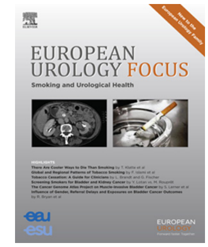
EUF-104; No. of Pages 15
ARTICLE IN PRESS
EUROPEAN UROLOGY FOCUS XXX (2016) XXX–XXX

available at www.sciencedirect.com
journal homepage: www.europeanurology.com/eufocus



Platinum Priority – Review – Education

Editorial by XXX on pp. x–y of this issue

Training Modalities in Robot-assisted Urologic Surgery: A Systematic Review

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Article info

Article history:
Accepted January 11, 2016

Associate Editor:
James Catto

Keywords:
Dry lab
Mentorship
Robot-assisted surgery
Simulation
Training
Wet lab

Abstract

Context: Novel surgical techniques demand that surgical training adapts to the need for technical and nontechnical skills.

Objective: To identify training methods available for robot-assisted surgical (RAS) training in urology, evaluate their effectiveness in terms of validation, educational impact, acceptability, and cost effectiveness, and assess their effect on learning curves (LCs).

Evidence acquisition: A systematic review following Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines searched Ovid Medline, Embase, PsycINFO, and the Cochrane Library. Results were screened to include appropriate studies. Quality was evaluated. Each method was evaluated, and conclusions were drawn regarding LCs.

Evidence synthesis: Of 359 records, 24 were included (521 participants). Training methods included dry-lab training ($n = 7$), wet-lab training ($n = 7$), mentored training ($n = 7$), and nonstructured pathways ($n = 5$). Dry-lab training demonstrated educational impact by reducing console time and was acceptable in a study; 100% of participants confirmed face validity. Wet-lab training principally uses human cadaveric material; effectiveness is well rated, although dry-lab training and observation were rated as equally useful. Mentored programmes combine lectures, tutorials, observation, simulation, and proctoring. Minifellowships were linked to greater practice of RAS 1 yr later. LCs vary according to experience. One study found that surgeons from robot-related fellowships demonstrated fewer positive surgical margins than surgeons from laparoscopic-related fellowships (24% vs 34.6%; $p = 0.05$) and reduced time (132 vs 152 min; $p = 0.0003$). Five studies examined nonstructured training pathways (clinical practice). Experience correlated with fewer complications ($p = 0.007$), improved continence ($p = 0.049$), and reduced time ($p = 0.002$).

Conclusions: RAS training methods include dry and wet lab, mentored training, and nonstructured pathways. Limited available evidence suggests that they affect LCs differently and are rarely used alone. The different methods of training appear effective when combined. Their benefits must be explored to facilitate validated acceptable training with educational impact.

Patient summary: Robot-assisted training encompasses several methods used in combination, but more evidence is required to gain the greatest benefit and formulate future training pathways.

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http://dx.doi.org/10.1016/j.euf.2016.01.006
2405-4569/

Please cite this article in press as: Lovegrove CE, et al. Training Modalities in Robot-assisted Urologic Surgery: A Systematic Review. Eur Urol Focus (2016), http://dx.doi.org/10.1016/j.euf.2016.01.006

1. Introduction

Surgical training has changed in response to transformations in surgical practice and the requirement for time and financial efficiency. The European Working Time Directive reduced training hours from expectations, although expectations and accountability are higher with litigation claims rising [1,2]. It is imperative that surgeons continue to achieve competencies necessary for safe practice.

Robot-assisted surgery (RAS) refers to the robot-controlled manipulation of remote-controlled robotic arms to facilitate a novel form of minimally invasive laparoscopic surgery [3]. This technological innovation is being used increasingly in urology [4]. Positive patient outcomes have been observed including survival and continence following robot-assisted radical prostatectomy (RARP) [5–8]. Unique technical and nontechnical (communication, teamwork, cognitive skills) competencies are required, and training must adapt accordingly [9,10].

Wright's learning curve (LC) principle assumes that training develops skills, improving outcomes [11]. LCs indicate when surgeons operate with the competence required for a plateau at a proficient level. Evaluating LCs provides information regarding skill development; more effective training results in shorter, more efficient LCs. LCs vary with the outcomes and procedures considered including time, positive surgical margins (PSMs), and estimated blood loss (EBL).

This systematic review aims (1) to identify training methods available for RAS in urology; (2) to assess their effectiveness in terms of validation, educational impact, acceptability, and cost effectiveness; and (3) to evaluate their effect on LCs.

2. Evidence acquisition

This study was completed with guidelines from the Preferred Reporting Item for Systematic Reviews and Meta-analysis statement (PRISMA; http://www.prisma-statement.org) [12]. Ovid Medline (1946–present), Embase (1980–2014, week 39), PsycINFO (1806–October, week 1, 2014), and the Cochrane Library were examined. Boolean searching combined these search terms with "AND" and "OR": *training, robotic, urological surgical procedures, prostatectomy, cystectomy, nephrectomy*, and *partial nephrectomy*.

Studies in English examining training in urologic RAS were analysed. Letters, abstracts, reviews, and studies not specific to urology or RAS were excluded. The first author screened the results, removing duplicates and inappropriate articles.

2.1. *Data collection process and data items*

Using Excel (Microsoft, Redmond, WA, USA), details of participants, interventions, controls, outcome measures, and statistical analysis were extracted. Quality and bias were assessed following PRISMA and Cochrane Collaboration guidance [12,13]. The p values <0.05 were statistically significant, and odds ratios (ORs) with 95% confidence interval (CI) were noted.

3. Evidence synthesis

3.1. *Study selection*

A total of 293 references were found (Fig. 1). After incorporating 66 references from reviews and removing duplicates, 195 studies underwent abstract review. On excluding irrelevant paper types, 53 studies underwent full-text review and 24 were included.

Table 1 reports quality and bias. Training identified includes (1) dry-lab training (virtual reality and bench-top synthetic models), (2) wet-lab training with animal or cadaveric tissue, (3) mentored training such as fellowships and minifellowships, and (4) miscellaneous nonstructured

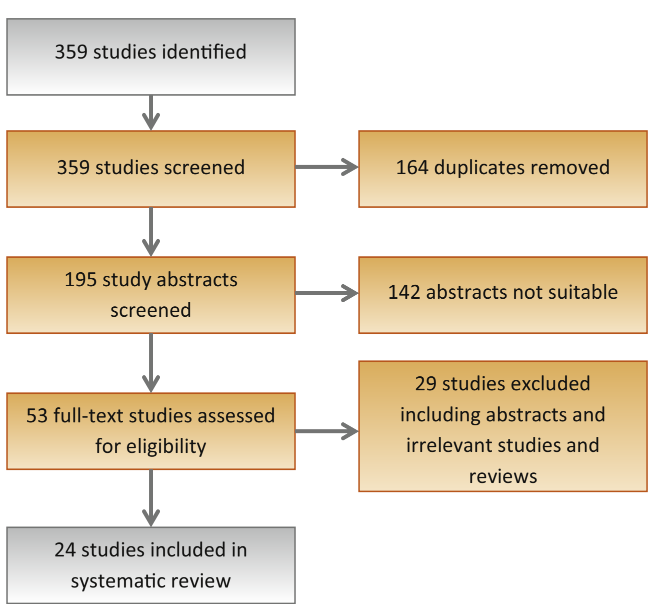

Fig. 1 – Study selection.