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REVIEW ARTICLE

Efficacy and safety of barbed suture in minimally invasive radical prostatectomy: A systematic review and meta-analysis

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Abstract As one of the earliest surgeries applying knotless barbed suture, the minimally invasive radical prostatectomy (MIRP) was reported to have various effects on the patients and the surgeons. This study reviewed the available evidence about the efficacy and safety of barbed sutures in MIRP. We searched ClinicalTrials.gov, Cochrane Register of Clinical Studies, PubMed, and Embase to identify randomized controlled trials (RCTs) and cohort studies addressing the application of barbed sutures and conventional sutures in MIRP (until August 2016). Quality assessment was performed according to Cochrane recommendations. The data were analyzed using Review Manager (Version 5.3), and sensitivity analysis was performed by sequentially omitting each study. A total of 12 studies, including three RCTs (low to moderate risk of bias, 211 patients) and nine cohort studies (low to moderate risk of bias, 698 patients), fulfilled the study criteria. The pooling of trials did not show statistical difference. Pooling data of cohort studies showed that suture time [mean difference (MD) = −8.52, 95% confidence interval (CI) = −12.60 to −4.43, $p < 0.0001$] and length of hospital stay (MD = −0.96, 95% CI = −1.80 to −0.11, $p = 0.03$) were significantly shorter in the barbed group. Results of continence rate varied according to different studies. Subgroup analysis by type of MIRP suggested that patients who underwent barbed suture during robot-assisted surgeries had a shorter hospital stay (MD = −1.13, 95% CI = −1.82 to −0.45, $p = 0.001$). During the laparoscopic surgery, patients in the barbed suture group had fewer postoperative complications [odds ratio = 0.29, 95% CI = 0.08–0.98, $p = 0.05$). However, more evidence is needed to validate this state-of-the-art technology.

Conflicts of interest: All authors declare no conflicts of interest.

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Introduction

Knotless barbed suture is a particularly designed monofilament suture with barbs orientated in an opposite direction to the needle, which has been widely used in both skin and deeper structures. In general, conventional knot tying sutures required time and training, which may easily extrude with high infection rate related to knots [1]. However, the novel barbs on the ligatures make the suture grab the tissue, without allowing the suture to slide back.

Since invented in 1964 [2], this technique has been developed into three types [3], which are commercially available, including Quill SRS (Quill Self-Retaining System; Angiotech Pharmaceuticals, Vancouver, British Columbia, Canada), the bidirectional barbed suture used in gynecologic laparoscopy; V-Loc Absorbable Wound Closure device (Covidien, Mansfield, MA, USA), the unidirectional barbed suture that has only one needle and a loop at the end; and the STRATAFIX (STRATAFIX Knotless Tissue Control Devices, Ethicon Inc, Somerville, NJ, USA), which presents a spiral distribution of the barbs anchors.

The use of barbed sutures has been first described in plastic and gynecological surgeries previously [4]. Then various animal and cadaveric experiments confirmed the equivalence of biocompatibility and tensile strength of knotless barbed suture to conventional sutures in urological field [5,6]. As one of the earliest urological surgeries that adopted this advanced technique, the minimally invasive radical prostatectomy [MIRP, including robot-assisted radical prostatectomy (RARP) and laparoscopic radical prostatectomy (LRP)] was reported to have various effects on both patients and surgeons. Thus, a meta-analysis and systematic review were carried out to obtain more validated results on the application of knotless barbed sutures in MIRP in comparison with the conventional sutures.

Methods

Study identification and selection

The Medline, Embase, and the Cochrane Library databases were searched using the following terms: "barbed" OR "knotless" AND "suturing" OR "suture" (last updated in August 2016). To modify the results and avoid the publication bias, we also searched clinical trials registered in ClinicalTrials.gov (last updated in August 2016).

All studies had to meet the following inclusion criteria: (1) study design had to be a randomized controlled trial (RCT) or observational studies based on human participants; (2) patients underwent RARP and LRP; (3) interventions had to be conventional suture versus barbed suture; (4) the studies provide short- or long-term outcomes. The following exclusion criteria were also applied: (1) no control; (2) conventional sutures were made with other materials such as mesh or staple rather than smooth sutures; (3) abstracts, reviews, and overlapped studies; (4) studies published in languages other than English. The computer search was supplemented with manual searches for references of included studies.

Data extraction and outcome measures

We imported the search results into a bibliographic citation management software (EndNote X7). Two reviewers independently collected the data and reached a consensus on all items. The following items were extracted from each study, if available: first author's surname, publication year, original country, study design, sample size, and postoperative complications.

The main outcome measures chosen for this meta-analysis were operative time, suturing time, estimated blood loss or change in hemoglobin level, length of catheterization, hospital stay, postoperative complications, and continence rate. Heterogeneity of outcomes was assessed to confirm the appropriateness of combining individual studies.

Definition

Operative time was defined as the total time of surgery. Suture time was defined as the time needed for the completion of the surgical site incision, anastomosis time, and closure time. Estimated blood loss or change in hemoglobin level was defined as the blood loss during the operation and it was usually obtained from anesthesia records and/or the surgeons' operative reports. After surgeries, data on postoperative complications of the suture, length of catheterization, and hospital stay were also recorded. After discharging from the hospital, patients were asked to report their pad usage for continence rates at different follow-up time points.

Methodological quality

The risk of bias of included RCTs was assessed following Cochrane recommendations, considering random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, and selective reporting [7]. Publication bias was evaluated by funnel plot.

We used the Newcastle—Ottawa Scale, a widely used and accepted instrument, for assessing the risk of bias of cohort studies [8]. We included the following items for cohort study: ascertainment of MIRP, representativeness of the barbed cohort, ascertainment of exposure to barbed suture, selection of the non-exposed cohort, demonstration that outcome of interest (i.e., suture time) was not present at the start of study, comparability of study controls for important factors (e.g., adequate adjustment for confounders or matching for important confounding factors), assessment of outcome (e.g., blinding assessment and adjudication), and completeness of the follow-up.

Data synthesis and analysis

The studies were divided into two subgroups, according to RARP and LRP; meanwhile, a separate meta-analysis was conducted within different subgroups. In all analyses, we estimated the pooled mean difference (MD) to assess continuous data, whereas pooled odds ratios (ORs) were calculated for the assessment of dichotomous data (postoperative complications). We used the method to pool randomized trials given the very low event rate, and