Robot-Assisted Augmentation Ileocystoplasty (AIC) for Genitourinary Tuberculosis Using a New Robot Platform

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ABSTRACT

Genitourinary tuberculosis (GUTB) can lead to a severely contracted bladder, often necessitating augmentation ileocystoplasty (AIC) for reconstruction. Robot-assisted laparoscopic techniques offer several potential advantages over open surgery, including enhanced visualisation and improved dexterity for executing complex reconstructive procedures. The authors present a case of a 31-year male with GUTB who underwent robot-assisted right nephroureterectomy and AIC on a new robotic platform. The patient's postoperative course was uneventful, and at the three-month follow-up, he was doing well. This case demonstrates the feasibility and potential benefits of robotic-assisted AIC on a new robotic platform, particularly for patients with a small, contracted bladder secondary to GUTB. Larger studies are required to validate this technique further.

Key Words: *Genitourinary tuberculosis, Robot-assisted augmentation ileocystoplasty, Small capacity bladder.*

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INTRODUCTION

Genitourinary tuberculosis (GUTB) is a common form of extrapulmonary tuberculosis (TB), often leading to significant bladder dysfunction and upper urinary tract damage. In advanced cases, the bladder can become severely contracted and fibrotic, necessitating reconstructive procedures such as augmentation ileocystoplasty (AIC) to restore bladder capacity and function.[1]

Traditionally, AIC has been performed through open surgery. However, the adoption of minimally invasive techniques, including laparoscopy and robotic assistance, has introduced several potential advantages. In particular, robot-assisted laparoscopic AIC offers enhanced visualisation and improved dexterity for the complex reconstructive steps involved in the surgery.[2]

The da Vinci robotic system has been a leader in performing complex urological surgeries for over two decades, with multiple upgraded versions, including the S, Si, and Xi systems.[3] Several cases of robot-assisted AIC have been reported in the literature, demonstrating that the outcomes of surgeries performed on these systems are equally effective compared to open and laparoscopic surgeries.[2,3] After the expiration of the da Vinci system's patent, several new robotic platforms have entered in the clinical practice.[4]

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The Versius robotic system, launched by Cambridge Medical Robotics (CMR) in 2019, is one of the newer platforms being used globally.[5] The Sindh Institute of Urology and Transplantation (SIUT) began its robotic programme in 2017 with the da Vinci Si system in collaboration with the Civil Hospital, Karachi, performing over 600 cases, followed by the establishment of a dedicated robotic teaching and training programme at SIUT in November 2021. This programme was equipped with the new Versius system. The SIUT robotic team adopted this robotic system very well and has performed over 2,000 cases to date.

Recently, we performed an AIC case on the Versius robotic system, which is probably the first surgery of this type performed on this system, as the authors did not find any case report of robot-assisted AIC on the Versius system. The authors are presenting this case report to enrich the existing scant literature.

CASE REPORT

A 31-year male presented to the outpatient department (OPD) with complaints of urge incontinence, stress incontinence, haematuria, and dysuria for one year. Following a detailed history and examination, cystourethroscopy was performed, revealing a small, trabeculated bladder with a capacity of approximately 100 ml. Multiple yellow-coloured papules and mucosal ulceration and granulomatous changes were also observed. These findings, combined with the contracted bladder, raised suspicion of TB. A biopsy confirmed the diagnosis of GUTB, showing epithelioid granulomas, Langhans giant cells, necrosis, and acute-on-chronic inflammation (Figure 1).

The patient was started on anti-TB therapy (ATT) as recommended by the infectious disease consultant. A contrast-enhanced CT scan of the abdomen and pelvis revealed moderate-to-severe hydroureter and hydronephrosis on the right side, with

no excretion of contrast and a small-capacity bladder (Figure 2). An MAG-3 renal scan further confirmed that the right kidney was non-functional. Urodynamic studies (UDS) were also performed before surgery.

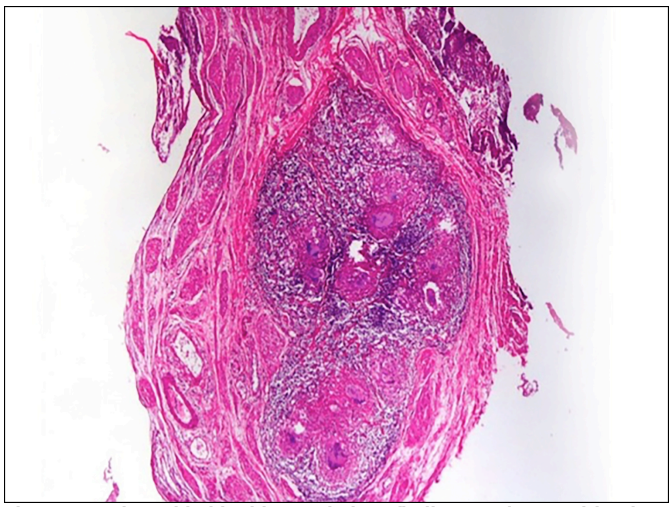

Figure 1: Urinary bladder histopathology finding consistent with tuberculosis.

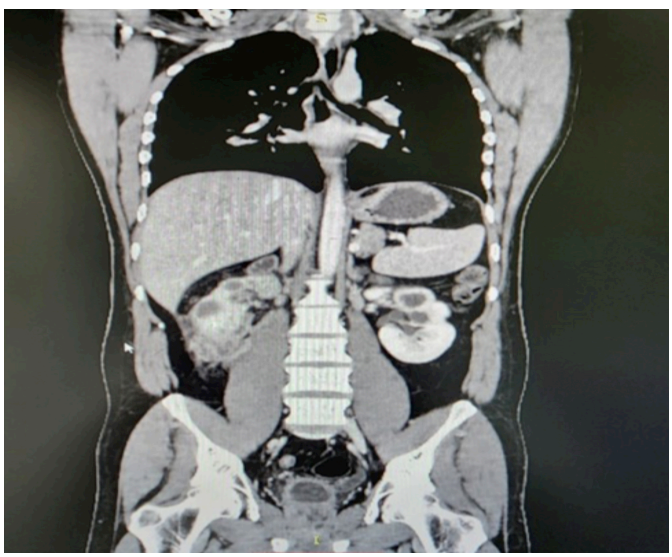

Figure 2: CT KUB showing right hydronephrotic kidney with small capacity bladder.

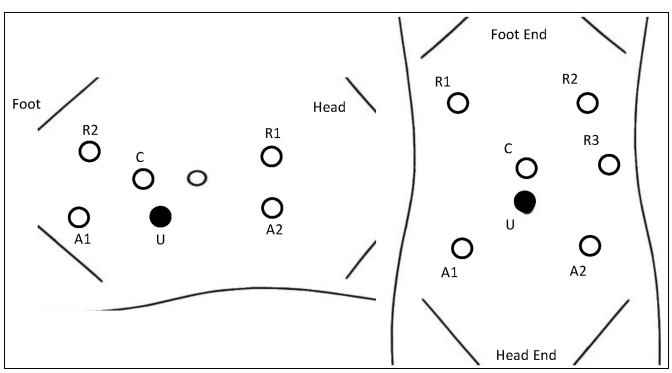

Figure 3: Port sites for right nephroureterectomy and augmentation cystoplasty. (A) Patient in lateral decubitus position. (B) Patient in spine position.
U: Umbilicus, C: Camera port, R1 and R2: Robotic working ports, A1 and A2: Assistant ports.

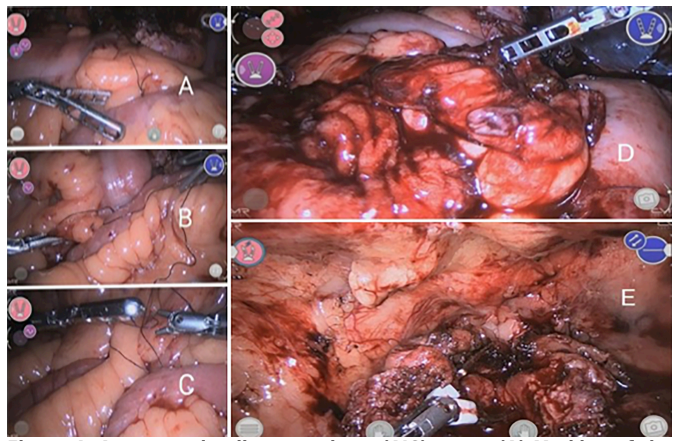

Figure 4: Augmentation ileocystoplasty (AIC) steps. (A) Marking of the proximal part of the bowel with silk. (B) 15 cm bowl loop marking. (C) Marking of the distal part of the bowel for augmentation with the help of Vicryl. (D) Detubularisation of the bowel segment for augmentation. (E) The opening of the bladder for anastomosis with bowel segment.

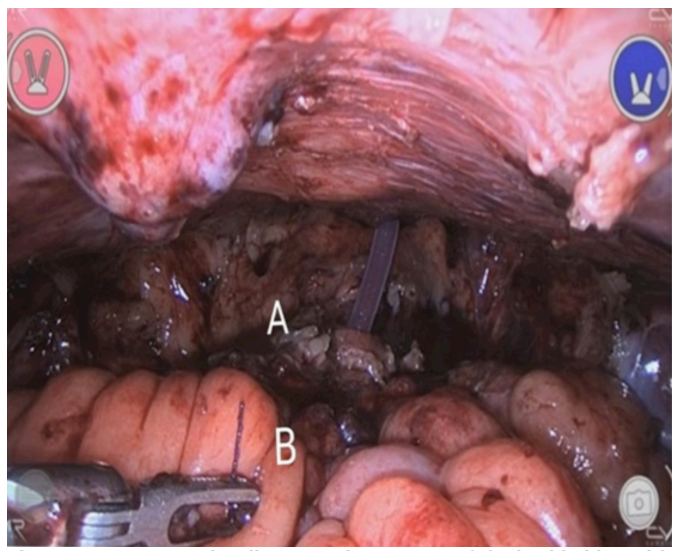

Figure 5: Augmentation ileocystoplasty steps. (A) The bladder with suprapubic catheter in it. (B) The bowel segment anastomosed with bladder.

UDS showed a small capacity, high-pressure bladder. A detailed discussion was held with the patient and his family regarding the proposed management plan. The patient was counselled on the need for a right nephroureterectomy and AIC. After thorough consideration, the patient consented to the proposed treatment. The procedure was performed using the Versius robotic system by CMR Surgical. A robot-assisted right nephroureterectomy was successfully followed by robot-assisted AIC.

After the anaesthesia was administered, the patient was positioned in the left lateral position. A camera port (C) was placed just above and lateral to the umbilicus, at the lateral border of the rectus muscle, using the open technique. The first robotic port (R1) was positioned in the mid-clavicular line, approximately 2 cm away from the ribs and 2 cm above the camera port line. Robotic arm 2 (R2) was placed between the anterior superior iliac spine and the camera port. The first assistant port (A1) was located 5 cm below and cephalad to the umbilicus, while the second assistant port (A2) was placed 5 cm below R2 (Figure

3A). The port sizes were as follows: C: 12 mm, R1: 6.8 mm, R2: 6.8 mm, A1: 12 mm, and A2: 5 mm.

After docking the robot, a right nephroureterectomy was performed up to the lower-third of the ureter using standard surgical protocols and techniques. Once the nephroureterectomy was completed, the patient was repositioned to the supine position, and re-porting was done for the robot-assisted AIC. For the AIC, the camera port was placed at the level of the umbilicus, with two robotic ports (R1 and R2), positioned in the mid-clavicular line, 8 cm lateral and slightly below the umbilicus. The third robotic arm (R3), measuring 6 mm, was placed 8 cm lateral and lower to the C and R2 port. Two assistant ports (A1, A2) were placed on each side, 8 cm lateral and port above the umbilicus on both sides (Figure 3B).

After port placement, the patient was positioned in the Trendelenburg position, and dissection of the urinary bladder commenced. Once the bladder was adequately dissected, the ileum was identified, and 15 cm of the ileum was marked 10 cm away from the ileocaecal junction. The marked ileum was then resected using a GI stapler, specifically the ECHELON FLEX™ 60 ENDO PATH® stapler. After resection, ileal continuity was restored with the same stapler.

Following bowel continuity restoration, the bladder was bivalved anteroposteriorly. The separated ileal segment was then incised along its antimesenteric border for its entire length to create a large ileal plate. This plate was subsequently anastomosed to the bladder using 3-0 Vicryl sutures (Figure 4, 5). A suprapubic catheter (SPC) and a Foley catheter were placed to ensure adequate drainage postoperatively.

The patient had an uneventful postoperative recovery and was discharged on the fifth postoperative day. At his three-month follow-up, he reported no irritative urinary symptoms and was voiding normally with an insignificant post-void residual volume. Uroflowmetry demonstrated a maximum flow rate (Qmax) of 27.2 mL/s.

A cystogram was performed three weeks postoperatively using both the SPC and perurethral approaches. The imaging demonstrated a well-capacity bladder with no evidence of leakage.

At the three-month follow-up, UDS was performed, showing satisfactory bladder capacity and optimal bladder pressure.

DISCUSSION

The field of surgery has been transformed by the rapidly growing discipline of minimally invasive surgery (MIS). MIS aims to perform surgical procedures with techniques that minimise morbidity and improve the quality of life compared to open surgery. This approach is favoured for many surgical procedures due to its numerous benefits, including reduced postoperative pain, faster recovery times, minimal scarring, decreased risk of complications, and lower costs, particularly in terms of shorter hospital stays and reduced utilisation of hospital disposables.[4]

This case highlights the feasibility and potential benefits of robot-assisted laparoscopic AIC in managing a small, contracted bladder secondary to GUTB using a new robotic system, the Versius platform, which is still in its early clinical stages. To the best of our knowledge, this is the first procedure of its kind performed using the Versius robotic system globally.

The first reported case of robot-assisted AIC was presented by Al-Othman *et al*. in 2008, where a completely intracorporeal technique was utilised.[5] Previous case reports have emphasised the advantages of this minimally invasive approach over open surgery, such as shorter hospital stays and quicker recovery times. Chowdhary *et al*. have reported successful robotic-assisted AIC in both adult and paediatric patients.[6] A similar case was reported by Dogra *et al*., where they performed AIC on a 43-year male with obstructive lower urinary tract symptoms (LUTS) for four years.[7]

The largest series to date was reported by Gould *et al*., who described their experience with five patients with neurogenic bladder undergoing robot-assisted AIC. They observed a reduction in operative time with increasing surgeon experience, from 7.3 hours to 5.9 hours, alongside minimal short-term morbidity.[8]

In this case, the procedure took 420 minutes, which is slightly longer than average; however, this can be attributed to the learning curve, as it was the first experience performing this type of surgery. The authors anticipate that the duration of surgery will decrease as we gain more experience with different types of robotic surgeries. The key advantages of the robotic approach include improved visualisation, dexterity, and suturing capabilities, which were greatly enhanced by using the Versius system. Compared to traditional laparoscopy, where complex surgical steps are more tedious, the robotic platform made these steps significantly easier, confirming its potential advantages.

In conclusion, although robotic surgery is not yet widespread in Pakistan and is only available at a few centres, its global presence and potential benefits cannot be overlooked. With the introduction of multiple robotic systems into clinical practice, costs are expected to decrease, addressing one of the main concerns associated with this modality. The authors are using the Versius robotic system, which has five years of clinical experience. Despite being a newer platform, the outcome of robot-assisted AIC appears to be effective and comparable to more established robotic systems. The authors recommend this type of surgery in high-volume centres such as SIUT, where a multidisciplinary team is available for such highly complex surgeries. Nevertheless, a larger number of cases and extended follow-ups are required to fully validate this technique on the Versius robotic platform.

PATIENT'S CONSENT:
Informed consent was taken from the patient.

COMPETING INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

RM: Contribution to the conception and design of the work.
HJ: Analysis and interpretation of data for the work.
HQ, GS: Drafting of the work and critical revision of the manuscript for important intellectual content.
HA: Final approval of the version to be published.
All authors approved the final version of the manuscript to be published.

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