for radical prostatectomy claim the superiority of this surgical position for avoiding transection of dorsal venous plexus and creation of direct access to the urethra.

Circulatory, respiratory and cerebrovascular consequences of these two surgical positions are direct result of the change in gradient between upper and lower part of the body, the had-down tilt. Venous distension of the upper body and jugular venous distension in head-down position, can lead to facial edema, swelling of the tongue and airway, and make airway management difficult. In conditions of general anesthesia, extubation may need to be postponed until the edema is resolved. Cephalad movement of the trachea in Trendelenburg position is result of the diaphragm pressure on lungs and carina upward. As the endotracheal tube may be firmly taped at its proximal end, the tube may not move upward with the trachea, causing bronchial intubation. (Figure 1. Surgical position for radical retropubic prostatectomy. (From Monk TG, Cancer of prostate and radical prostatectomy. In: Malhothra V. Anesthesia for renal and genito-urologic surgery,Mc Graw-Hill 1996; Ch10:177-195) (Figure 2. Surgical position for radical perineal prostatectomy. (From Monk TG, Cancer of prostate and radical prostatectomy. In: Malhothra V. Anesthesia for renal and genito-urologic surgery,Mc Graw-Hill 1996; Ch10:177-195)

Venous pressure is increased as much as four times normal in head-down position, and increase in central venous pressure raises intracranial pressure, that can lead to the decrease of cerebral perfusion. Healthy patient does not experience any problems as long as the mean arterial pressure is maintained . In presence of glaucoma, intraocular venous pressure can be increased too in Trendelenburg position. Extensive head-down position should be avoided in patients with prior craniocerebral trauma, neurosurgical operations and cerebrovascular insult.

During radical prostatectomy procedures operative site in pelvis is placed above the heart, creating gravitational gradient between the right ventricle and prostatic fossa. As venous network in prostatic fossa is opened, air embolism may occur at any time.

**INTRAOPERATIVE MONITORING**

Together with widely accepted basic intraoperative monitoring (noninvasive blood pressure, pulse oxymetry, capnography, respiration rate, continuous ECG), in radical surgery some parameters require invasive monitoring. Direct arterial blood pressure measurement may be helpful in high-risk or elderly patients. As the bladder is opened during the procedure, it is impossible to monitor fluid status by urine output, and hemodynamic monitoring of volume status in these conditions or during acute hemorrhage with a central venous pressure catheter is essential. The possibility for air embolism during radical prostatectomy also supports central venous catheter insertion, with
recommendation for precordial Doppler ultrasound monitoring for detection of air emboli and possible air aspiration. Only in patients with severe preoperative cardiovascular conditions pulmonary artery catheter may be needed for accurate assessing of hemodynamic status and cardiac filling pressures, or early detection of heart failure. Intraoperative monitoring of blood loss is essential, as hemorrhage is the most common intraoperative problem during radical prostatectomy.

**ANESTHESIA FOR RADICAL PROSTATECTOMY**

Radical prostatectomy can be performed under the conditions of general, regional or combination of these two anesthetic techniques. The combined general anesthesia and epidural analgesia become widely accepted for radical surgery in last decade. Advantages of central neuraxial blocks are: avoiding use of intravenous anesthetics that all are cardio-depressants, decreased stress response and fast recovery due to better postoperative pain control, decrease of incidence of postoperative nausea and vomiting, and early recovery of gut motility. The inconveniences of regional anesthesia in conditions of Trendelenburg position are: ventilation restriction in spontaneously breathing patient, and, even with good sedation, we operate on conscious patient, who may be aware of potential operative risks during radical surgery. Despite the quality of lumbar epidural anesthesia, it can be insufficient, as for radical retropubic prostatectomy it is necessary to achieve sensor block up to the level of sixth thoracic vertebra. Combining epidural analgesia, followed by general anesthesia, comfortable operative conditions are achieved, together with decrease of possibility of perioperative anesthetic complications, with regard of fact that later findings indicate that rate of complications is less in thoracic epidural, than in lumbar epidural block.

After routine premedication with sedative and anticholinergic drug, patient is positioned into full lateral or sitting position, and in aseptic conditions desired epidural space is identified. With bevel pointing cephalad, after a test dose of 3 ml of local anesthetic solution, an 18- to 20-gauge radiopaque catheter is threaded into the epidural needle, and placed at desired distance. Administration of local anesthetic is continued every 3-5 minutes until the total dose is given. General anesthesia is conducted with intravenous barbiturate, muscle relaxant for intubation, and maintained with inhalational anesthetic and repeated relaxant doses during surgery. Analgesia achieved by epidural is maintained with "top-up" doses in anticipation of receding block. Small doses of opioid analgesics may be used at the beginning of surgery, depending on quality of epidural block. For postoperative analgesia, intrathecal opioid in local anesthetic solution is advocated.

Advantages of combined epidural and general anesthesia have been proven through many studies, and they include reduced incidence of thromboembolic events, perioperative myocardial infarction, reduced intraoperative blood loss, reduced infection rate, incidence of pneumonia, respiratory depression and renal insufficiency. Meta-analysis of 141 published studies concerning regional anesthetic techniques and perioperative complications in more than 9 thousand patients have shown significant reduction of short-term (30-day) postoperative mortality in patients who underwent surgery in regional anesthesia, versus patients who received general anesthesia. Incidence of total perioperative mortality was lower in patients who had combined epidural and general anesthesia versus those who had central neuraxial block alone. Risk for venous thromboembolism is less by half in regional anesthesia, incidence of pulmonary embolism the same, incidence of perioperative myocardial infarction is less for one third. Demand for transfusion of more than two units of blood is reduced for 50%, in same percentage is reduced postoperative need for blood components. Respiratory depression postoperatively was reported to be by 59% more seldom after central block, and incidence of acquired pneumonia was significantly smaller after thoracic epidural versus lumbar epidural or subarachnoid anesthesia.

The benefits seen for neuraxial blockade may be conferred to multifactorial mechanisms, including altered coagulation, increased blood flow, improved ability to breathe free of pain. Possibly the most important, reduction of operative stress response is confirmed in neuraxial blockade, but not in general anesthesia.

### TABLE 1

<table>
<thead>
<tr>
<th></th>
<th>Lepor, 2001*</th>
<th>Maegawa, 2001(12)**</th>
<th>Lecombe, 1999(13)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (ml)</td>
<td>800</td>
<td>1600</td>
<td>800</td>
</tr>
<tr>
<td>Blood transfusion demands (%)</td>
<td>9,7</td>
<td>11</td>
<td>7,8</td>
</tr>
</tbody>
</table>

### TABLE 2

**COEXISTING DISEASES IN PATIENTS SCHEDULED FOR RADICAL PROSTATECTOMY**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular condition</td>
<td>51.06%</td>
</tr>
<tr>
<td>Varicose veins</td>
<td>14.89%</td>
</tr>
<tr>
<td>Respiratory condition</td>
<td>6.38%</td>
</tr>
<tr>
<td>Peptic ulcer</td>
<td>12.77%</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>6.38%</td>
</tr>
</tbody>
</table>
COMPLICATIONS AFTER RADICAL PROSTATECTOMY

Perioperative complications of radical prostatectomy are mainly hemodynamic and cardiovascular. According to some authors, comorbidity or anesthesia do not influence outcome\textsuperscript{9,10}, while others declare that surgical and anesthetic techniques do influence short-term outcome after radical prostatectomy\textsuperscript{4,5}. The most common intraoperative problem is hemorrhage, with excessive bleeding requiring transfusion of more than three units of blood in 2% of all radical prostatectomy procedures\textsuperscript{10}. Intraoperative blood loss rates reported in some of the studies of complications of radical prostatectomy are shown in Table 1. It is most likely that there can be up to 70% of cases of intraoperative blood transfusion demands, although it can be reduced by 9-20% with preoperative blood donation and autologous transfusion\textsuperscript{11}. (Table 1).

Measures for decreasing intraoperative blood loss today are, beside improvement of surgical technique, normovolemic hemodilution for reduction of hematocrit before surgical blood loss, autologous transfusion, and preoperative deliberate erytrocytosis induced with erythropoietin. Recommended autologous pre-donation of 800 ml of blood in patients without anemia is sufficient\textsuperscript{12}. Intraoperative blood loss rates reported in some of the studies of complications of radical prostatectomy are shown in Table 1. It is most likely that there can be up to 70% of cases of intraoperative blood transfusion demands, although it can be reduced by 9-20% with preoperative blood donation and autologous transfusion\textsuperscript{11}. (Table 1).

Measures for decreasing intraoperative blood loss today are, beside improvement of surgical technique, normovolemic hemodilution for reduction of hematocrit before surgical blood loss, autologous transfusion, and preoperative deliberate erytrocytosis induced with erythropoietin. Recommended autologous pre-donation of 800 ml of blood in patients without anemia is sufficient\textsuperscript{12}. If preoperative values of hemoglobin and hematocrit are normal (hemoglobin at least 110 g/L, hematocrit at least 0.30), hemodilution with crystalloids is induced, and normovolemia is maintained and approximately three units of blood are donated. Post-hemodilution hematocrit is usually 0.28 in standardized protocols. Intraoperative blood collection is not a method of choice in patients with carcinoma, as malignant cells could be disseminated. If erythropoietin is option, patients received it on preoperative days 14 and 7, and it may be good alternative strategy in blood management.

Surgical perioperative complications in radical prostatectomy, according to the published data, are: rectum injury (0.5-2%), ureteral ligation (0.1%), and femoral or obturator nerve injury (0.1%)\textsuperscript{11,12,13}. Hemodynamic instability due to rapid hemorrhage is reported in 8% of cases and transitory arrhythmia in 2%, according to our data\textsuperscript{14}.

Incidence of reported short-term complications after radical prostatectomy varies according to various authors. Evaluation includes venous thromboembolism (deep vein thrombosis and pulmonary embolism), myocardial infarction and postoperative mortality. Incidence of pulmonary embolism has decreased in past decade from 5% to 0.2%, and incidence of deep vein thrombosis from 16% to 0.1%\textsuperscript{10,11}. Introduction of routine anticoagulation is mostly responsible for decrease of thromboembolic complications, as well as improvement of surgical technique. Re-operations due to hemorrhage are reported in 0.3% of cases, due to anastomosis rupture in 0.2%, while the incidence of wound infection is 0.7-1%\textsuperscript{10,11}\textsuperscript{13}.

CONCLUSION

Together with careful preoperative evaluation (more aggressive preoperative cardiac assessment) and adequate preparation of patients for surgery, preoperative planing of anesthetic technique, blood strategy and anticoagulation are essential for minimising operative risk for complications and adverse events. Contemporary tendency in anesthetizing patients with combination of general anesthesia and epidural analgesia has proven its benefits, through reduction of operative stress response and decrease of the incidence of cardiovascular complications. Regarding reduction of intraoperative blood loss, ultimate recomen-
Anesthesia for radical prostatectomy


11. Lepor H., Nieder M, Ferrandino M., Intraoperative and postoperative complications of radical retropubic prostatectomy in a consecutive series of 1,000 cases. J Urol Nov; 166:1729-1733


