25 Radical Prostatectomy

Alexander Haese and René Sotelo

General Considerations

Complications will never be completely eliminated from surgery and surgeons must learn from complications. In contrast to open surgery, routine recording of robotic surgery permits documentation and analysis of complications more thoroughly than previously possible. Due to the rapid uptake of robotic surgery in less than a decade, many surgeons underwent its learning curve in a short time. This, plus a potentially distinct manner of complications from robotic compared to open surgery, caused the complications of robotic surgery to be apparent and more frequent.

There are distinct risks from robotic over open surgery. Complications can affect structures outside the camera view. As complications are rare, and the length of hospital stay commonly is shorter for robotic than open surgery [1, 2], the treating physician has to have an even more watchful eye on those surgical steps, intra- or postoperative events and symptoms leading to or indicating complications during the surgery, hospital stay, and recovery phase of the procedure.

Routine anonymously self-reporting of complications to further patient care is useful, as large prospective national projects, such as the National Confidential Enquiry into Patient Outcome and Death (NCEPOD), have shown that confidential reporting of operative outcomes improve patient care by identifying common risk events, practices of concern, and strategies to overcome these.

Robotic-assisted laparoscopic radical prostatectomy (RALP) is the most common of all urologic surgeries [3]. Many urologists start their robotic experience with RALP. It might therefore serve as a template for other pelvic surgeries, both benign and malignant, in men and women. In this chapter, we follow the course of a RALP, demonstrate risks, dangers, and pitfalls leading to immediate or delayed complications, and highlight strategies to prevent them.

Patient Positioning

In few other surgical procedures is proper patient positioning so crucial, for both a successful procedure and low complication rate, as in RALP. The typical transperitoneal approach requires steep Trendelenburg position (20°–35°) to permit adequate pelvic exposure. Readjustment of table

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A. Haese, MD
Martini Klinik Prostate Cancer Center, University Clinic Eppendorf, Hamburg, Germany
e-mail: haese@uke.de

R. Sotelo, MD (✉)
USC Institute of Urology, University of Southern California, Los Angeles, CA 90089, USA
e-mail: rene.sotelo@med.usc.edu

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position mid-procedure is only possible in those rare situations where last-generation robotic systems equipped with table motion technology are used. Proper patient positioning can prevent countless complications that may be confused with other diseases [4]. When starting a robotic program, we suggest that positioning is always done by the same team.

Patient Fixation The most feared positioning complication mid-procedure is patient sliding, which might lead to transient or permanent severe skin, muscle, or nerve injuries, for example, incisional tear, postoperative hernia formation, and increased postoperative pain due to overstretching of the abdominal wall. Some tools such as shoulder straps, shoulder braces, restraints, body straps, or head rests intended to prevent slippage may actually contribute injury and should be avoided. A secure fixation of the patient on the table requires a soft mattress such as a Tempur – or a gel mattress, the friction of which will, in part, prevent movement [5]. Vacuum mattresses may also be used; however, when evacuated, these are quite hard, and inappropriate modeling of the mattress to the patient contour may lead to compression injuries. Another rare but critical issue of vacuum mattresses is that they might slowly lose the vacuum due to gas leakage (often unnoticed, due to the draping of the patient), and therefore their ability to maintain a stable patient position.

Face and Eye Protection Face and eyes are at risk of direct injury during robotic surgery due to the proximity of the robotic camera, the console surgeon's lack of bedside view and drapes. Particularly risky is the 30° down lens, where the camera may be only a few centimeters away from the face. Face masks, metal shields, or metal bars or foam pads protect the face. Eyelids must be tape-closed and protective goggles applied. Instruments not in use must not be placed on the drape, as the patient's face or chest are underneath and unrecognized compression injuries can occur.

Shoulder, Arms, and Chest Of utmost importance is shoulder padding with pillows specifically designed for steep Trendelenburg positioning. These should be soft, but firm, and have sufficient contact surface to evenly distribute the weight of the patient on an as large as possible shoulder area. Ideally, these pillows are in one piece for both shoulders, with a notch stabilizing the patient head without compression, which may lead to alopecia. These pillows also avoid continuous rotation and lateral flexion of the neck, which increases tension in the brachial plexus on the opposite side, and provide a firm but stable fixation of the entire shoulder, without isolated clavicular compression, both factors contribute to preventing *brachial plexus injury*. An easy and safe way to position the arms is to put a sheet of approximately 100 × 50 cm horizontally in the middle of the table, corresponding to the position of the patient's arms. Egg-crate foam or gel mattresses protect the arms when the sheet is tucked, in a way that arms are fixed closely but not tight to the patient's body. Alternatively, well-padded arm rests can be used. At the level of the elbow, the *ulnar nerve* passes through the olecranon. Care should be taken to prevent *ulnar lesions* [6] that later can present as a sensitive damage of the fourth and fifth fingers in the palmar region, which can progress to motor nerve damage and ultimately to a claw hand [7–9]. Placing the arms on the side prevents hyperabduction of the upper limb, causing *brachial plexus* injury. The hands should be in an anatomically neutral position. Improper fixation might cause the hand to drop laterally, and hyperextend causing *radial nerve injury*.

Lower Extremities Irrespective of the tools that the legs are positioned in (split leg table, stirrups), it is crucial to avoid hyperextending at the hips, which risks femoral nerve stretch injury. Compression of muscles must be avoided to prevent crushing injuries, which in its extreme form may lead to rhabdomyolysis, compartment syndrome, and ultimately fasciotomy. The risk of rhabdomyolysis is increased particular in long procedures, obese patients, and steep Trendelenburg combined with other common risk factors such as diabetes, hypertension, or peripheral vascular disease [10–12]. Gluteal, back, calves, and shoulder muscles are at particular risk [13]. Postoperative pain in these areas should serve as a warning sign. The diagnosis is confirmed if the total serum creatinine kinase level is higher than 1000 IU/L or if myoglobinuria is present. Management includes aggressive fluid resuscitation and correction of metabolic acidosis [14] and in case of a compartment syndrome, early fasciotomy.

Complications During Robotic Prostatectomy: Access

Access Complications A pre-incision checklist should include the following: availability of CO_2, insufflation settings as specified, electrocautery setting as specified, automatic function on the bipolar deactivated, and all equipment (suction, irrigation, fully functional and white balanced camera) checked and ready for immediate use. In the early experience, an open tray should be available. The first (camera) trocar for pelvic surgery is typically placed in the periumbilical region. As the other trocars are placed under visual control, the safe placement of the camera trocar is of utmost importance.

Veress needle access, optical-access trocar, and access via a mini-laparotomy using Hasson technique [15–20] are the most common access forms. Injuries during access range from mild to life-threatening [21, 22], where most injuries involve either visceral or vascular organs or a combination thereof. The surgeon should be familiar with all access forms, their advantages, pitfalls, and contraindications to be able to alter the approach when needed.

The Veress needle is inserted blindly, and this maneuver can result in injury to intraabdominal structures, commonly intestine or large blood vessels [23–26]. The Veress needle should be checked by the surgeon to ensure that the spring-loaded blunt obturator retracts when going through the abdominal wall, but also slides back into its protective position after entry into the peritoneal cavity. The abdominal wall should be lifted upward with two sharp towel clamps creating distance between the parietal peritoneum and intraabdominal structures to increase safety distance between the tip and viscera. In very obese patients, it is preferable to use points in the fascia that elevate the entire abdominal wall as lifting only the skin and subcutaneous fat tissue will not lift the entire abdominal wall. The surgeon should brace the hand on the patient while advancing the needle in a 45° direction (90° in more obese patients) to avoid inadvertently pushing the needle too deep. The double-click test indicates the two points of resistance as the needle is passed through the anterior and posterior rectus fascia. After passing through the second point of resistance, and before insufflation, a syringe half-filled with saline should be placed on the Veress needle and aspirated to identify vascular or intestinal lesions. Subsequently, saline should be passed through the needle (drop test) to verify intraperitoneal position. Opening pressure upon CO_2 insufflation should be <10 mm Hg. Flow rate should be low until well-documented, symmetrical abdominal distension. The camera trocar is then carefully introduced with a braced hand. Camera inspection should occur immediately thereafter so that early identification of injury is possible. In patients with previous abdominal surgery, an open access should be performed.

Vascular Injuries Vascular injuries during access are rare, ranging from 0.03% to 0.2% [27–29]. Most vascular injuries are caused by the Veress needle or the initial trocar placement [21, 30, 31]. The aorta and common iliac vessels are most commonly injured [32]. To minimize the risk of injury, the patient should lie without Trendelenburg in the access phase, as Trendelenburg rotates the promontory and positions the aortic bifurcation closer to the umbilicus, increasing the likelihood of vascular injury [33]. If vascular injury occurs, management should be tailored to the situation: small, non-expanding lesions can be marked with clips, monitored during surgery and be reinspected afterward with CO_2 pressures at 5 mmHg. If the hematoma expands, additional trocars should be placed and the system docked. The hematoma should be opened and the bleeding site exposed. If repair is possible, repairing with robot-assisted technique is the first approach. Inserting gauze, compression, increased pneumoperitoneum (in venous lesions) and adequate instruments for repair (see below) should be available. If it cannot be repaired laparoscopically or robotically, apply compression and perform prompt laparotomy. Doing this is preferable to losing time trying, with potential harm to the patient.

Bowel Injuries Bowel injuries during access are rare, ranging from 0.07% to 0.09%. If viscera are injured [32, 34, 35], the trocar should be left with its obturator and shaft in place, and another trocar to explore should be inserted. Depending on surgical expertise and defect size, repair can be done with a purse string or double-layer suture. Alternatively, the bowel can be externalized and repaired through a small incision. Significant or complex tears may require laparotomy.

It is discouraged to do a Veress approach in case of previous abdominal surgery. Here, access via a mini-laparotomy [17], under vision [18], or optical entry far from prior scars should be standard of care.

Secondary Trocar Placement Subsequent trocars must always be placed under direct vision. Marking trocar sites with a pen after a full pneumoperitoneum is established is useful, as the optimal points of trocar entry with their respective safety distances are better identified in an inflated abdomen. Transillumination may help visualize subcutaneous vessels, even though the larger epigastric vessels at the lateral border of the rectus muscle are often invisible. Overly small skin incisions are to be avoided as they require excessive force for trocar insertion, which may cause injury.

Adhesions and prior open or laparoscopic abdominal surgery pose a significant challenge to trocar placement. If scars are visible, one should avoid placing trocars through or in a direction toward the scar. After placement of the camera trocar using Hasson technique, the abdomen is verified for adhesions. The degree of adhesions is unpredictable; they can be surprisingly extensive despite only minor previous surgeries, or almost nonexistent despite previous major abdominal interventions. If adhesions are present, the next trocars to be placed for any procedure are those distant of the adhesion but in a position that permits manual laparoscopic adhesiolysis. After adhesiolysis, the reminder of the trocars can be placed safely.

Vascular Injury During Secondary Trocar Placement Injury to other abdominal vessels, in particular the inferior epigastric arteries and veins, may occur during placement of secondary trocars, affecting abdominal wall vessels in 35% and the aorta or iliac arteries in 30% of cases, respectively [16]. Transillumination and dimmed OR light help identify and bypass abdominal wall vessels. At the end of the procedure, ports should be removed under direct vision and the port sites inspected for arterial bleeders. A figure-of-eight suture should be placed for adequate control, as cautery might not be sufficient.

Complications During Robotic Prostatectomy: Mid-Surgical Complications

Injuries Caused by Direct Instrument Contact A unique feature of robotic surgery is that during the procedure some crucial steps are not in the hands of the surgeon, but in those of the bedside surgeon or scrub nurse [36, 37]. This is particularly true for the insertion and change of robotic or laparoscopic instruments. Still it is the console surgeon's responsibility to guarantee the safety of the procedure. Hence, he or she must ensure that no actions are taken without adequate view. *Never should a robotic instrument be inserted without direct vision as it has no memory and can go further than desired.* During instrument change if the bedside assistant manually redirects the robotic arm, instrument position is erased and reinsertion must be done under direct vision. Intestinal loops can move during surgery, leading to possible injury during instrument exchanges.

Venous Lesions Due to their anatomically favorable position, even large venous lesions of the external iliac veins can typically be controlled by increasing pneumoperitoneum to 20–25 mmHg, applying moderate compression and suturing. It is more difficult to control veins branching off the iliac during pelvic lymph node dissection. Suction should be reduced to the absolute minimum, because this maneuver decreases pneumoperitoneum, increasing bleeding.

Arterial Lesions Lesions of large arteries require immediate compression or clamping, for example, with a ProGrasp robotic instrument. The two other robotic arms may then be used first to identify the lesion as precisely as possible. This permits the bedside surgeon to have two hands available for (moderate) suctioning, additional compression with laparoscopic-robotic instrument with rolled gauze sponges to tamponade the bleeding, or needle insertion. Clips can be used for preliminary control, followed by definitive suturing. A rescue suture should be available. The rescue suture is a suture with Hem-o-lok at the end. Applying the suture and placing it on tension rapidly stops the bleeding by apposition of the vascular injury. It consists of a Vicryl suture with a CT1 needle with no memory (unlike monofilament) to facilitate suturing.

If robotic closure of an artery is not feasible but compression permits a preliminary hemostasis, conversion is required and the following steps, as given in Fig. 25.1, should be taken.

Bowel Injuries These are less prone to acute complications, however, as they may occur out of camera view, they may to present in a delayed fashion. Bowel injuries may be divided into perforation and abrasion, with an incidence of 0.2–0.6%, respectively. Fifty percent were a result of electrocautery and 80% required laparotomy. Critically, 69% were not recognized intraoperatively [38]. The basis of prevention is a high level of alertness when the bedside surgeon enters laparoscopic or robotic instruments as to unusual resistance when outside the camera view. If in doubt, the console surgeon must inform the bedside surgeon if he needs visual help to place the instruments into view. To maximize the safe range of instrumentation, intraoperatively detected adhesions of small or large bowel

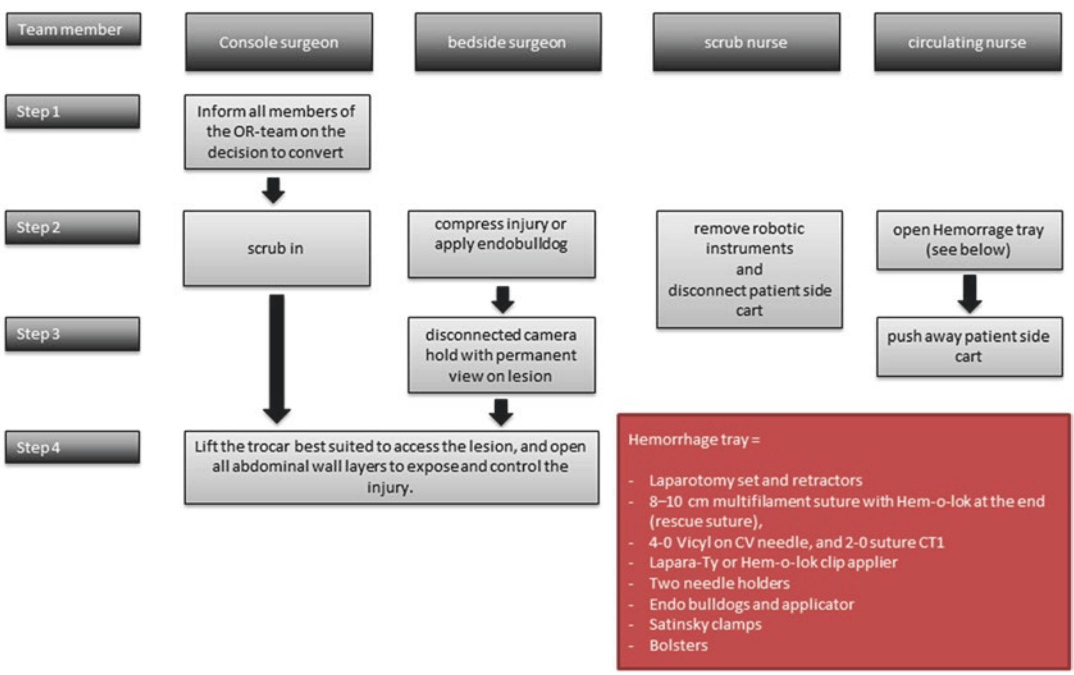

Fig. 25.1 Flow chart of emergency conversion in case of bleeding

should be freed sufficiently to drop cephalad, out of the range of both robotic and laparoscopic instruments. The additional time required for this is well invested for increased safety. If abdominal viscera are injured, repair can be done by primary robotic or laparoscopic repair. Alternatively, the closest trocar site to the injury can be opened, the bowel exteriorized for repair, repositioned intraabdominally, followed by trocar closure and continuation of the procedure. If only an abrasion of serosa is seen, a primary repair is done robotically. In doubt, the site of injury should be closed preliminarily, marked with a long thread, and the prostatectomy finalized. Intestinal injury from trocar insertion should be inspected on both sides, since the perforation can be through and through. In the extraperitoneal approach, transgression of the peritoneal reflection with a trocar can cause unrecognized bowel injury; hence, proper understanding of this potential danger is important. At the surgeon's discretion, consultation with a general or colorectal surgeon may be advisable.

Signs and Management of Undetected Visceral Injuries If unrecognized during surgery, patients with bowel injury will require laparotomy with or without fecal diversion. The patient generally is asymptomatic on the first postoperative day, as peritonitis will not yet have developed. If dissection was difficult or if significant adhesions were found and possible injury is suspected, the patient should remain hospitalized for further surveillance. Symptoms of unrecognized visceral injuries include focal trocar site pain, generalized abdominal pain, distension, fever, diarrhea, leukocytosis or leukopenia, peritoneal signs, wound succus, or elevated drain amylase levels. Diagnosis is made clinically and biochemically, but a low threshold for an abdominal CT-scan is advisable. Radiographic signs of intestinal injury include free intraperitoneal fluid, extravasation of enteric contrast, and ileus. Free intraperitoneal air is ambiguous, as even several days after a laparoscopic procedures, some free air may exist.

Pelvic Nerve Injury The most common nerve injury involves the obturator nerve [39, 40]. An incidence of 0.7% has been reported in laparoscopic radical prostatectomy and 0.4% in RALP. Injuries are caused by stretching, but more commonly by direct thermal injury, or complete transection during lymph node dissection. As the obturator nerve is highly constant, the only way to prevent its injury is a high degree of alertness during lymph node dissection and proper visualization at all times. The nodal packet should be pulled medially and not anteriorly to visualize the nerve. Hem-o-lok clips must be placed in parallel, not perpendicular to the nerve, and only after completely visualization. Likewise, electrocautery must be used carefully, rather than blindly grabbing tissue where a bleeder is suspected. Control bleeding at this level is important because it has also been reported obturator neuropraxia secondary to an expanding hematoma compressing the nerve that required surgical drainage for clinical improvement [41].

Recovery of obturator function from neuropraxia occurs spontaneously within 6 weeks. After a full unrecognized transection, however, gait disturbance will persist, followed by atrophy of the adductor muscles. If recognized during the procedure, an attempt should be made to align the ends of the transected nerve and suture it [41, 42].

Rectal Injury The incidence of rectal injury is similar with different approaches: open (0.5–1.5%) [43, 44], laparoscopically (0.7–2.4%) [44, 45] and robotic (0.2–0.8%) [44, 46, 47]. The most important point is to recognize the injury during surgery and to perform tension-free primary repair using sufficient vascularized tissue interposition [43, 45, 47, 48]. When the defect is too large or complex to be sutured tension-free, if fecal contamination is extensive or in a salvage-prostatectomy situation, a fecal diversion is indicated.

In the early postoperative phase, rectal injury may lead to major complications including septic peritonitis and death. Very small injuries may lead to rectourethral fistula development. In men with unrecognized rectal injury, rectourethral fistulae tend to persist and eventually require delayed surgical repair. The sequelae of rectal injuries are pelvic abscess (0.1%) and rectourinary fistula (0.03–1%) [43, 45, 47, 48].

As in the open procedure, salvage RALP has an increased risk of rectal injury and should be avoided in the earlier learning phase. Likewise, a high degree of alertness, avoidance of both electrocautery and aggressive blunt dissection reduce the risk on rectal injury [49, 50]. Sharp dissection also can cause rectal lesions; however, these have typically smooth, well-vascularized edges that can be sewn safer than larger lacerations occurring with blunt dissection, or thermal necrosis that can be unrecognized. Diagnosis during surgery is done with the bubble test, which consists of passing a 22 Fr. catheter through the rectum and injecting 60 cc of air, while observing the pelvis filled with saline. If bubbling occurs, air is passing through the rectum to the pelvic cavity. The lesion should be closed in two-layers. In non-nerve-sparing surgery, the lateral tissue can be moved to the midline as an additional layer of safety. The rectal repair should be moved away from the anastomosis to reduce the risk of fistula formation.

After repairing the injury, repeat the bubble test. Generous irrigation of the operative field dilutes bacterial contamination. Even if normally no drain is placed after rectal injury, this should be done. Additional days of hospitalization, 3–7 days of antibiotic therapy with anaerobe coverage, and prolonged catheter placement is recommended. A cystourethrogram is mandatory prior to catheter removal.

Early symptoms of rectal injury are lower abdominal pain, fever, abnormal white blood count, and sepsis. If unrecognized, a larger rectal lesion may progress to septic peritonitis. Late presentation occurs as recurrent or persistent urinary tract infection, rectourethral fistula, pneumaturia, or urine loss per rectum. Such fistulae are diagnosed by retrograde urethrogram, urethrocystoscopy, colonoscopy, or CT-scan with rectal contrast.

Ureteric Injuries The incidence of ureteral injuries is <1% [44, 51, 52] and more than 70% of ureteral injuries are diagnosed postoperatively. Its incidence during urologic laparoscopy surgery is 0.8% and 0.1–0.3% during RALP.

The ureter may be injured in several typical locations:

- *Intertrigonal injuries*: After the anterior bladder neck is separated, dissection continues downward, along the plane between prostate and bladder. If this plane is harder to identify, or in patients with median lobes, it is possible to “button-hole” the bladder neck. This typically happens in the trigonal area. In larger dorsal intertrigonal defects, the ureteral orifices can also be injured. To prevent this, it is recommended to repeatedly inspect the bladder via the orifice and delineate the full thickness of the detrusor with an inside and an outside view. If such defects occur, they must be closed; however, the ureteral orifices must be visualized for their location and urine efflux after each stitch with a Vicyl 4–0 suture. The catheter must not be removed without cystography. In predictably challenging cases (post-TURP, salvage) cystoscopy with ureteral catheter insertion at the beginning of the case may be prudent and should be considered in select cases.
- *The distal ureter* is prone to injury when using the Montsouris approach [53, 54]. On too lateral a dissection, the ureter can be mistaken for the vas, thereby transected, thermally injured, or ligated. If a Montsouris approach is used, a tubular structure should never be divided without being completely sure it is the vas. Vas and ureters have different trajectories, where the vas converges in the midline from lateral to medial.
- *Medial ureteral injury* occurs during extended lymph node in the vicinity of the iliac vessels. Again, visualization of the ureter at all times eliminates the risk of injury. The use of the third robotic arm to pull the ureter away from the lymph node template increases safety distance.
- *Special considerations after TUR-P*: In patients with previous TURP, the ureteral orifices might be displaced from their typical location. Here, the anterior opening results in the bladder being wider open than usual.

This permits visualization of the orifices. When the dorsal dissection is done, it is of utmost importance to continuously focus both orifices and check for urine efflux. Great care has to be taken to avoid cutting close to the ureteral orifice. In the early phase of the learning curve, post TURP patients should be avoided. Intravenous indigo carmine may be helpful in select cases.

Treatment of Intraoperatively Detected Ureteral Injuries As a rule of thumb, all ureteral injuries can be corrected robotically. Cauterized, nontransecting ureteral injuries should be stented in a retrograde fashion. Partially or fully transected ureters can be repaired after stent placement with a 5–0 monocryl suture. Longitudinal defects should be closed transversally to prevent narrowing of the ureter. For trigonal lesions, the extent of the repair depends on the size of the injury. As mostly the distal end of the orifice is affected, the roof of the orifice can be incised after stent placement. If the ureter or orifice is widely injured, a ureteral reimplantation is recommended.

Technical Errors and Malfunction

Injuries Caused by Electrocautery or Thermal Energy Electrical arcs can arise from monopolar instruments. Insulation failure is the typical cause for this type of injury [55]. Surgeons should avoid excessive instrument collision to maintain integrity of the insulation, and ensure insulation sleeves are placed properly and without defects. Electrosurgical arcs can cause immediate injuries to blood vessels. Thermal intestinal injury can lead to delayed necrosis and perforation several days after the procedure.

Great care must be taken when a monopolar instrument is in proximity of metallic tips of instruments of the bedside surgeon, such as a grasper or suction. Electronic arcs may jump over from the tip of the scissor to the nonisolated parts of the instrument, leading to bowel or visceral injury. As a safety measure, cautery should be minimized or avoided particularly on the rectal wall during posterior dissection.

Instrument Malfunction The most common event of instrument malfunction is a break of the wires controlling the endowrist and instrument jaws. If this happens, the instrument can be removed easily. Events such as a break of an instrument tip or a disintegration of an instrument can be dangerous as the loose part might get lost intraabdominally [56, 57].

Needle Loss A critical issue is needle loss during surgery [58, 59]. Preferably, only one needle at a time should be in situ, except when double-armed sutures are used. When needles are inserted or removed, a needle holder must be used (no grasper due to less grip), needles should be grasped directly but not on the thread and the bedside surgeon should verbally confirm successful needle retrieval each time.

In case of needle loss, it is extremely important not to move any robotic or laparoscopic instrument in a hurry [58]. Typically, the needle stays below to where it escaped, and careful, but easy search with the robotic camera will be successful. Too early movement with instruments will move intestines and potentially hide a needle. Magnetic search devices have been described [60]. In the process of searching, the lumen of the trocar should be inspected, and if in doubt, the trocar should be removed and X-rayed. Finally, the needle might be lost outside the abdominal cavity, between the surgical drapes.

End of Case Considerations

When finishing the case, the scrotum should be empty of gas, since this can distend it, causing skin lesions and breakdown. It is also crucial to assess for subcutaneous emphysema as this can easily be confused with other conditions such as generalized edema. Reduce insufflation pressure to 5 mm Hg to check for bleeders masked by higher pneumoperitoneal pressures.

Postoperative Complications

The incidence of postoperative complications is reported to be 1.9–9.0% [44, 61, 62]. The most common complications occur early after the procedure, thus it is crucial to evaluate the patient thoroughly in the first 2 or 3 h postoperatively. Assessment includes speed of regaining consciousness, vital signs, skin coloration, drainage type and volume, and abdominal tenderness.

Postoperative Hemorrhage, Blood Transfusion, and Reintervention As in open surgery, this is the most relevant immediate to early complication. The incidence of blood transfusion is low (<1.5%) [44, 61, 62]. The transperitoneal approach allows larger blood loss before detection, as the space for the hematoma to spread is large and hematomas may not irritate intraabdominal structures, which is a unique difference to the open approach. The indication for transfusion and intervention is based on clinical findings [63, 64]. Particularly in rapidly worsening patients (tachycardia, hypotension, abdominal distension) immediate reintervention is preferable, as compared to waiting for a CT-scan, which may delay a necessary intervention. Drainage output is not a reliable sign of bleeding, as the blood clots in the drain, obscuring bleeding. More often than not, open exploration is advisable, as a larger hematoma, with its associated poor vision, slower chance of hematoma evacuation via suction, and vital instability, which worsens when the patients goes back to Trendelenburg position, requires a swifter, safer, and more predictable control.

In clinically stable patients, who experience postoperative bleeding, as determined by a drop in hemoglobin, a CT-scan with IV-contrast helps to assess the urgency to intervene: If an active bleeder is seen, reintervention is necessary. In the more common situation without active bleeding, the need to intervene is determined by size and position of the hematoma: smaller hematomas in the prostate fossa that do not expand will resolve over time. Hematomas affecting the anastomosis – evidenced by bloody catheter output – indicate anastomotic rupture, pelvic urinoma, ultimately longer catheterization time and increased risk of strictures. Here, a laparoscopic evacuation of the hematoma – albeit requiring reintervention – is more beneficial for the patient in the long-term perspective.

Urinary Anastomotic Leakage The most common sign of massive urinary leakage is increased drain output, the type of fluid determined by drain fluid creatinine levels. The presence of urine is confirmed when drainage creatinine is higher than serum creatinine. To determine the origin of the leakage (anastomosis or ureteral injury), a cystography is the easiest form of assessment. A cystography shows either a partial or a total disruption of the anastomosis. To differentiate urine from a ureteric lesion from urine from an anastomotic insufficiency, the method of choice is a CT-scan with IV-contrast and urographic phase combined with 3D reconstruction: If ureter is partially or fully transected, an increased drain output with elevated creatinine can be expected. In particular after transperitoneal approach, abdominal pain and distension due to urine peritonitis is a common symptom.

Retrograde ureteropyelography has the advantage of both identifying and possibly treating ureteral lesions. If the defect is small and guidewire passage is possible, stent placement for 4–6 weeks typically resolves minor lesions. If retrograde ureteropyelography shows a larger defect, or when passage of a guidewire is not possible, reintervention, combined with percutaneous renal drainage is inevitable.

Fully obstructed ureters due to sutures or clips cause hydronephrosis and flank pain. Ultrasonography raises the suspicion, and a CT-scan with IV-contrast will identify the level and degree of obstruction.

Port Site Hernia The incidence of port site hernia ranges from 0.04% to 0.477% [64, 65]. They generally occur at larger trocars and are more frequent in sites of multiple incisions. For prevention, closure of all >10 mm ports is recommended. Port site hernias have also been described at 5 and 8 mm port sites, and occur because the size of incision of the port differs between the internal abdominal wall and the external incision, as the movement of the trocar causes a cone effect in the abdominal wall incision. Blunt obturators reduce the incidence of trocar hernias [35, 66].

Signs of trocar hernia are abdominal pain, (sub)-ileus, nausea, and vomiting. Diagnosis is made by CT-scan with oral contrast media. Laparoscopic exploration, hernia reduction and, if needed, resection of necrotic intestine and enteroanastomosis is the treatment.

Stricture and Bladder Neck Contracture These contractures have a low incidence of 0.7–1.4%, occur at a median of 5 months after surgery [67–69], and may present as acute urinary retention. Patients usually report being previously incontinent or that their urine stream has changed and that the stream now fans out. The standard precautions of anastomotic suturing (mucosa-to-mucosa, tension-free, initial watertightness) reduce the incidence of strictures.

Lymphoceles With an incidence of up to 50% – mostly asymptomatic, though – lymphoceles are the most common long-term sequelae of RALP [70]. They are more common in patients who underwent pelvic lymphadenectomy and present with pelvic pressure or pain, abdominal distension, thrombosis formation, and/or leg edema [71]. Ultrasound confirms the diagnosis, and US- or CT-guided percutaneous drainage is the treatment of choice after Doppler sonography excludes a deep venous thrombosis (DVT) [72, 73]. More than 90% of drained lymphoceles subside spontaneously, and only those persisting require laparoscopic fenestration [71].

Thromboembolic Complications These events include DVT and the resultant pulmonary embolism. Sporadic cases have been reported, with a low incidence below 1% [44]. However, the development of DVT usually has predisposing factors, such as vascular injury, hypercoagulability, and venous stasis. Prophylaxis is advised, involving intermittent compressive devices or low molecular weight heparin [73].

Conclusions

For all its complexity, RALP is a remarkably safe procedure in experienced hands. Complications are inevitable, but open confidential reporting allows sharing of experience knowledge and lessons to be learned by other surgeons. Common pitfalls occur in RALP and these may be avoided by experience, knowledge of other surgeons' complications and open reporting. Low index of suspicion affords early diagnosis of sequelae, minimizing their potential impact.

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