

Dual-endoscope-assisted retrograde ureteral stenting after kidney transplantation: a case series and historical meta-analysis

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Abstract

Purpose

Ureteral complications after kidney transplantation remain technically challenging to manage endoscopically. Retrograde access to the transplant ureter is often difficult because of an unfavourable ureteroneocystostomy angle, oedema, or scarring. We evaluated a dual-endoscope-assisted technique combining a rigid cystoscope with a flexible ureteroscope and benchmarked it against the published performance of conventional retrograde techniques.

Methods

We conducted a retrospective single-centre case series of kidney transplant recipients undergoing dual-endoscope-assisted retrograde ureteral stent placement for ureteral stenosis, urolithiasis, urinary leakage, or lymphocele-related obstruction. The primary outcome was first-attempt technical success. In parallel, we performed a systematic review and single-arm random-effects meta-analysis (PROSPERO CRD420261328594) of conventional retrograde techniques to derive historical pooled success rates and 95% prediction intervals (PIs).

Results

First-attempt success was 96.4% (27/28; exact 95% confidence interval [CI] 81.7–99.9%), and overall procedural success was 97.4% (38/39; 95% CI 86.5–99.9%). Pooled historical first-attempt success was 68.4% across 17 studies (95% CI 55.1–79.2%; 95% PI 21.1–94.6%; $I^2=80.5\%$). All-procedure success was 71.3% across 18 studies (95% CI 57.7–81.8%; 95% PI 19.3–96.3%; $I^2=86.1\%$). Three patients had Clavien-Dindo grade $\geq$ urinary tract infections; no higher-grade procedure-related complication was identified.

Conclusion

Dual-endoscope assistance was technically feasible and achieved high access rates in this small series. Because comparison with the literature was indirect and heterogeneous, the findings should be confirmed in prospective multicentre studies.

Clinical trial registration

This study was a retrospective case series and did not involve the prospective assignment of participants to an intervention for research purposes. Therefore, it was not considered a clinical trial. Clinical trial number not applicable.

Introduction

Kidney transplantation is the preferred renal replacement therapy for eligible patients with end-stage kidney disease. Despite advances in surgical technique and perioperative management, ureteral complications remain an important source of morbidity and may adversely affect allograft function and survival. Ureteral stricture, urinary leakage, urolithiasis and extrinsic ureteral compression are among the principal complications requiring urological intervention. It has been reported that the incidence of ureteral complications among kidney transplant recipients is approximately 1–15%[1–4] .

Prompt decompression of the transplanted collecting system is essential to protect allograft function. Percutaneous nephrostomy provides reliable drainage and facilitates antegrade intervention, whereas open or robotic reconstruction can offer definitive correction [5, 6]. However, these approaches are relatively invasive and may be technically demanding because of altered pelvic anatomy, peri-graft fibrosis, immunosuppression and the proximity of vascular anastomoses[7, 8]. Retrograde ureteral stent placement is therefore an attractive initial option because it avoids percutaneous access and can permit simultaneous ureteroscopy, balloon dilation, lithotripsy or stone extraction.

Retrograde access for stent placement into the transplant ureter remains difficult[7]. The ureteroneocystostomy has an ectopic and variable position, and access may be impeded by acute ureteral angulation, mucosal oedema, anastomotic stenosis and poor alignment between the endoscope and ureteric orifice[9, 10]. A rigid cystoscope provides stable visualisation and mechanical support but has limited manoeuvrability. A flexible ureteroscope provides improved directional control but may lack adequate shaft support during guidewire, balloon or stent advancement. Several variables may underlie the wide variation in success rates reported in the literature, such as the degree of ureteral stenosis, the orientation of the ureter, the anastomotic technique employed, and the surgeon's experience and determination[10].

To address these complementary limitations, our centre developed a dual-endoscope-assisted approach in which a rigid cystoscope provides visual guidance and mechanical support while a flexible ureteroscope is advanced through its working channel to cannulate the transplant ureter. This study had two objectives: first, to evaluate the feasibility, safety and clinical outcomes of this technique in a retrospective case series; and second, to estimate the historical performance of conventional retrograde techniques through a systematic review and single-arm meta-analysis, including analyses by clinical indication.

Methods

Institutional series

We screened 360 adult kidney transplant recipients treated at the Second Affiliated Hospital of Nanjing Medical University from January 2021 to June 2026. The dual-endoscope-assisted technique was introduced after conventional retrograde access proved technically difficult in two earlier patients, who

were not included in this series. Following its introduction, the technique was used consecutively in all subsequent patients undergoing retrograde intervention for transplant ureteral stricture, calculi, urinary leakage, or lymphocele-related obstruction, yielding 28 initial attempts. No patient in the screened transplant population underwent primary percutaneous nephrostomy or ureteral reconstruction without a preceding retrograde attempt. Patients with loss of graft function, uncontrolled genitourinary infection, pregnancy, or severe cardiopulmonary or psychiatric illness were excluded. The institutional analysis comprised 39 procedures in total: 28 initial dual-endoscope-assisted attempts and 11 subsequent stent exchanges. The Ethics Committee of the Second Affiliated Hospital of Nanjing Medical University approved the protocol (No. [2022]-KY-116-01), and all patients provided written informed consent.

For each recipient, we reviewed the underlying renal disease, donor and graft characteristics, transplant technique, immunosuppressive regimen, interval from transplantation to diagnosis, and the indication for urological intervention. Operative records were checked for the site and severity of obstruction, the steps used to obtain retrograde access, adjunctive dilatation or stone treatment, and whether later stent exchange or reconstructive surgery was required. Laboratory values and postoperative imaging were collected from the same clinical record.

All procedures were performed under general anaesthesia with the patient supine by the same experienced urologist and assistant. A 21-Fr 30° rigid cystoscope was kept close to the transplant ureteric orifice, providing a stable platform and continuous visual control. An 8.5-Fr disposable flexible ureteroscope was then passed through the cystoscope working channel and deflected towards the neo-orifice. A hydrophilic guidewire was advanced under direct vision into the transplant collecting system before any balloon, catheter, or stent was introduced (Fig. 1). Balloon dilatation, double-J stenting, holmium laser lithotripsy, or stone extraction followed according to the underlying lesion. Failure to pass an access sheath was not classified as technical failure when the ureteroscope, guidewire, catheter, or stent had crossed the transplant ureter and the intended treatment remained feasible.

The primary outcome was successful cannulation and stent placement at the first assisted attempt. Secondary outcomes included success across all procedures, clinical cure, reintervention, operative time, length of stay, Clavien-Dindo complications,[11] and serial serum creatinine and blood urea nitrogen. Clinical cure was assessed among patients with evaluable follow-up and required sustained clinical and imaging resolution without further drainage or reconstructive surgery. The patient who underwent open reconstruction after failed retrograde access was retained in the technical-success analysis but was not included in this conditional clinical-cure denominator. Clinical cure was reported descriptively across all institutional indications and was not compared with the historical stricture-cure estimate.

Recurrence after stent removal, unplanned drainage, repeat endoscopy, and definitive reconstruction were recorded separately. Later graft loss or transplant nephrectomy was not automatically attributed to the index endoscopic procedure; the clinical record had to support a procedure-related association.

Serum creatinine and blood urea nitrogen were evaluated before intervention and on postoperative days 1, 3, 7, and 10 and at one month, when measurements were available.

Systematic review and statistical analysis

The review was registered prospectively (PROSPERO CRD420261328594) and followed PRISMA 2020[12]. PubMed/MEDLINE, Embase, the Cochrane Library, and CNKI were searched from inception to 30 April 2026. Eligible studies reported ≥ 10 eligible retrograde procedures, including initial procedures and exchanges, with extractable outcome data. This threshold applied to each study's total eligible retrograde procedures, not individual outcome or indication subgroups. Both successful and failed retrograde attempts were counted; antegrade procedures, diagnostic-only procedures, and procedures performed solely to retrieve migrated stents were excluded. Two reviewers independently selected studies and extracted data; disagreements were resolved by consensus. Case-series quality was assessed with the Joanna Briggs Institute checklist[13]. First-attempt success was analysed per patient; all-procedure success included exchanges. Studies contributed to each analysis when the relevant data were extractable. Gerrard et al.[14] contributed only to the all-procedure analysis (51/79), as patient-level first-attempt outcomes were unavailable. Antegrade procedures were excluded from retrograde numerators, and patients who never underwent a genuine retrograde attempt were excluded from denominators. Prespecified subgroups covered stone-related obstruction, ureteral stricture, and urinary leakage. Included reports are cited in the reference list [8–10, 14–28].

Reported cure of ureteral stricture after retrograde or antegrade stenting was synthesised as a separate secondary clinical outcome, using the definitions and denominators reported by each study. This analysis described stricture outcomes across access routes and was not used as a benchmark for the institutional clinical-cure rate across all indications.

Proportions were pooled on the logit scale using restricted maximum-likelihood random-effects models with normal-approximation inference and a 0.5 continuity correction when required [29–32]. Heterogeneity was summarised with I^2 , τ^2 , Cochran's Q, and 95% prediction intervals (PIs); leave-one-out analysis assessed robustness. Institutional proportions used exact binomial confidence intervals (CIs). Renal markers were analysed in mixed-effects models with patient-level random intercepts and Dunnett-adjusted comparisons with baseline. A repeated-measures generalised least-squares model with an unstructured covariance matrix served as a sensitivity analysis. All tests were two-sided with $P < 0.05$ considered statistically significant. Analyses used SPSS 28.0 and R 4.4.0[32].

Results

Study selection and evidence quality

The search found 2,333 records; 1,724 remained after deduplication, 74 full texts were assessed, with 18 studies included: 17 contributed to the first-attempt analysis and 18 to the all-procedure analysis (Fig. 2).

The evidence base consisted mainly of small retrospective case series spanning different indications, endoscopic instruments, outcome definitions, and follow-up periods. Checklist scores ranged from 7 to 10 of 10 (median 8), although consecutive and complete inclusion were often unclear (Supplementary Table S3). These differences were clinically important and supported the use of random-effects models and prediction intervals rather than a single fixed benchmark.

Pooled outcomes

Pooled first-attempt success was 68.4% across 17 studies (95% CI 55.1–79.2%; 95% PI 21.1–94.6%; $I^2=80.5\%$). All-procedure success was 71.3% across 18 studies (95% CI 57.4–81.5%; 95% PI 19.2–96.1%; $I^2=86.1\%$) (Fig. 3). Clinical cure was 48.3% (95% CI 22.9–74.6%; 95% PI 2.7–96.9%; $I^2=88.0\%$). No single study materially changed the first-attempt estimate in leave-one-out analysis. For stones, strictures, and leakage, pooled success was 70.0%, 65.0%, and 72.0%, respectively. The leakage subgroup contained only three studies, so the apparent absence of heterogeneity should be interpreted cautiously. Disease-specific estimates and institutional benchmarks are shown in Table 1; the clinical-cure and disease-specific forest plots are provided in Supplementary Figs. S1-S4.

Table 1
Historical technical-success estimates and institutional outcomes

Outcome	Historical studies	Historical pooled estimate (95% CI; 95% PI)	Institutional estimate	Interpretation
First retrograde attempt	17	68.4% (55.1–79.2; 21.1–94.6)	27/28 (96.4%)	Above historical PI
All procedures, including exchanges	18	71.3% (57.7–81.8; 19.3–96.3)	38/39 (97.4%)	Above historical PI
Clinical cure	12	48.3% (22.9–74.6; 2.7–96.9)	19/27 (70.4%)	Incomparable
Stone-related obstruction	5	70.0% (38–90;11.5–97.7)	5/6 (83.3%)	Within PI
Ureteral stricture	15	65.0% (50.0–77.0; 17.4–94.2)	17/17 (100%)	Above historical PI
Urinary leakage	3	72.0% (44.0–89.0; 44.5–89.4)	1/1 (100%)	Single institutional case

CI, confidence interval; PI, prediction interval. Historical values derive from single-arm random-effects meta-analysis. Comparisons with the institutional series are descriptive and do not estimate comparative treatment effects.

Institutional cohort and procedures

The institutional cohort comprised 28 recipients, 16 men and 12 women. All grafts were procured from donation after circulatory death donors, whose mean age was 37.4 years. One recipient underwent bilateral kidney transplantation, giving 15 left and 14 right donor kidneys. Ureterovesical reimplantation with a submucosal tunnel (Lich-Gregoire technique) had been used in every recipient, with double-J stenting for initial internal drainage. Twenty-six recipients received tacrolimus, mycophenolate mofetil, and corticosteroids; two also received antithymocyte globulin. The mean age at diagnosis of a ureteral complication was 43.4 years (range 18–66), and the median interval from transplantation to diagnosis was 67.5 days (range 19–639). Ureteral stricture was the dominant indication (n = 17), followed by stones (n = 6), lymphocele-related compression (n = 4), and urinary leakage (n = 1). Hypertensive nephropathy was the most common recorded primary renal disease (n = 8), followed by IgA nephropathy (n = 5) and lupus nephritis (n = 2). Table 2 summarises the institutional cohort and outcomes; fuller baseline and patient-level data are reported in Supplementary Tables S2 and S4.

All 15 patients with anastomotic stricture at the ureterovesical junction were successfully cannulated. Twelve underwent balloon dilatation followed by stent placement, while three were treated with stenting alone. The mid-ureteral stricture was crossed with difficulty and stented without dilatation; the upper-ureteral stricture was treated with dilatation and stenting. Seven patients in the stricture group later underwent eight scheduled exchanges. Among the six patients with stones, one had approximately 5-mm calculi in both allograft renal pelves and underwent single-stage laser lithotripsy. Two further patients underwent single-stage lithotripsy with stenting, and two with 5-mm upper-ureteral stones were first stented and returned for planned flexible ureteroscopic lithotripsy. One of the latter later developed an anastomotic stricture that was treated by balloon dilatation and repeat double-J stenting. The remaining stone patient had a 6-mm grey-yellow cast-like calculus obstructing the reimplantation orifice; retrograde access failed and ureterovesical reimplantation was performed. This patient remained included as a technical failure in the initial-attempt analysis. All four lymphocele-related obstructions were stented successfully, with decompression confirmed on imaging. The single urinary leak resolved after stenting and continuous bladder drainage.

Table 2
Institutional cohort, treatment, and clinical outcomes

Domain	Measure	Institutional result
Cohort	Recipients / evaluable procedures	28 / 39
Cohort	Age at diagnosis	43.4 years (range 18–66)
Cohort	Male sex	16/28 (57.1%)
Presentation	Transplant-to-diagnosis interval	Median 67.5 days (range 19–639)
Presentation	Stricture / stones / lymphocele / leakage	17 / 6 / 4 / 1
Technical outcome	First-attempt success	27/28 (96.4%; 95% CI 81.7–99.9%)
Technical outcome	All-procedure success, including exchanges	38/39 (97.4%; 95% CI 86.5–99.9%)
Clinical outcome	Clinical cure	19/27 (70.4%; 95% CI 49.8–86.2%)
Procedure	Scheduled exchanges	11 procedures in 9 patients
Perioperative	Operative time / hospital stay	34.6 ± 14.3 min / 5.3 ± 2.9 days (initial retrograde)
Safety	Clavien-Dindo grade ≥ urinary tract infection	3/28 (10.7%)
Safety	Higher-grade procedure-related complication	0

CI, confidence interval. Clinical cure was assessed among the 27 patients with successful initial retrograde stent placement. Detailed patient-level data are provided in Supplementary Table S4.

Institutional technical and clinical outcomes

First-attempt stenting succeeded in 27 of 28 patients (96.4%; exact 95% CI 81.7–99.9%), above the upper limit of the historical PI. Across all 39 procedures, including exchanges, 38 were successful (97.4%; exact 95% CI 86.5–99.9%); this estimate was above the historical PI. First-attempt success was 17/17 for stricture, 5/6 for stones, 4/4 for lymphocele-related obstruction, and 1/1 for leakage. Clinical cure was documented in 19 of 27 patients with successful initial retrograde stent placement (70.4%; exact 95% CI 49.8–86.2%). This descriptive institutional outcome was not compared with the historical stricture-cure estimate because the populations, access routes, and denominator definitions differed.

Perioperative safety and renal function

Mean operative time was 34.6 ± 14.3 min and mean hospital stay was 5.3 ± 2.9 days. Three patients developed Clavien-Dindo grade $\geq$ urinary tract infections; no higher-grade perioperative event attributable to the dual-endoscope procedure was identified. Postoperative serum creatinine was available for 26 patients on day 1, 24 on day 3, 25 on day 7, and 24 on day 10 and at month 1. Model-estimated mean creatinine declined from 196.2 $\mu\text{mol/L}$ (SE 19.6) before intervention to 125.2 $\mu\text{mol/L}$ at month 1. Dunnett-adjusted changes from baseline were -27.4 $\mu\text{mol/L}$ on day 1 ($P = 0.149$), -33.6 on day 3 ($P = 0.058$), -46.4 on day 7 ($P = 0.003$), -54.3 on day 10 ($P < 0.001$), and -71.0 at month 1 ($P < 0.001$). Blood urea nitrogen declined from a model-estimated 15.9 mmol/L before intervention to 9.9 mmol/L at month 1, with all postoperative measurements significantly below baseline after adjustment. These uncontrolled trends are consistent with restored drainage but cannot be attributed to the endoscope configuration alone.

Discussion

Main findings

Because no concurrent conventional-retrograde comparison group was available, we performed a systematic review and meta-analysis to provide a historical benchmark for the institutional results. The pooled estimates and prediction intervals allowed the observed success rate to be considered alongside both the average performance and the variability reported in previous studies. The assisted technique achieved retrograde access in nearly all initial procedures. Its practical advantage is straightforward: the rigid cystoscope stabilises the entry point and maintains a wide view, while the flexible ureteroscope negotiates an eccentric or sharply angled anastomosis. This arrangement may be most useful during initial cannulation, which is consistent with the first-attempt result falling just above the historical PI. The comparison should nevertheless remain descriptive. Published series differed in indications, anastomotic anatomy, equipment, operator experience, and definitions of success, and the present cohort was not concurrently controlled. Moreover, the historical PI describes the distribution expected for the underlying success rate of a new setting; it is not a formal test against an observed single-centre proportion. The position of our estimate relative to that interval is therefore a signal worth investigating, not proof that the devices themselves caused the difference.

Technical and clinical interpretation

The aetiology of ureteral stricture after kidney transplantation is multifactorial and can be divided into early and late presentations[33]. Early strictures (within the first post-transplant month) are uncommon and are mainly attributable to technical factors, including excessive ureteral length, anastomotic tension, overly tight bladder muscle tunnelling, and compression by postoperative haematoma or lymphocele; most of these are preventable by meticulous surgical technique[34]. Late strictures, which predominate, are primarily ischaemic in origin. The distal ureter is the segment furthest from the renal artery and depends on a tenuous blood supply conveyed through the periureteral adventitia; excessive stripping of the adventitia during donor nephrectomy or graft preparation devascularizes the ureter, leading to

mucosal ischaemia, fibrosis, and impaired contrast drainage on antegrade imaging[9, 10, 16]. Chronic rejection, high-dose immunosuppression, periureteral fibrosis, and viral infection are additional contributors. Consistent with this vascular anatomy, 75%–90% of strictures occur at the ureterovesical anastomosis[35, 36]. These considerations have direct implications for endoscopic management. First, because ischaemic strictures tend to recur after simple dilatation or short-term stenting, patients with markedly elevated creatinine before treatment or recurrence after double-J stenting should be considered for combined endoluminal therapies, and surgical reconstruction should not be delayed when endoscopic options are exhausted; antegrade pyelography is advisable to define stricture length and severity before selecting treatment. Second, in chronically immunosuppressed recipients, long-term indwelling stents carry substantial risks of infection, encrustation, haematuria, and obstruction, so that a strategy of periodic exchange, as adopted in our protocol, must be weighed against early definitive reconstruction in suitable candidates. The ischaemic and fibrotic nature of the strictured segment also explains why gentle, wire-first cannulation under direct vision—as in the present technique—is preferable to forceful blind instrumentation, which risks perforation of a friable ureter.

Several prior reports have identified the same anatomical obstacle that motivated the development of our technique. Because the ureteral neo-orifice after reimplantation is frequently located at the dome of the bladder, the course of the transplant ureter forms a sharp angle against the direction of cystoscopic access, so that the guidewire tends to slide off the orifice toward the posterior bladder wall; in some cases even guidewire insertion, let alone stent advancement, is impossible[9, 16, 17]. M. Balaban addressed this problem using a 5 Fr torque catheter (Boston Scientific) together with a hydrophilic guidewire to redirect the wire through the neo-orifice, advancing the stent through the working channel of a rigid cystoscope kept close to the orifice to prevent intravesical coiling; they reported a first-attempt retrograde success rate of 75% (6 of 8 patients) and a 100% success rate for subsequent stent exchanges[9]. Gerrard et al. reported 53.8% success for non-exchange placements (28/52) and 64.6% across all procedures, including exchanges (51/79), illustrating that angulation remains the rate-limiting step of the retrograde approach[14].

The concept of using a rigid endoscope to overcome the difficult access to the transplant ureteral orifice is not new. More than two decades ago, Gerrard et al. observed during the review of their retrograde stenting series that a rigid ureteroscope might facilitate visualization of the neo-orifice and guidewire passage, although they did not attempt this maneuver[14]. Our Double-endoscope technique targets the same mechanical problem from a different direction: rigid cystoscopy alone provides stable visualisation and a firm platform but may not align with an ectopic or acutely angled transplant ureteric orifice. Flexible ureteroscopy improves directional control but can become unstable when guidewires, balloons or stents are advanced. The Double-endoscope configuration combines these functions: the rigid cystoscope maintains proximity, vision and support, while the flexible ureteroscope permits precise directional cannulation, which may explain the higher first-attempt success observed in our cohort (96.4%). This arrangement may reduce loss of alignment and facilitate guidewire passage, particularly when the ureteroneocystostomy is difficult to identify or approach. This comparison, although indirect,

suggests that combining stable support with steerable visualization addresses both failure mechanisms—wire slippage at the orifice and stent coiling within the bladder—simultaneously.

First-attempt success is clinically relevant independently of eventual success. Avoiding repeated manipulation may reduce mucosal trauma, operative duration, anaesthetic exposure, patient discomfort, rescue manoeuvres and conversion to percutaneous access. Nevertheless, these potential benefits require direct evaluation rather than inference from technical success alone.

Technical success and clinical cure

The gap between technical success and clinical cure is also important. A stent can restore drainage without correcting an ischaemic or fibrotic stricture, and repeated exchange carries risks of infection, encrustation, and treatment burden [37–42]. Retrograde treatment is therefore best regarded as a low-morbidity first step for selected patients, not a substitute for definitive reconstruction when obstruction persists or recurs. Open or robotic revision remains an important fallback [14, 33–36]. In practice, the technique may be most attractive when bladder access is straightforward, the ureteric orifice can be seen, and the obstruction is short enough to cross safely. A completely occluded anastomosis, an impacted stone at the orifice, sepsis requiring urgent dependable drainage, or repeated stent failure should lower the threshold for antegrade drainage or reconstruction.

Safety, renal function, and limitations

Interpretation by indication is limited by small denominators. The stricture result was encouraging, whereas the leakage comparison rests on one institutional patient and should not be taken as evidence of superiority. The renal-function improvement is clinically reassuring and follows the expected course after relief of obstruction, but it may also reflect infection control, hydration, or changes in immunosuppression. The three grade 3 urinary tract infections support an acceptable short-term safety profile, although the cohort was too small to exclude uncommon serious events. Late reconstruction, graft loss, or transplant nephrectomy should be interpreted in the context of the underlying disease rather than automatically labelled a complication of the index endoscopy. Strengths of the study include a clearly defined first-attempt endpoint, separation of initial access from exchanges, and the use of PIs to show the breadth of historical performance. Its main limitations are the retrospective single-centre design, a small cohort treated by an experienced team, incomplete follow-up for some outcomes, and substantial heterogeneity in the historical studies. The broad PIs make that heterogeneity visible and are more useful for clinical interpretation than a pooled mean alone. Our cohort also included several different causes of obstruction, which reflects practice but limits precision within each indication. Prospective multicentre evaluation should compare this approach with standard retrograde access, report crossover to antegrade drainage or reconstruction, and follow stent burden, infection, graft function, recurrence, and quality of life.

Conclusion

Dual-endoscope assistance offered a feasible route to the transplanted ureter and produced high technical success with few low-grade complications. The result supports further evaluation but does not establish comparative superiority over conventional retrograde, antegrade, or reconstructive approaches.

Statements and Declarations

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Author contributions: Zikai Fang, Heyu Guo and Zihuan Xia contributed equally to this work and share first authorship. Zikai Fang: Protocol/project development, literature search, study selection, data collection or management, data analysis, and manuscript writing/editing. Heyu Guo and Zihuan Xia: Protocol/project development, literature search, study selection, data collection or management, data analysis, and manuscript writing/editing. Jixian Liu, Jun Xue, Kangyu Liu, Heyu Guo and Xi Chen: Surgical procedures, clinical investigation, data collection or management. Jing Luo and Hongdi Cao: Nephrology patient management, clinical investigation, data collection or management. Ming Gu and Qingyi Zhu: Protocol/project development, study supervision and critical revision of the manuscript. Ming Zheng: Surgical procedures, clinical investigation, protocol/project development, data analysis, study supervision, and manuscript writing/editing. Baixin Shen: Surgical procedures, clinical investigation, protocol/project development, study supervision, project administration, and manuscript writing/editing. Ming Zheng and Baixin Shen are co-corresponding authors. Baixin Shen served as the primary corresponding author and submission contact. All authors read and approved the final manuscript.

Clinical trial registration This study was a retrospective case series and did not involve the prospective assignment of participants to an intervention for research purposes. Therefore, it was not considered a clinical trial. Clinical trial number: not applicable.

Ethics approval: The study was approved by the Ethics Committee of the Second Affiliated Hospital of Nanjing Medical University (No. [2022]-KY-116-01) and was conducted in accordance with the Declaration of Helsinki and its later amendments.

Consent to participate: Written informed consent was obtained from all participants.

Consent to publish: Written informed consent for publication of the intraoperative images presented in Fig. 1 was obtained from the relevant participant.

Transplantation statement: No organs or tissues from prisoners were used in this study. All donor kidneys were obtained from donation after circulatory death donors. Organ procurement and allocation were coordinated by the Jiangsu Provincial Human Organ Procurement Service Management Center (Jiangsu Provincial OPO), Jiangsu, China. Donor organs were sourced from multiple licensed donor hospitals across Jiangsu Province, including Nanjing. Kidney transplantation and subsequent urological care were performed at the Second Affiliated Hospital of Nanjing Medical University, Nanjing, China.

Data availability: All data generated or analysed during this study are included in this published article and its Supplementary Information files. De-identified patient-level renal-function measurements and clinical follow-up data are provided in Supplementary Tables S4A and S4B.

Systematic review registration: PROSPERO CRD420261328594.

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Figures

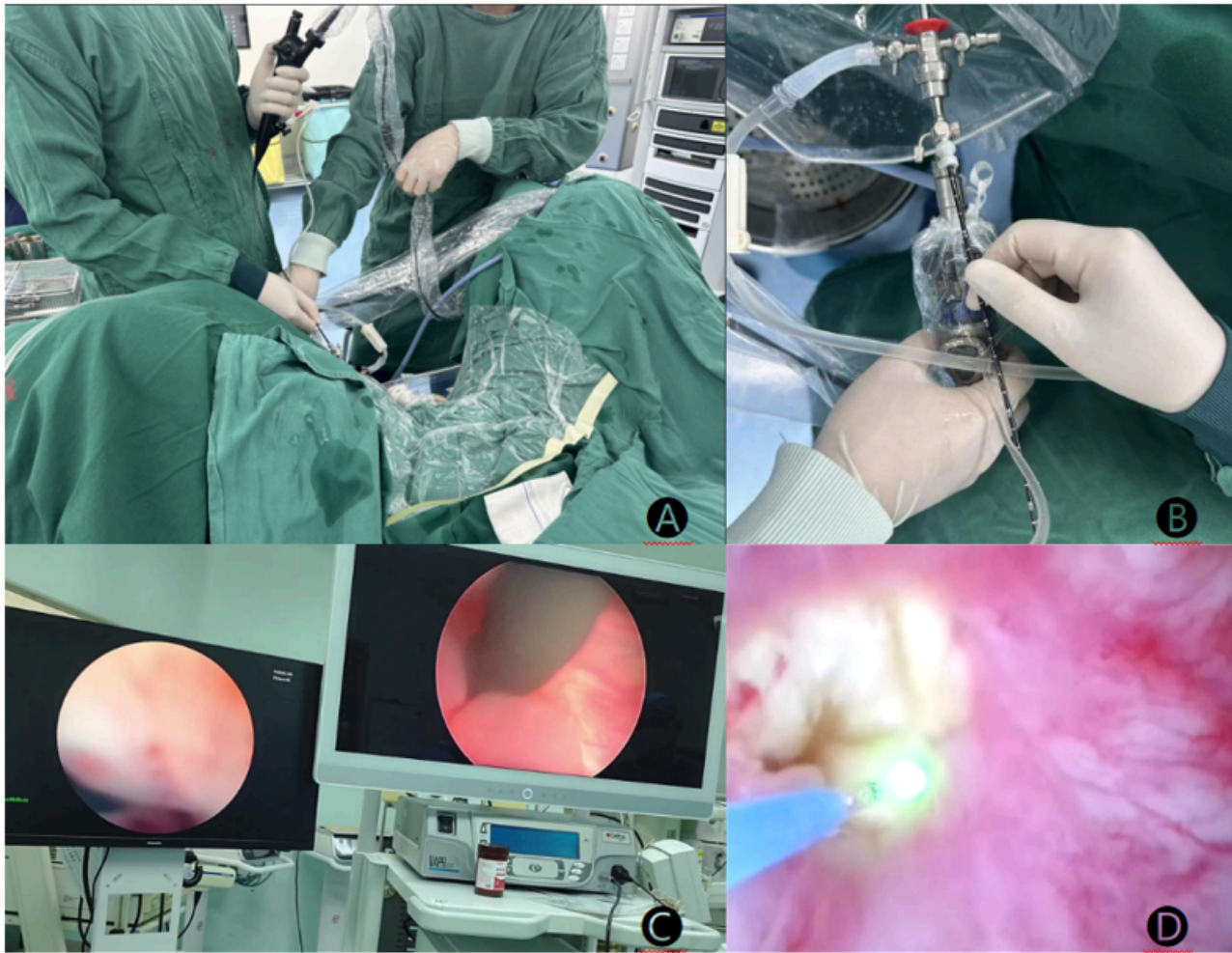


Figure 1

Dual-endoscope-assisted access to the transplant ureter. (a) The rigid cystoscope is stabilised near the ureteric orifice. (b) The flexible ureteroscope is advanced through the cystoscope. (c) Simultaneous rigid and flexible endoscopic views. (d) Endoscopic treatment after retrograde cannulation

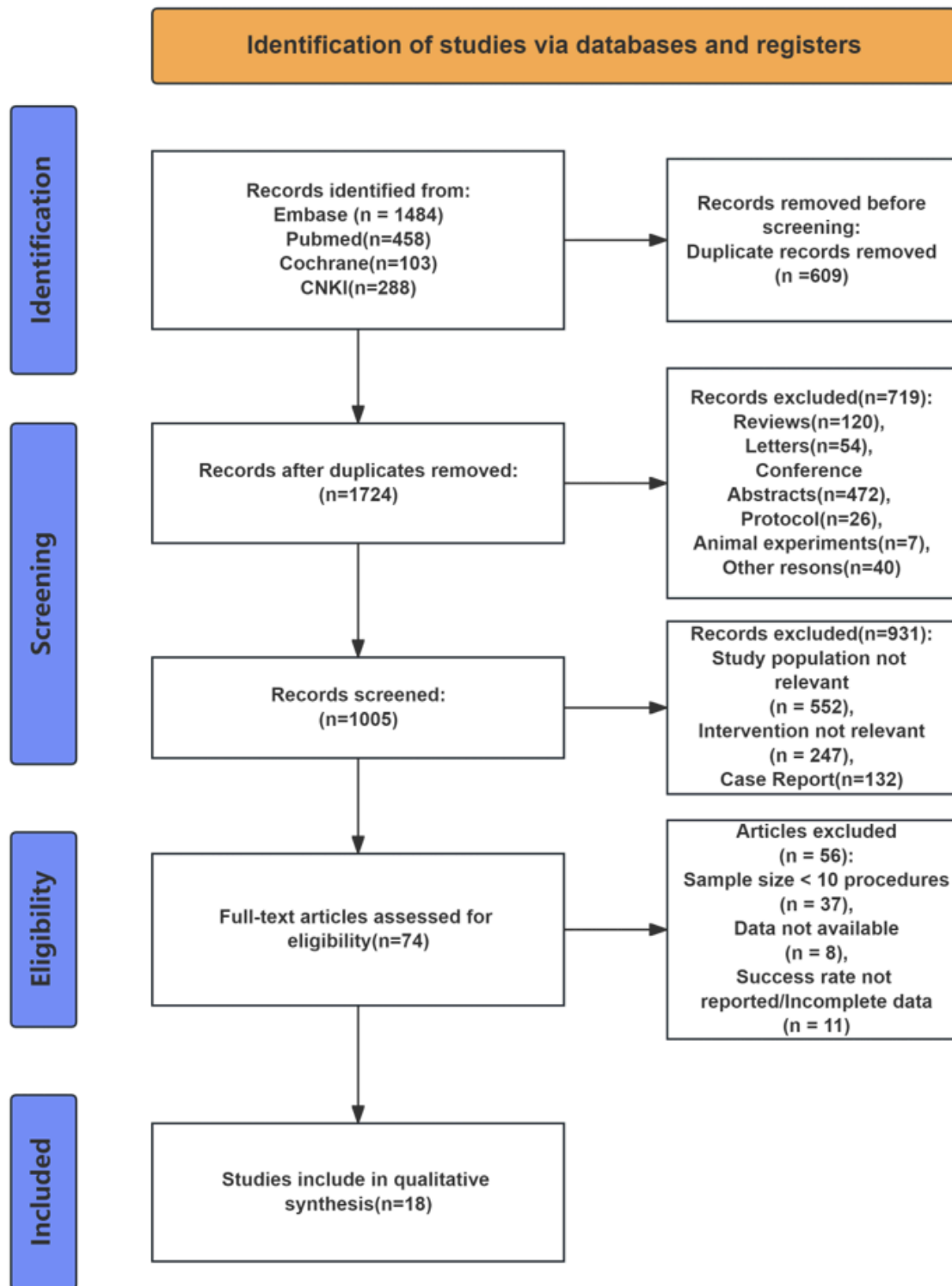
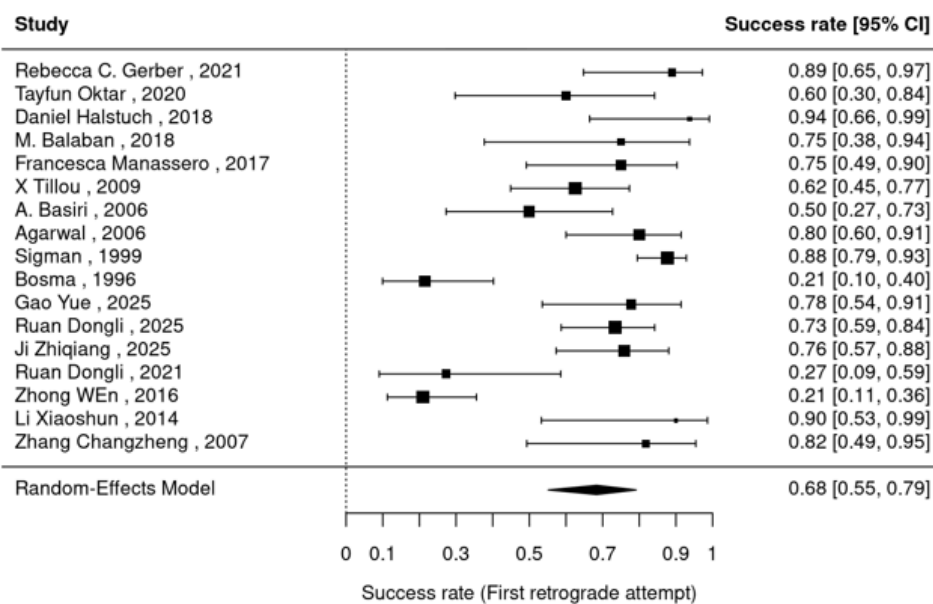


Figure 2

Study selection for the systematic review and meta-analysis. Publication-type screening was separated from title-and-abstract screening to show how the 2,333 identified records were reduced to 18 included studies

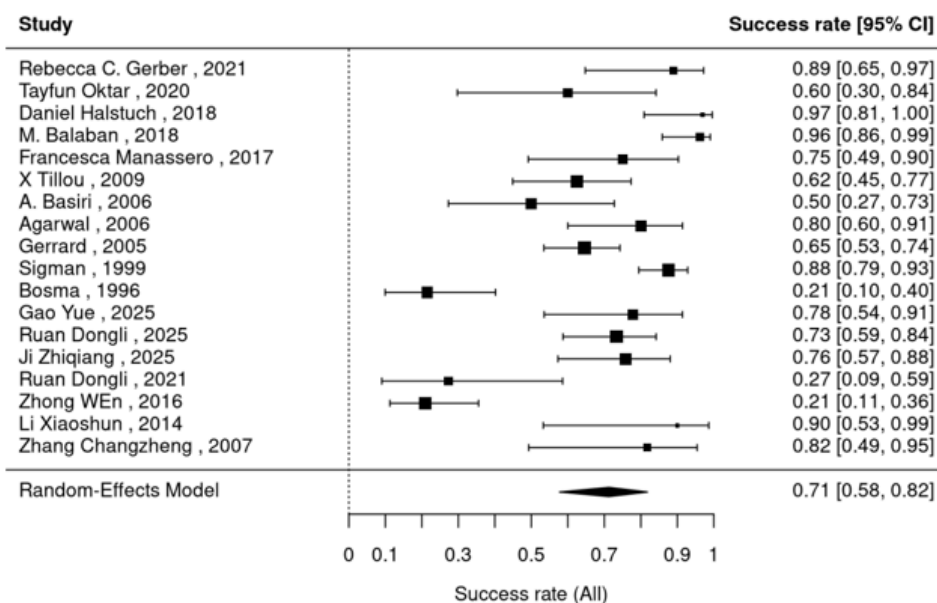
a



Heterogeneity: $Q = 89.06$, $df = 16$, $P = 3.72e-12$; $I^2 = 80.7\%$; $\tau^2 = 1.053$

95% prediction interval: 0.211 to 0.946

b



Heterogeneity: $Q = 104.62$, $df = 17$, $P = 1.23e-14$; $I^2 = 86.1\%$; $\tau^2 = 1.330$

95% prediction interval: 0.193 to 0.963

Figure 3

Random-effects meta-analysis of retrograde ureteral stenting after kidney transplantation. (a) Success at the first retrograde attempt. (b) Overall procedural success, including subsequent stent exchanges. Squares represent study estimates and horizontal lines their 95% confidence intervals; diamonds represent pooled estimates

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