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Minimally Invasive, Laparoscopic, and Robotic-assisted Techniques Versus Open Techniques for Kidney Transplant Recipients: A Systematic Review

Sven Wagenaar[a,b,*], *Johanna H. Nederhoed*[a], *Arjan W.J. Hoksbergen*[a], *H. Jaap Bonjer*[a], *Willem Wisselink*[a], *Gabrielle H. van Ramshorst*[a,c]

[a] *Department of Surgery, VU Medical Center, Amsterdam, The Netherlands;* [b] *Department of Urology, Meander Medical Centre, Amersfoort, The Netherlands;* [c] *Department of Surgery, Dutch Cancer Institute/Antoni van Leeuwenhoek Hospital, Amsterdam, The Netherlands*

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Abstract

Context: Literature on conventional and minimally invasive operative techniques has not been systematically reviewed for kidney transplant recipients.
Objective: To systematically evaluate, summarize, and review evidence supporting operating technique and postoperative outcome for kidney transplant recipients.
Evidence acquisition: A systematic review was conducted in PubMed–Medline, Embase, and Cochrane Library between 1966 up to September 1, 2016, according to Preferred Reporting Items for Systematic Review and Meta-analysis guidelines. Articles were included and scored by two independent reviewers using Group Reading Assessment and Diagnostic Evaluation (GRADE), Newcastle–Ottawa Quality Assessment Scale (NOS), and Oxford guidelines for level of evidence. Main outcomes were graft survival, surgical site infection, incisional hernia, and cosmetic result. In total, 18 out of 1954 identified publications were included in this analysis.
Evidence synthesis: Included reports described conventional open, minimally invasive open, laparoscopic, and robotic-assisted techniques. General level of evidence of included studies was low (GRADE: 1–3; NOS: 0–4; and Oxford level of evidence: 4–2). No differences in graft or patient survival were found. For open techniques, Gibson incision showed better results than the hockey-stick incision for incisional hernia (4% vs 16%), abdominal wall relaxation (8% vs 24%), and cosmesis. Minimally invasive operative recipient techniques showed lowest surgical site infection (range 0–8%) and incisional hernia rates (range 0–6%) with improved cosmetic result and postoperative recovery. Disadvantages included prolonged cold ischemia time, warm ischemia time, and total operation time.
Conclusions: Although the level of evidence was generally low, minimally invasive techniques showed promising results with regard to complications and recovery, and could be considered for use. For open surgery, the smallest possible Gibson incision appeared to yield favorable results.
Patient summary: In this paper, the available evidence for minimally invasive operation techniques for kidney transplantation was reviewed. The quality of the reviewed research was generally low but suggested possible advantages for minimally invasive, laparoscopic, and robot-assisted techniques.
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* Corresponding author. Department of Surgery, VU Medical Center, Boelelaan 1118, 1081 HZ Amsterdam, The Netherlands. Tel. +31 20 4444444/+31 6 51919735.
E-mail addresses: svenwagenaar@gmail.com, s.wagenaar@vumc.nl (S. Wagenaar).

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1. Introduction

In recent years, minimally invasive techniques have become increasingly popular for kidney transplantation surgery (KTx) and for living kidney donation in particular. Minimally invasive living donor nephrectomy has been shown to minimize adverse effects for living donors, by decreasing incisional hernia rates and pain, while improving body image compared with lumbotomy [1–3]. In contrast, many kidney transplant recipients are still operated through conventional incisions using Gibson incision (GIBI) or hockey-stick incisions (HSI).

Traditionally, KTx was performed with an oblique incision from the symphysis in the midline, curving in a lateral and superior direction to the iliac crest (GIBI) [4,5]. In the recent past, a shift was observed toward a pararectal curvilinear incision (also described as an HSI or an inverted J-shaped incision), for enhanced exposure [6]. These incisions cause morbidity, including abdominal wall relaxation of up to 24%, abdominal wound dehiscence (4%), and incisional hernia (up to 16%) [7–9]. In addition, larger incisions have been associated with an increased risk of surgical site infection (SSI), especially in light of delayed wound healing due to the use of immunosuppressants, such as sirolimus, in KTx recipients [10]. Wound healing complications are a major cause of morbidity in KTx recipients, as both graft and patient survival are worse in KTx recipients who develop SSI [11,12].

Recently, minimally invasive techniques including laparoscopic, robotic-assisted, minimally invasive video-assisted (MIVAKT), minimal-access kidney transplantation (MAKT), and minimal skin incision (MSI) techniques have been described for kidney recipients [13–21]. In 2015, laparoscopic kidney transplantation (LKT) following transvaginal insertion of the kidney was described as a novel option [22]. In 2016, transvaginal insertion was first performed in conjunction with robotic-assisted kidney transplantation (RAKT) [23].

These techniques proclaim to have the advantages of smaller incisions, less complications, and faster recovery. Despite potential advantages, adverse effects also need to be considered. For instance, prolonged duration of cold ischemic time (CIT) and warm ischemic time (WIT) and operation time have been reported, with corresponding lower graft and patient survival [13,19,22,24,25] Our study aim was to systematically evaluate literature on conventional and minimally invasive techniques with regard to graft survival, SSI, incisional hernia, and cosmesis.

2. Evidence acquisition

2.1. Search strategy

A systematic search of PubMed–Medline, Embase, and Cochrane Library was performed with expertise of a medical librarian. Searches were limited to studies in adults and published in English, German, French, Spanish, and Dutch between 1966 and September 1, 2016. The main keywords were "kidney," "transplantation," and "incision." Appendix A contains full search strategies.

2.2. Inclusion criteria

All articles were evaluated by two independent researchers (S.W. and G.H.V.R.). Preferred Reporting Items for Systematic Review and Meta-analysis guidelines were followed (Fig. 1) [26]. After selection based on title and abstract, full-text manuscripts were assessed and cross referencing was applied. Types of research, which included patient data, were considered eligible (randomized controlled trials [RCTs], prospective and retrospective cohort studies, case–control studies, and case series).

2.3. Study eligibility

Articles were graded and evaluated independently based on quality using the Group Reading Assessment and Diagnostic Evaluation (GRADE) scale [27], Newcastle–Ottawa Quality Assessment Scale (NOS), and level of evidence based on Oxford Centre for Evidence Based Medicine (EBM, version 2011) [28,29].

Based on study type, studies were classified into four GRADE categories: high, moderate, low, and very low quality [27]. Articles were downgraded for suspected bias, inconsistency, indirectness, imprecision, or publication bias. Articles were upgraded in case of a low risk of bias, or all plausible confounding and bias would reduce demonstrated effect. Articles showing a relatively large effect were upgraded.

For the NOS, the applicable assessment score was used. Cohort studies and case–control studies could be awarded maximum scores of 10 and 9 points, respectively. Studies were scored based on selection of cases and controls, comparability of cases and controls, and exposure to bias [29].

Level of evidence of included articles was assessed following EBM guidelines [28]. Both researchers independently assessed the risk of bias and graded the articles. Articles were categorized in three subcategories (low, intermediate, and high). In case of disagreement, consensus was reached after discussion. A reported p value ≤ 0.05 was considered statistically significant.

3. Evidence synthesis

3.1. Included studies

Database searches yielded a total of 1954 records. After removing duplicates and assessing all records for eligibility, a total of 17 articles were selected for a systematic review. One article was added upon reviewer suggestion, see Figure 1 [30]. Two articles describing other techniques were excluded; one was a case report on RAKT using a transperitoneal technique through a transverse suprapubic incision, and the other lacked patient data [31,32].

3.2. Study characteristics

Using the GRADE methodology, most studies were rated 1–2. One study was an RCT, which could not be assessed using GRADE or NOS methodology [33], Most publications were

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