Canada's first robotic-assisted totally intracorporeal orthotopic ileal neobladder

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Cite as: *Can Urol Assoc J* 2013;7(7-8):e537-42. http://dx.doi.org/10.5489/cuaj.417
Published online August 19, 2013.

Abstract

Despite robotic-assisted radical cysto-prostatectomy being performed in several centres, the urinary diversion is most often performed extra-corporeal. A robotic intra-corporeal ileal neobladder is technically demanding and long-term functional outcome data is lacking. We performed a robotic intra-corporeal ileal neobladder in a 73-year-old man for muscle invasive non-metastatic bladder cancer. The total operative time was 6 hours 8 minutes. The estimated blood loss was 900 mL. There were no complications and he was discharged on day 12. The principles of open neobladder surgery were maintained, however key modifications were used to reduce technical difficulty and enable timely completion. We found that robotic intracorporeal ileal neobladder can be safely performed with an experienced robotic unit.

Introduction

Open radical cysto-prostatectomy with extended pelvic lymphadenectomy is the gold standard surgery for non-metastatic muscle invasive bladder cancer.[1] Robotic surgery is an option, however, there is little robust long-term oncological and functional outcome reporting.[1] The feasibility and safety of robotic radical cystectomy with extended pelvic lymphadenectomy and either extracorporeal or intracorporeal urinary diversion have been published.[2-4] More often the urinary diversion is completed openly/extracorporeally, after the robot is un-docked.[2,3] There was a recent study on the 90-day follow-up of 15 successfully performed robotic-assisted intracorporeal diversions.[5] Eight were Studer orthotopic ileal neobladders and 7 were ileal conduits. General concerns about performing robotic neobladders include the level of technical difficulty and the high risk of complications. In our centre, we have had extensive robotic experience since 2007, and to date the total experience includes: 500 robotic-assisted radical prostatectomies with extended pelvic lymph node dissection, 50 complex partial nephrectomy, 30 radical cysto-prostatectomy, 5 intracorporeal ileal conduits, 15 retroperitoneal lymph node dissection, 20 radical nephro-ureterectomy, and 10 adrenalectomy. We based our operative approach on the approach by Wiklund and Poulakis, and integrated some of our own modifications.[6] To our knowledge, this is the first reported robotic intracorporeal ileal neobladder performed in Canada. The purpose is to highlight key steps that make it feasible and safe to perform within experienced robotic centres.

Case report

We performed a robotic intra-corporeal ileal neobladder on a 73-year-old male with non-metastatic muscle invasive bladder cancer (stage T2 high grade)[7] with left hydronephrosis. Preoperative staging was negative. His body mass index was 29.8. His ASA (American Society of Anesthesiologists) score was 2.

Preparation and positioning

The urine was sterile. A mechanical bowel preparation was given. At induction, intravenous piperacillin/tazobactam 4.0 g/0.5 g, and subcutaneous enoxaparin prophylaxis were used. The position was steep Trendelenburg, however, the robot was un-docked and the table flattened (not completely) prior to the neobladder to allow the ileum to reach the pelvis.

Ports

We used the 6-port transperitoneal technique (Fig. 1). All ports were more cranially positioned than for robotic radical prostatectomy. The camera port position is measured at up

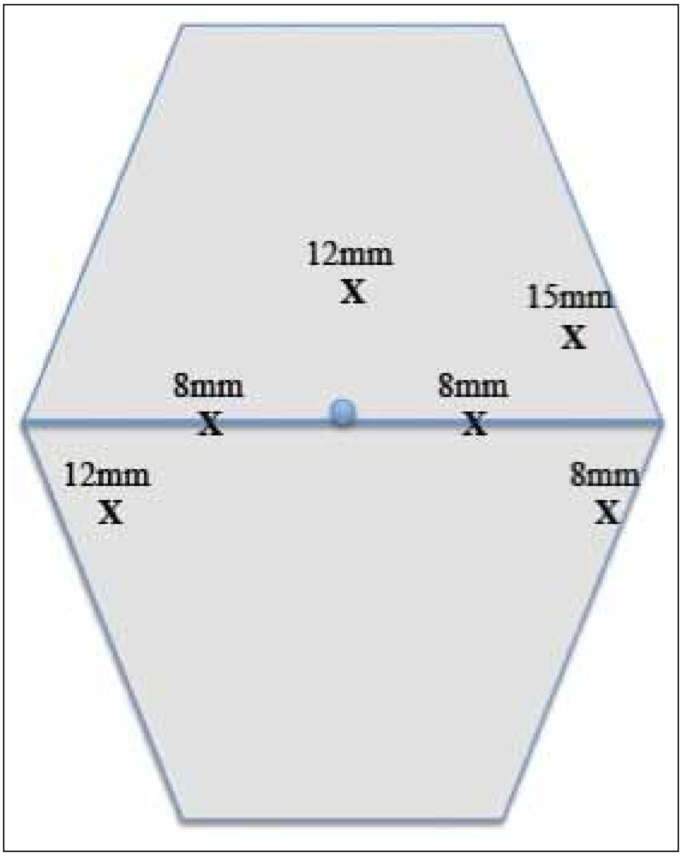

Fig. 1. Port placement.

to 5 cm cranial to the umbilicus. A 15-mm left-sided port was needed for the Endo GIA (Covidien, Mansfield, MA) stapler. Three 8-mm robotic trocars and a 12-mm assistant port were used.

We used a variety of robotic instruments and laparoscopic tools and sutures (Table 1).

Operative and 30-day outcome

The docking time was 13 minutes. The robotic radical cysto-prostatectomy with extended pelvic lymphadenectomy took 2 hours, 25 minutes; the neobladder took 3 hours, 30 minutes, for a total operative time of 6 hours, 8 minutes. The estimated blood loss was 900 mL. The ureteral stents were removed on day 10, followed by a cystogram and removal of the urethral catheter on day 20. No blood transfusion was needed. The patient was discharged on day 12. He was readmitted on day 14 for a urinary tract infection requiring 2 days of intravenous antibiotics. At this time, a contrast computed tomography scan of the abdomen and pelvis was normal. The pathology was high-grade urothelial cancer stage pT2N2M0 with negative surgical margins. Three out of 4 perivesical lymph nodes were positive for urothelial cancer, while 21 pelvic lymph nodes were all negative. He was referred for adjuvant chemotherapy.

Surgical technique

Robotic radical cysto-prostatectomy and extended pelvic lymphadenectomy: Key steps

We perform the extended pelvic lymphadenectomy (PLND) prior to starting the radical cysto-prostatectomy. The boundaries of this dissection have been previously described by Studer.[8] The proximal extent of the PLND is the common iliac artery, and continues caudally to include internal and external iliac templates and obturator fossa. This allows for precise identification and control of the vesical arterial pedicles at the origin of the internal iliac artery, mimicking the open surgical technique.

The key parts of a radical cysto-prostatectomy are:

1. The bladder is left suspended from the anterior abdominal wall until the end.
2. The vesical arterial branches are sequentially clipped and divided using Hem-o-lok clips.
3. In terms of the urethra, after the anterior urethral wall is divided, the urethral catheter is pulled into the pelvis and a Hem-o-lok clip placed on the catheter which is cut outside the patient by the assistant. This prevents urine/tumor spillage.
4. In terms of ureteral division, the ureters are divided as the final step of the cysto-prostatectomy. This prevents tumour spillage and avoids long periods of renal obstruction. Frozen sections of the urethral and ureteric margins are sent to pathology.

Robotic totally intracorporeal orthotopic ileal neobladder

We adhered to the open principles of a Studer orthotopic ileal neobladder.[9] Not all the steps are the same as the original description. The steps that are the same are: 55-60 cm ileum used, scissor detubularization of the ileum, sewn pouch construction, equal cross folding, externalized and direct ureteral stenting, globular shape and the presence of an afferent limb.

We followed modifications proposed by Wiklund and Poulakis.[6] They included:

1. Early transposition of the left ureter under the sigmoid meso-colon, prior to un-docking.
2. Un-docking and flattening out the table to a minor degree of Trendelenburg, allows the ileal loop to fall into the pelvis, which reduces tension at the anastomosis.
3. Urethro-ileal neobladder anastomosis was performed first, prior to disconnecting the ileum with the Endo GIA stapler (Fig. 2).
4. Four cartridge reloads of the Endo GIA stapler were used via the left sided 15 mm port to facilitate ileal harvest and entero-enterostomy (Fig. 3, Fig. 4).
5. A Wallace ureteral anastomosis (Fig. 5) was performed to the afferent limb.

Table 1. Equipment

Robotic instruments	– Two needle drivers – One Cardiere atraumatic forcep (Intuitive Surgical Inc., Sunnyvale, CA) – One Maryland bipolar forceps – One monopolar curved scissors – A 0° laparoscope
Laparoscopic	– A 45-mm long suction irrigator (5 mm) – A needle driver (5 mm) – DeBakey grasping forceps (5 mm) – Hem-o-lok clips (10 mm, 5 mm) – Lapra-Ty (10 mm) (Ethicon Inc., Somerville, NJ) – Laparoscopic stapler Endo GIA articulating 60 mm length (Covidien, Mansfield, MA) with a total of 4 cartridge reloads – One 15-mm Endo Catch (Covidien) bag (main specimen) – Two 5-mm Endo Catch bags (pelvic nodes)
Sutures: Left Ureteric transposition	– One Hem-o-lok clip is applied to each ureter prior to division – A 2.0 silk 12-cm suture is tied to the Hem-o-lok, making it easier to transpose the left ureter under the meso-colon
Sutures: Ileal work	– 3.0 PDS (polydioxanone) SH-1 (22 mm taper point) monofilament absorbable (Ethicon, Inc., Blue Ash, OH) – Each suture should be prepared at a length of 25 cm with a Lapra-Ty at the end secured by 6 knots
Sutures: Urethro-ileal neobladder anastomosis	– Two 3.0 PDS SH-1 sutures, each at 18 cm length, are tied with 8 knots at their midpoint to form a double-needled continuous suture – Two 3.0 PDS SH-1 sutures, each at 18 cm length, are tied with 8 knots at their midpoint to form a double-needled continuous suture – The anastomosis is commenced at the 6 o'clock position on the ileal side, as described by Van Velthoven.[10]
Sutures: Anterior and posterior wall neobladder reconstruction	– A total of six 3.0 PDS SH-1, 25 cm long sutures (Lapra-Ty clip, 6 knots) are used for suturing
Sutures: Posterior ureteral plate	– One 4.0 PDS RB-1 taper point, 18-cm long suture
Sutures: Wallace ureteral anastomosis to ileal afferent limb	– Two 4.0 PDS RB-1 taper point, 18 cm long sutures are tied together by 6 knots making a continuous 36-cm long suture – Alternatively for individual Bricker-type ureteric anastomosis, 4.0 PDS RB-1 15 cm interrupted suturing is used.
Drainage	– Two 7 Fr single-J Cook Ureteral Stents (Cook Medical Inc., Bloomington, IN) – Three silastic urinary catheters – One 20 Fr (during cystectomy) – One 20 Fr (initial neobladder formation) – One 24 Fr urethral catheter (final neobladder), – One Cook Suprapubic Catheter Set (trocar with access sheath – 11 Fr/9.7 cm length)

6. The ureteral stents were exteriorized (Fig. 6) and inserted via a suprapubic stab incision with the aid of a suprapubic cystostomy set.

Step by step robotic intracorporeal neobladder

1. The left ureter is transposed. The silk stay suture on the Hem-o-lok clip is delivered to the assistant's DeBakey forcep, to pull the ureter under the meso-colon.[6]
2. The robot is then un-docked and the table flattened.
3. The ileal loop is measured (15 cm from the ileo-ceacal valve); 55-60 cm is needed. The afferent limb of the neobladder, into which the uretero-ileal anastomoses are later performed, is positioned on the right hand side of the pelvis, and is not detubularized.
4. The urethro-ileal anastomosis is performed before disconnecting the ileal segment (Fig. 2), using the Van Velthoven technique.[10] The position of the anastomosis is 20 cm from the distal aspect of the neobladder segment, which corresponds to the most dependent portion of the neobladder within the pelvis.
5. The ileal segment is disconnected, and the entero-enterostomy performed, using 4 reloads of the Endo GIA linear stapler 60 mm through the left-sided 15 mm assistant port (Fig. 3).

Fig. 2. Completion of the urethro-ileal anastomosis prior to disconnecting the ileal loop.

Fig. 3. Disconnecting the ileal limb with the Endo GIA (Ethicon Endo-Surgery, Inc.) linear stapler.

6. The ileal loop is detubularized using the monopolar scissors. The fourth robotic arm and assistant provide counter-traction (Fig. 4).
7. The staple line is excised from the cranial section of the afferent limb, and either oversewn with 3.0 PDS, or when the Wallace technique is used it will be the future site of the ureteric anastomosis so can be left open until that time.
8. The posterior and anterior wall of the neobladder is reconfigured using 3.0 PDS. We aim for a globular shape, and cross-folding is performed as well.
9. A small opening remains at the anterior wall just below the afferent limb, which is where the ureteric stents will pass through the neobladder and into the ureters.
10. The posterior ureteral plate is formed, using 4.0 PDS, in preparation for the Wallace-type uretero-ileal anastomosis (Fig. 5).
11. The afferent limb and ureters are lined up on the right side.
12. The two 7 Fr ureteral stents are inserted via a suprapubic puncture using the Cook Suprapubic Catheter trocar and access sheath.
13. The stents are pulled through the small hole in the anterior wall of the neobladder pouch, and are guided through and out of the afferent limb, and up each ureter.
14. The suprapubic access sheath must be quickly removed otherwise the pneumoperitoneum will be lost.
15. The Wallace ureteral-ileal (neobladder afferent limb) anastomosis is performed using 4.0 PDS.
16. The small gap in the anterior neobladder wall, where the ureteral stents exit, is closed.
17. A new 24 Fr catheter is placed into the neobladder, and leak testing is done with 180 ml normal saline (Fig. 7).
18. One Jackson-Pratt drain is placed.
19. The specimens are retrieved.

Postoperative care

In postoperative care, the neobladder is flushed with 60 mL normal saline every 8 hours; the drain is removed when drain-creatinine excludes a leak. The urine must remain sterile. The metabolic acidosis is corrected with sodium bicarbonate. Ureteral stents are removed on day 10. A cystogram is done on day 20 and the urethral catheter is removed the same day if there is no leak. Voiding intervals are gradually increased from 2 hours (day and night) to 4 hours.

Discussion

The purported benefits of robotic radical cysto-prostatectomy include faster recovery, decreased postoperative pain, decreased blood loss and shorter hospital stay. Several small series of robotic-assisted radical cysto-prostatectomy have confirmed favourable medium-term oncological and functional results.[2-4,11] The technical complexity, operative duration and potential complications related to performing a robotic totally intracorporeal orthotopic ileal neobladder make it the most challenging robotic operation within urology. The first robotic totally intracorporeal ileal neobladder was performed by Beecken and colleagues.[12] Since then, few robotic intracorporeal neobladders have been performed.[5,11,13] Most units perform an extracorporeal urinary diversion.[2,3,14]

We maintained the open surgical principles of reconstruction based on the Studer technique.[15] We believe that

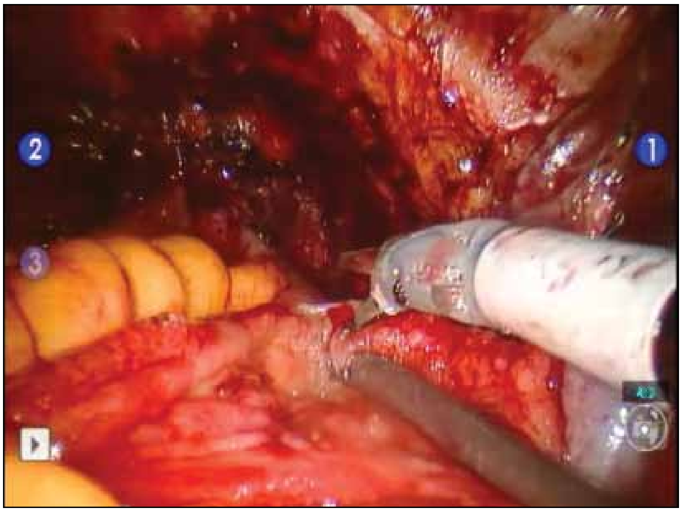

Fig. 4. Ileal detubularization along the anti-mesenteric border. The urethro-ileal anastomosis can be seen at the pelvic floor.

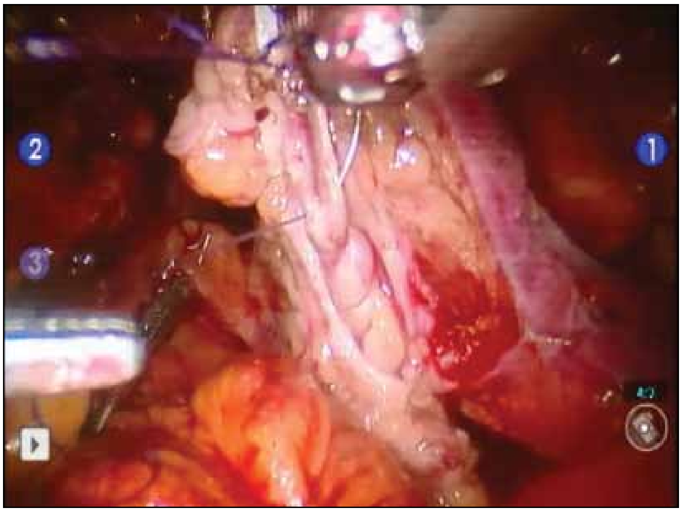

Fig. 5. Suturing the posterior ureteric plate in preparation for the Wallace anastomosis.

robotic intracorporeal urinary diversion is the next logical step in the progression of robotic surgery for non-metastatic bladder cancer. Performing a robotic intracorporeal urinary diversion amplifies the benefits of the robotic radical cystoprostatectomy. Furthermore, it has been our experience that the loss of pneumoperitoneum when converting to open for the urinary diversion results in decreased hemostasis. Due to our experienced robotic team, our total operative duration was favourable (6 hours, 8 minutes). We modified the Wiklund and Poulakis technique.[6] Long-term data are required to validate the functional outcomes of robotic intracorporeal ileal neobladder.

The USC Gill series includes 8 Studer intracorporeal robotic neobladders (7 ileal conduit).[5] There was a minimum 90-day follow-up, with median time to regular diet 5 days, and median hospital stay 8 days. There were 3 readmissions. There were 4 infectious complications within 30 days, 1 urinary fistula and 1 ureteral stricture requiring intervention beyond 30 days. Longer follow-up of functional outcomes is needed.

The series by Jonsson and colleagues in Europe includes 36 robotic ileal intracorporeal neobladders, with a 25-month mean follow-up.[11] The early complication (<30 days) rate was 40%. There were 2 open conversions: one for bleeding and the other for technical difficulty with the anastomosis to the ileal pouch. The Clavien late morbidity was 33%. The day and night continence rates (0-1 pad) were 97% and 83%, respectively.

The series by Canda and colleagues had 23 intracorporeal robotic Studer pouches.[16] The mean operative time

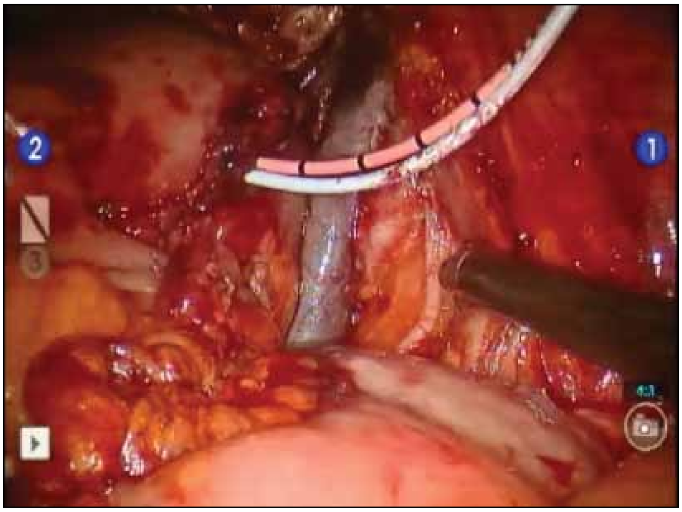

Fig. 6. The ureteric stents pass through the anterior neobladder wall, and are exteriorized.

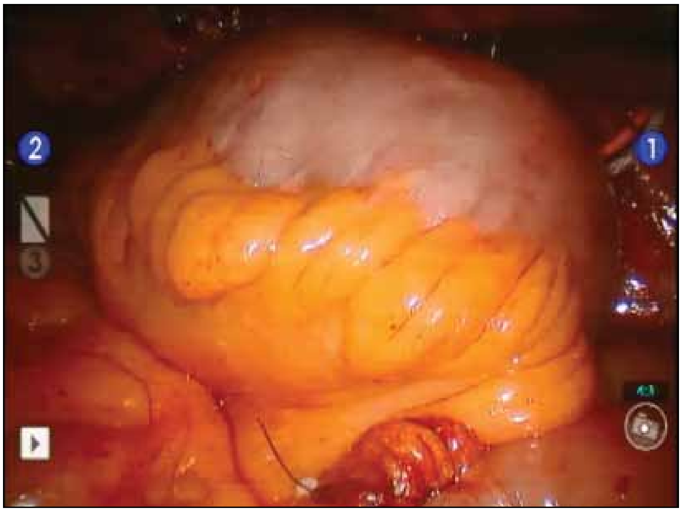

Fig. 7. The globular neobladder is leak tested.

was 9.9 hours, the estimated blood loss averaged 430 mL, and the hospital stay was 10.5 days. The grade 3-5 Clavien 30-day morbidity was 17%, and the day continence rate was 61%.

In the series by Pruthi and colleagues from the University of North Carolina, there were 3 intracorporeal neobladders. However, their results combined 9 intracorporeal ileal conduits with the 3 neobladders.[13]

These series are limited by the small numbers and short follow-up. The estimated blood loss ranged from 250 to 600 mL, but can be as high as 2200 mL.[11] The short-term day continence rates ranged from 60% to 90%. Longer follow-up is needed to assess continence and how this relates to robotic pouch configuration as compared with the open technique. Open neobladder day continence rates were >90%.[17] Open series nocturnal incontinence rates were quoted at 20% to 40%, and often an alarm was needed to void once at night to improve outcomes.[18]

In terms of oncological outcome of the robotic radical cystectomy and PLND, positive surgical margin rates are low (typically 0-1 per series). The positive lymph node rates from these series are:17%, 25%, 26%, with 3 deaths from metastatic cancer in one series.[5,11,16]

Conclusion

Robotic-assisted intracorporeal orthotopic ileal neobladder is technically demanding and can only be performed within an experienced robotic unit. Key technical modifications make it feasible and safe, while maintaining the principles of open neobladder surgery. Long-term follow-up is mandatory to better assess morbidity, functional and oncological outcomes.

Competing interests: None declared.

This paper has been peer-reviewed.

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