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Laparoscopic radical prostatectomy with flexible instruments and 3D imaging: An alternative to traditional robotic platforms

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ABSTRACT

Objective: To report a laparoscopic radical prostatectomy utilizing a three-dimensional (3D) camera and flexible instruments in a patient with localized prostate cancer.
Patient and Surgical Procedure: The procedure employed the Endoeye® Flex 3D system (Olympus, PA, USA) and ArtiSential flexible instruments. It included transperitoneal extended pelvic lymphadenectomy, followed by anterograde prostate dissection, reconstruction of the vesical neck, and urethrovesical anastomosis. Both the surgeon and assistant wore 3D glasses.
Results: 3D imaging provided excellent surgical field visualization, while flexible instruments facilitated tissue dissection and urethrovesical anastomosis. The use of 3D glasses and perception was well-tolerated by the surgeon. No intraoperative or immediate postoperative complications were reported. Pathological examination revealed a Gleason score of 4 + 4 adenocarcinoma with negative margins and no evidence of lymph node metastasis. At the six-month follow-up, the patient remained continent and demonstrated adequate biochemical control.
Conclusions: Combining a 3D camera with flexible instruments during laparoscopic radical prostatectomy offers benefits comparable to robotic surgery. This presents a valid alternative for centers where the cost of robotic systems may be a limitation.

Introduction

Due to its numerous advantages, the robotic approach to radical prostatectomy has become the preferred choice in many centers [1,2]. Several studies have shown that robotic-assisted radical prostatectomy (RARP) is superior to 2D laparoscopic radical prostatectomy (2D LRP) in both functional and oncological terms [2]. However, the high cost of RARP compared to open and 2D laparoscopic approaches remains a significant concern [3]. To address this limitation, 3D laparoscopic equipment has been introduced to produce images comparable to those obtained with robotic platforms but at a lower cost. Studies of patients undergoing radical prostatectomy have shown that it is superior to the conventional 2D approach and comparable to the robotic approach [4,5] .

To further replicate the robotic experience, devices with flexibility have been developed. ArtiSential instruments, produced by the South Korean company LIVSMED, offer a 360° range of motion and tactile feedback [6]. They have been tested in gynecology, general surgery, and renal surgery [6–9].

Given the described technology, we decided to perform a laparoscopic radical prostatectomy combining 3D imaging and ArtiSential flexible instruments.

Materials and methods

We present a case of a 59-year-old patient diagnosed with stage cT2aN0M0 Gleason 4 + 3 prostate adenocarcinoma. His PSA level was 7.2 ng/ml. A bilateral intrafascial dissection of the neural hammock was planned.

A laparoscopic radical prostatectomy was performed using the Endoeye® Flex 3D system (Olympus, PA, USA). The first assistant held the camera. The ArtiSential instruments consisted of fenestrated forceps, a dissector, and needle-holders. The surgery proceeded sequentially through [1] transperitoneal trocar placement, [2] extended pelvic lymphadenectomy, [3] dissection of the Retzius space, [4] transverse bladder neck incision, [5] dissection of the vas deferens and seminal vesicles, [6] posterior prostatic surface dissection, [7] prostate pedicle ligation, [8] bilateral posterolateral dissection, [9] apical dissection,

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[10] transection of the dorsal vascular complex and urethra, (11) posterior reconstruction of the vesical neck, and (11) urethrovesical anastomosis with continuous 3-0 polydioxanone suture (Van Velthoven technique). The procedure was performed by one surgeon (JG) with experience of over 700 2D LRP. Throughout the procedure, both the surgeon and assistant wore 3D glasses.

Results

The Endoeye camera offered three-dimensional (3D) imaging and significant tip articulation, enhancing surgical field visualization. 3D visualization and the instrument's flexibility facilitated the entire procedure, particularly the posterolateral dissection, where depth perception was greatly improved.

3D image perception with 3D glasses was well-tolerated by the surgeon with immediate adaptation and no reported adverse effects such as dizziness or nausea.

Furthermore, the instrument's flexibility allowed for more expedited dissection and was particularly beneficial during the ureterovesical anastomosis. Its 360-degree maneuverability significantly aided needle orientation, contrasting favorably with the limited angles achievable with rigid needle holders.

The operative time was 190 min, and intraoperative blood loss was 250 mL. The patient was discharged on postoperative day two without a drain. Pathological examination revealed a Gleason 4 + 4 adenocarcinoma with negative margins and no evidence of lymph node metastasis. No transoperative or immediate postoperative complications were reported. At the six-month follow-up, the patient remained continent and had adequate biochemical control.

Discussion

To our knowledge, this is the first report describing the combined use of laparoscopic 3D imaging and flexible instrumentation during radical prostatectomy. We propose this technique as an alternative to conventional robotic approaches, particularly in settings where robotic surgery is not readily accessible, such as many institutions across Latin America.

From a performance standpoint, 3D laparoscopic surgery offers a surgical field visualization comparable to robotic systems, enabling surgeons to adapt quickly and efficiently. ArtiSential instruments allow mobility with a range of 360 degrees, enhance tissue dissection, and facilitate urethrovesical anastomosis, comparable to robotic-assisted procedures, with the added benefit of tactile feedback [6] . Previous studies have demonstrated the advantages of this technology. A systematic review by Shuai et al. found that 3D LRP resulted in shorter operative times, reduced blood loss, decreased drainage duration, and earlier continence recovery compared to 2D LRP [4]. Moreover, a meta-analysis comparing 3D LRP and RARP revealed no significant differences in oncological or functional outcomes [5]. A study by Min et al. further highlighted the versatility of ArtiSential instruments, showing that surgeons with no prior experience in robotic surgery or flexible instruments could perform suturing tasks with similar efficiency using either a robotic console or ArtiSential instruments [7].

Economic analysis does not favor RARP. Bolenz et al. compared the costs of RARP, 2D LRP, and open radical prostatectomy, reporting that RARP was significantly more expensive at $9,450 USD per operation compared to $5,687 for 2D LRP and $4,437 for open surgery [3]. A systematic review of cost-effectiveness analyses revealed inconsistent findings across studies, largely due to varying cost-effectiveness thresholds between healthcare systems [10]. The high acquisition cost of robotic systems, coupled with annual maintenance fees ranging from $112,000 USD to $150,000 USD, further underscores the economic burden of RARP [3]. In our country, the cost of the DaVinci Xi platform is approximately $2,700,000 USD.

In contrast, the 3D laparoscopic system combined with ArtiSential instruments represents a more cost-effective alternative. Based on current prices in our country, the latest Olympus 3D camera set requires an investment of $150,000 USD and an annual maintenance cost of $2,250 USD. ArtiSential instruments are priced at $600 USD per unit and are reusable in most surgical centers.

In conclusion, our study presents a novel approach to radical prostatectomy utilizing 3D imaging and flexible instrumentation. This technique offers comparable technical benefits to robotic surgery, making it a viable option for institutions with limited resources.

Consent statement

Written informed consent was obtained from the patient to publish the patient's case.

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CRediT authorship contribution statement

Jose Gaona: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Santiago Gaona:** Data curation, Resources, Writing – review & editing, Visualization. **Sebastian Ortiz:** Software, Data curation, Writing – review & editing, Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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