

The Value of Endoscopic Intracorporeal Suturing Devices for the Reconstruction of Urinary Diversions



Schmid R, Löhmann C and Martinschek A*

¹Department of Urology, Bundeswehr Hospital of Ulm, Ulm, Germany

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*Corresponding author: Andreas Martinschek, Department of Urology, Bundeswehr Hospital of Ulm Oberer Eselsberg, Germany, Tel: +49 731/1710-2101; Fax: +49 731/1710-2108; E-mail: Martinschek@web.de, AndreasMartinschek@bundeswehr.org

Abstract

Introduction: The reconstruction of the urinary diversion remains the most time-consuming part in robotic-assisted radical cystectomies. The review was performed to evaluate possible endoscopic suturing or knotting devices, able to facilitate intracorporeal suturing.

Material and methods: PubMed research was performed for intracorporeal suturing or knotting devices, which are able to place single stitches or running sutures. Literature was reviewed for their use and their possible role in reconstruction of urinary diversions.

Results: We found two single stitching devices and six devices able to place running sutures in an intracorporeal application. Most of them are published in experimental settings or animal model series, only a few have come to use in humans. EndoSew™ shows the most encouraging results for urinary diversions, EndoStitch™ has the most clinical series and Endo360™ and Proxisure™ also seem to be helpful tools for intracorporeal suturing in the future.

Conclusion: Several promising devices are able to facilitate intracorporeal suturing of urinary diversion, although their true benefit has to be proven in larger clinical series.

Keywords: Laparoscopic suturing ; Cystectomy; Urinary diversion; Ileal neobladder; Running suture

Abbreviations: RARC: Robotic-Assisted Radical Cystectomies; ORC: Open Radical Cystectomy; NMIBC: Non-Muscle Invasive Bladder Cancer; LRC: Laparoscopic Radical Cystectomy; RARC: Robot-Assisted Radical Cystectomy

Introduction

The reconstruction of the urinary diversion remains the most time-consuming part in robotic-assisted radical cystectomies (RARC), ranging up to 180 minutes even in experienced hands in «high-volume»-centers [1]. Although operation time has decreased over time, it remained longer than for open surgery [2]. One reason could be difficulties in intracorporeal suturing.

Beside extracorporeal urinary diversion, several intracorporeal techniques have been described to facilitate suturing (pyramid form, Y-Pouch, Double limb U-Pouch) [3-5]. Recently, a technique for the W-shaped neobladder, analogous to the «Hautmann-neobladder», has been described [6].

Although robotic assistance facilitates intracorporeal sewing [7] and the use of barbed sutures can minimize the risk of urinary leaks by preventing slippage and ensuring the appropriate tension is applied [8], this remains the most demanding skill in minimally invasive surgery [9].

The necessity for endoscopic absorbable staplers or specific training for laparoscopic sutures and knot tying [10] has been disputed, to minimize the technical difficulties associated with intracorporeal reconstruction [10,11].

Material and Methods

PubMed research was performed for intracorporeal suturing or knotting devices, which are able to place single stitches or running sutures. Literature was reviewed for their use and their possible role in reconstruction of urinary diversions.

Results

We found two single stitching devices and six devices able to place running sutures.

The SewRight 5 SR (LSI Solutions, Rochester, New York, USA) is a 5-mm reloadable laparoscopic device, which uses two built-in needles to place a simple suture precisely through even relatively thick tissue. It was used in percutaneous endopyeloplasties for suturing the endopyelotomy incision, passed through a nephroscope in an animal model (20 kidneys, 11 pigs) in 2002 and in a second publication in 2005 for a transrenal Anderson-Hynes endopyeloplasty (3 pigs) for interrupted sutures [12,13]. No human use of this suturing device is described.

Endostitch™ (Covidien/Autosuture Company, Norwalk, Connecticut, USA) is a 10mm single use stitching device for the placement of single or running sutures, passing a small needle

back and forth between jaws. The needle can only be passed perpendicularly from jaw to jaw and may require excess tissue manipulation for proper suture placement [14]. After description of feasibility in 1995, several publications exist, showing its use in urological (pyeloplasty, ureteroneocystostomy, vesicourethral anastomosis), surgical (endoscopic Zenker's diverticulostomy, esophagojejunostomy, gastropexie) in smaller series [15-18].

Based on the EndoStitch™, in 2011, a partially automated tool has been developed, named AutoStitch™. With the aid of a DC motor, triggered by a button, the suture can be created by one-fingered handling [19]. AutoStitch™ has been used in experimental settings so far.

Duraknot® (Ethicon, Somerville, New Jersey, USA) is a single-patient-use pretied-knot delivery system, deploying an intracorporeal knot (reloadable, curved needles, different suture materials) for interrupted sutures. No clinical series could be found.

The OverStitch™ (Apollo Endosurgery Inc, Austin, Texas, USA) allows the placement of sutures through a flexible endoscope to provide secure approximation of tissue endoscopically, able to place interrupted and running sutures. Several applications in gastric surgery or intestinal defect closure have been published, but no urological publication could be found [20,21].

EndoSew® (Karl Storz Endoscopes, Tuttlingen, Germany) is a suturing device designed for the placement of intracorporeal running sutures by creating an over-edge stitch (industrial stitch type 501). The device has three key components, the motor, gear and needle unit [22,23]. The stitchbuilding tools consist of two downholders, looper, stitch plate and needle. In 2008 Bremer et al. [22] published their first experiences in an pig model, first human use was published by Martinschek et al. [24] in 2011 for suturing parts of an ileal neobladder in an open setting [22,24]. The first series (10 patients) was done by Roth et al. [23] for closure the proximal end of an ileal conduit extracorporeally [23]. Although the combination of the EndoSew® and the DaVinci-Robot was shown to be possible for suturing an U-shaped neobladder in an experimental setting, no intracorporeal application has been published so far [25].

Currently available are Endo360°™ (EndoEvolution, Raynham, Massachusetts, USA) and Proxisure™ (Ethicon, Somerville, New Jersey, USA), both flexible 12mm laparoscopic instruments (released 2017) with curved needles and different threads, which can be rotated and angulated and are able to place running sutures [26]. We found no publication for Proxisure™ and Endo360°™ on humans so far.

Discussion

Different suturing and knotting devices have been described so far, urological applications in larger series are quite rare. As open radical cystectomy (ORC) with lymph node dissection is the standard treatment for localized muscle invasive (MIBC)

and an option for high-grade non-muscle invasive bladder cancer (NMIBC), laparoscopic radical cystectomy (LRC) and robot-assisted radical cystectomy (RARC) are still considered investigational procedures [2].

Intraoperative, 30-day complication rate and mortality are similar for RARC and ORC, but complication grade and grade 3, 90-day complication rates favored RARC. Overall complication rates were reported as >50% which illustrates, that cystectomy and diversion remains major surgery [2].

Several devices are able to place single knots or sutures, for urinary diversions, however, running sutures are essential [23]. New techniques other than traditional suturing, e.g. laparoscopic stapling, are in widespread use for the construction of urinary diversions [27,28]. Urinary stones and chronic UTIs, however, are well known complications of non-absorbable staplers [29,30]; therefore, currently available, non-absorbable stapler lines are not suitable for the construction of urinary diversion [23].

Out of the devices, mentioned above, EndoSew® seems to be the most promising one, as it has been used in humans without suture related complications or interference of the postoperative clinical course of the patient. The creation of an anastomosis does not seem to be possible with this device, because the tissue has to be moved through the branches. This appears to be possible with EndoStitch™, proven by Miki et al., over a mini-laparotomy. Endo360°™ and Proxisure™ also seem to be helpful tools for intracorporeal suturing in the future. For all devices, larger clinical series are missing.

Conclusion

Several promising devices are able to facilitate intracorporeal suturing of urinary diversion, although their true benefit has to be proven in larger clinical series.

Video-Links

EndoStitch™: Medtronic Minimally Invasive Therapies Group (2011): EndoStitch™ 10mm Single Use Suturing Device.

Overstitch™: Apollo Endosurgery, Inc (2016): OverStitch Full Animation SD.

EndoSew®: Martinschek et al. (2017) Robot-Assisted Suturing of a U-Shaped Ileal Neobladder with EndoSew, J Endourol Part B, Videourol, 2017.

Endo360°™: Wave Design Works (2013): PRODUCT DEMO: Endo360° Suturing device.

Proxisure™: Ethicon (2017): PROXISURE™ Suturing Device In-Service.

Author Disclosure Statement

All the authors will disclose any commercial associations that might create a conflict of interest in connection with submitted manuscripts. No competing financial interests exist.

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