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REVIEW

Review of the role of robotic surgery in male infertility

Mohamed Etafy [a,c,*], **Ahmet Gudeloglu** [b], **Jamin V. Brahmbhatt** [a], **Sijo J. Parekattil** [a]

[a] *The Personalized Urology and Robotics (PUR) Clinic, South Lake Hospital, Clermont, FL, USA*
[b] *Department of Urology, Hacettepe University Hospital, Ankara, Turkey*
[c] *Department of Urology, AlAzhar University Hospital, Assiut, Egypt*

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KEYWORDS

Robotic testicular sperm extraction;
Robotic varicocelectomy;
Robotic vasectomy reversal;
Robotic vasoepididymostomy (RAVE);
Robotic vasovasostomy

ABBREVIATIONS

ART, assisted reproductive technology;

Abstract ***Objectives:*** To present the current state of the art in various robot-assisted microsurgical procedures in male infertility and review the latest literature, as the technology in infertility procedures has substantially developed since the incorporation of the Vinci® robotic platform (Intuitive Surgical, Inc., Sunnyvale, CA, USA).

Materials and methods: The search strategy in this review was conducted in accordance with Cochrane guidelines and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A search strategy was conducted in MEDLINE, PubMed and the Cochrane electronic databases (from 2000 to present) to identify studies that included both robotic and male infertility.

Results: In all, 23 studies were found, 12 of which met our inclusion criteria. Articles were excluded if the study did not include both male infertility and robotics.

Conclusions: Robotic assistance for microsurgical procedures in male infertility appears to be safe and feasible. It has several advantages including elimination of tremor, multi-view magnification, additional instrument arms, and enhanced dexterity with articulating instrument arms. It also has a short learning curve with a small

* Corresponding author at: The Personalized Urology and Robotics (PUR) Clinic, South Lake Hospital, 1900 Don Wickham Drive, Clermont, FL 34711, USA.
E-mail addresses: mhamdan102@gmail.com (M. Etafy), sijojp@gmail.com (S.J. Parekattil).
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3D, three-dimensional;
FDA, USA Food and Drug Administration;
PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses;
MeSH, Medical Subject Heading;
TESE, testicular sperm extraction;
RAVV, robot-assisted vasovasostomy;
RAVE, robot-assisted microsurgical vasoepididymostomy;
RAVx, robot-assisted microsurgical varicocelectomy;
RCT, randomised controlled trial;
US, ultrasonography

skin incision. However, larger, prospective studies are needed to establish the clinical benefits over standard microsurgery.

Introduction

In 1970s, the operative microscope was introduced into male infertility procedures. Since then, several developments have occurred in assisted reproductive technology (ART) [1,2]. The technology in infertility procedures has evolved substantially since the incorporation of the da Vinci® robotic platform (Intuitive Surgical, Inc., Sunnyvale, CA, USA) into microsurgical procedures [3].

The da Vinci surgical system is currently the only commercially available USA Food and Drug Administration (FDA) approved robotic platform. Today all types of microsurgical procedures for male infertility can be performed using this robotic platform [3]. The latest version of the da Vinci robot features a high-resolution three-dimensional (3D) view (with u p-to × 10–15 magnification) and three robotic instrument arms. These instruments are capable of six degrees-of-freedom, thus mimicking the surgeon's hand, wrist and finger movements with 180° articulation and 540° rotation. It enhances the ability of the surgeon to rotate instruments to a wider range than the human hand and provides a new capability in microsurgery. The robotic instrument arms also eliminate physiological tremors and provide motion scaling. The surgeon console provides a comfortable, ergonomic interphase to minimise surgeon fatigue. Having an extra third robotic instrument arm also allows the surgeon to control one additional instrument and be less reliant on the surgical bedside assistant. This extra arm can also hold adjunctive imaging or sensing tools, e.g. a Doppler ultrasonography (US) probe and provide additional real-time inputs to aid the surgeon [4].

Abbou et al. [5] first reported the use of robot-assisted laparoscopic radical prostatectomy in 2000 to help alleviate some of the surgeon fatigue and technical limitation issues of laparoscopy.

As robot-assisted laparoscopic procedures became more widespread, the potential for using this platform for robot-assisted microsurgery was also explored in animal studies [6–8]. These studies were then followed by early human trials [9–11]. Further exploration of the use of this platform in larger studies is ongoing [12].

The present article reviews the latest literature in robot-assisted microsurgical procedures in male infertility: microsurgical vasectomy reversal, microsurgical subinguinal varicocelectomy, and microsurgical testicular sperm extraction (micro-TESE).

Material and methods

The search strategy was conducted in accordance with Cochrane guidelines and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [13]. A search strategy was conducted in MEDLINE, PubMed and the Cochrane electronic databases (from 2000 to present) to identify studies that included both robotic and male infertility. The search was conducted using the following keywords; 'robotic', 'robot-assisted' and 'male infertility'. Medical Subject Heading (MeSH) phrases included: ('Robotic' [MeSH]) AND ('male infertility' [MeSH]), ('Robotics' [Mesh]) AND ('Andrology' [MeSH]), ('Varicocelectomy' [MeSH]) AND ('Robotics' [MeSH]). Both retrospective