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Optymalizacja postępowania okołooperacyjnego u pacjentów poddawanych przeszczepieniu nerki

Optimization of perioperative management of patients undergoing kidney transplantation

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2. **Zawistowski M**, Nowaczyk J, Domagała P. Peritoneal dialysis catheter removal at the time or after kidney transplantation: a systematic review and meta-analysis. Langenbecks Arch Surg. 2022;407(7):2651-2662. doi:10.1007/s00423-022-02637-y **[IF: 2,3, MEiN: 100]**
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Wykaz stosowanych skrótów

BM, oszacowana wartość statystyki Brunnera–Munzela

CI, przedział ufności (ang. confidence interval)

ERAS, protokół kompleksowej opieki okołooperacyjnej (ang. Enhanced Recovery After Surgery)

GRADE, system oceny pewności dowodów naukowych i siły zaleceń (ang. Grading of Recommendations Assessment, Development and Evaluation)

OR, iloraz szans (ang. odds ratio)

Streszczenie w języku polskim

Tytuł: Optymalizacja postępowania okołooperacyjnego u pacjentów poddawanych przeszczepieniu nerki

Optymalna opieka okołooperacyjna nad pacjentem poddawanym przeszczepieniu nerki może przyczyniać się do poprawy krótko oraz długoterminowych wyników tej modalności leczenia nerkozastępczego. Mimo to nadal występuje wiele luk w wiedzy, co na wielu etapach leczenia utrudnia transplantologom podejmowanie decyzji klinicznych opartych na dowodach naukowych.

Celem tej pracy było dostarczenie danych pomagających zoptymalizować postępowanie okołooperacyjne u biorców nerek przeszczepionych poprzez analizę korzyści płynących z rutynowego stosowania drenów chirurgicznych, a także optymalnego czasu na usunięcie cewnika do dializ otrzewnowych. Rozprawa ta składa się z serii trzech powiązanych tematycznie recenzowanych publikacji naukowych.

Artykuł pierwszy jest przeglądem systematycznym z metaanalizą skupiającą się na porównaniu korzyści oraz powikłań powiązanych z rutynowym zakładaniem drenów chirurgicznych po przeszczepieniu nerki. Porównanie grup pacjentów z i bez drenażu chirurgicznego nie wykazało żadnych istotnych statystycznie różnic w występowaniu zbiornika okołonerkowego, zakażenia miejsca operowanego, torbieli limfatycznej, krwiaka czy rozejścia się rany pooperacyjnej.

Druga publikacja jest przeglądem systematycznym i metaanalizą, w której badano korzyści i ryzyka wynikające z różnego czasu usuwania cewników do dializ otrzewnowych u biorców nerek przeszczepionych. Porównanie pacjentów, u których cewniki te usuwano w czasie transplantacji nerki z tymi, u których to robiono po operacji nie wykazało istotnych różnic między grupami względem konieczności dializoterapii we wczesnym okresie po przeszczepieniu, zapalenia otrzewnej oraz zakażeń związanych z cewnikiem do dializ otrzewnowych. Praca ta wykazała jednocześnie niską jakość dostępnych danych i siłę dowodu naukowego stając się tym samym podstawą do zaprojektowania ostatniego badania.

Trzeci artykuł przedstawia wyniki wieloośrodkowego retrospektywnego badania kohortowego porównującego dorosłych biorców nerki przeszczepionej, u których cewnik do dializ otrzewnowych usunięto w trakcie przeszczepienia nerki, z pacjentami, u których dokonano tego w późniejszym terminie. Praca nie wykazała znamiennej statystycznie różnicy w konieczności dializoterapii w ciągu pierwszych dwóch miesięcy po operacji ani częstości zakażeń

związanych z cewnikiem, zapaleń otrzewnej i/lub zakażeń miejsca operowanego. Jedyną istotną statystycznie różnicą był krótszy okres hospitalizacji w pierwszej grupie pacjentów.

Uzyskane wyniki przemawiają przeciwko rutynowemu stosowaniu profilaktycznego drenażu chirurgicznego po przeszczepieniu nerki, a także odraczaniu usunięcia cewnika do dializ otrzewnowych po tym zabiegu.

Streszczenie w języku angielskim

Title: Optimization of perioperative management of patients undergoing kidney transplantation

Optimal management of patients undergoing kidney transplantation can significantly enhance both short-term and long-term transplant outcomes and overall quality of life. However, there are still some knowledge gaps that hinder transplantologists from making evidence-based clinical decisions at various stages of the treatment process.

This work aims to generate evidence supporting the optimization of perioperative management of kidney graft recipients. It was achieved through the analysis of benefits associated with the routine use of prophylactic surgical drainage, as well as the investigation of the optimal timing for peritoneal dialysis catheter removal. This dissertation consists of three peer-reviewed scientific publications that are thematically related.

The first article is a systematic review and meta-analysis comparing the risks and benefits of the routine use of prophylactic intra-abdominal drainage following kidney transplantation. The comparison of groups of patients with and without drainage did not show any statistically significant differences in the occurrence of perirenal transplant fluid collection, surgical site infection, lymphocele, hematoma, and wound dehiscence.

The second publication is a systematic review and meta-analysis focusing on the risks and benefits of various timings for peritoneal dialysis catheter removal in renal transplant recipients. The comparison of participants whose catheters were removed at the time or after surgery did not show any significant differences in the occurrence of dialysis shortly after transplantation, peritonitis, or catheter-related infections. The analysis revealed poor quality of the available evidence, which led to the development of the protocol for the last study.

The third work summarizes the results of a multicenter retrospective cohort study comparing adult renal graft recipients whose peritoneal dialysis catheters were removed at the time of or after the procedure, respectively. They do not reveal any significant differences in the need for dialysis within the first two posttransplant months, catheter-related infections, peritonitis, and/or surgical site infections. However, the study noted a statistically significantly shorter hospitalization time in participants with catheters removed during the transplantation procedure.

Results summarized in the publications do not support the routine use of prophylactic intra-abdominal drainage after kidney transplantation, nor the postponement of the removal of the peritoneal dialysis catheters.

Wstęp uzasadniający połączenie wskazanych publikacji w jeden cykl, jak i komentujący osiągniecie naukowe kandydata na tle dotychczasowego stanu wiedzy

Prace stanowiące cykl publikacji [1–3] skupiają się na interwencjach chirurgicznych, którymi poddawani są pacjenci poddawani przeszczepieniu nerki. Analizują zarówno korzyści z nich płynące, jak i powiązane z nimi powikłania. Wszystkie prace przyczyniają się do pogłębienia wiedzy na temat optymalnego postępowania okołooperacyjnego u biorców nerki.

Pierwsza publikacja [1] jest przeglądem systematycznym i metaanalizą pięciu badań analizujących dane 2 094 pacjentów. Celem tej pracy było określenie zasadności stosowania profilaktycznego drenażu jamy brzusznej po przeszczepieniu nerki. Poprzez porównanie częstości występowania zbiornika okołonerkowego, zakażenia miejsca operowanego, torbieli limfatycznej, krwiaka, przecieku moczu, rozejścia się rany pooperacyjnej, utraty przeszczepionej nerki i potrzeby reoperacji u pacjentów, u których założono drenaż chirurgiczny z tymi, u których go nie stosowano, wykazano brak istotnych różnic między porównywanymi grupami. Na tej podstawie wysunięto wniosek o braku zasadności rutynowego stosowania profilaktycznego drenażu chirurgicznego u dorosłych biorców graftu nerkowego.

Stosunek korzyści do ryzyka dla interwencji w postaci rutynowego zakładania drenów chirurgicznych dobrze zbadano w wielu obszarach zabiegowych [4–10]. Artykuł włączony do cyklu publikacji jest pierwszą pracą, która w kompleksowy sposób zsyntetyzowała dane z dostępnych badań i uzupełniła lukę w wiedzy na ten temat dla operacji przeszczepiania nerki u osób dorosłych [11].

Druga publikacja [2] jest przeglądem systematycznym ośmiu badań, z których pięć obejmujących 338 pacjentów, włączono do metaanalizy. Praca ta analizowała częstość potrzeby dializoterapii, zapalenia otrzewnej, a także zakażeń związanych z cewnikiem do dializ otrzewnowych w dwóch grupach: (1) pacjentów, u których cewnik do dializ otrzewnowych został usunięty w czasie przeszczepienia nerki oraz (2) pacjentów, u których jego usunięcie zostało odroczone. Badano podgrupę osób dorosłych i populację pediatryczną. Przeprowadzona krytyczna ocena danych wykazała niski poziom dostępnych dowodów naukowych, zostawiając tym samym nierozstrzygniętym dylemat postępowania z cewnikiem do dializ otrzewnowych w okresie okołooperacyjnym.

Omawiany artkuł jest pierwszą metaanalizą poruszającą problematykę optymalnego czasu usunięcia cewnika do terapii dializą otrzewnową u biorców nerki. Wcześniejsze dowody opierały się głównie na opinii ekspertów [12] oraz pojedynczych badaniach obserwacyjnych

[13]. Drugi artykuł, który został włączony do cyklu publikacji wykazał dalsze luki wiedzy w tej dziedzinie, lecz obserwacje i wnioski z niego płynące stały się inspiracją oraz podstawą do zaprojektowania protokołu trzeciego badania.

Trzecia publikacja [3] jest wieloośrodkowym retrospektywnym badaniem kohortowym wykorzystującym metodę statystyczną funkcjonującą pod anglojęzycznym terminem *cardinality matching* [14]. W pracy tej porównano podobne grupy, jak we wcześniej omówionym artykule z tą różnicą, że uczestnikami badania było 324 pełnoletnich biorców nerki przeszczepionej z pięciu ośrodków transplantacyjnych w Polsce. Praca wykazała brak klinicznie i statystycznie istotnej różnicy między grupami względem pierwszorzędowego punktu końcowego, którym była potrzeba dializy w przeciągu dwóch miesięcy od przeszczepienia, jak i złożonego drugorzędowego punktu końcowego składającego się z infekcji powiązanych z cewnikiem do dializ otrzewnowych, zapalenia otrzewnej oraz zakażenia miejsca operowanego. Jedyną istotną statystycznie różnicą, którą zidentyfikowano był dłuższy czas hospitalizacji u pacjentów, u których odroczono usunięcie cewnika do dializ otrzewnowych.

Założenia i cel pracy

Stale postępujący rozwój wiedzy w dziedzinie leczenia nerkozastępczego, w szczególności przeszczepiania nerki, wymaga równoległego doskonalenia i optymalizacji opieki okołooperacyjnej dostosowanej do aktualnych standardów medycznych [15]. Wprowadzanie nowych technik chirurgicznych, protokołów immunosupresyjnych, a także dobrze skoordynowanej, długoterminowej opieki medycznej po przeszczepieniu nerki przyczyniły się do znacznego polepszenia przeżywalności przeszczepionych narządów oraz jakości życia pacjentów [16]. Mimo to, brakuje wysokiej jakości danych, a co za tym idzie wytycznych i szeroko uznanych standardów postępowania okołooperacyjnego u biorców nerki [17].

Celem pracy jest określenie optymalnego postępowania okołooperacyjnego u pacjentów poddawanych przeszczepieniu nerki poprzez analizę korzyści i powikłań powiązanych z wybranymi interwencjami chirurgicznymi.

Prace wchodzące w skład cyklu publikacji w szczególności analizowały następujące pytania kliniczne:

1. Czy zasadne jest rutynowe zakładanie drenów chirurgicznych po przeszczepieniu nerki?
2. Kiedy powinien zostać usunięty cewnik do dializ otrzewnowych u pacjenta poddawanego przeszczepieniu nerki?

Ważnym założeniem i oczekiwanym rezultatem niniejszej pracy jest dostarczenie danych umożliwiających odpowiedzenie na wymienione wyżej pytania kliniczne, co może pozytywnie przyczynić się do dalszego polepszenia wyników przeszczepiania nerki, w tym przeżywalności graftu lub jakości życia pacjentów. Ponadto, omawiane wyniki mogą przyczynić się do opracowania wytycznych postępowania oraz nierozpowszechnionych jeszcze szeroko w transplantologii nerki protokołów kompleksowej opieki okołooperacyjnej (ang. Enhanced Recovery After Surgery, ERAS) [18].

Kopie opublikowanych prac

INDEX COPERNICUS INTERNATIONAL

META-ANALYSIS

Prophylactic intra-abdominal drainage following kidney transplantation: a systematic review and meta-analysis

Profilaktyczny drenaż jamy brzusznej po przeszczepieniu nerki: przegląd systematyczny i metaanaliza

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Manuscript Preparation
E – Literature Search
F – Funds Collection

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ABSTRACT:

Introduction: An ongoing debate concerns the need for routine placement of prophylactic intra-abdominal drains following kidney transplantation.

Aim: We conducted a systematic review and meta-analysis to determine whether such an approach brings any advantages in the prevention of perirenal transplant fluid collection, surgical site infection, lymphocele, hematoma, urinoma, wound dehiscence, graft loss, and need for reoperation.

Methods: We conducted a random-effects meta-analysis of non-randomized studies of intervention comparing drained and drain-free adult renal graft recipients regarding perirenal transplant fluid collection and other wound complications. ROBINS-I tool and funnel plot asymmetry analysis were used to assess the risk of bias.

Results: Five studies at moderate to critical risk of bias were included. A total of 2094 renal graft recipients were evaluated. Our analysis revealed no significant differences between drained and drain-free patients regarding perirenal transplant fluid collection (pooled odds ratio [OR], 0.77; 95% confidence interval [CI], 0.28–2.17; $I^2 = 72\%$), surgical site infection (OR, 1.64; 95% CI, 0.11–24.88; $I^2 = 80\%$), lymphocele (OR, 0.61; 95% CI, 0.02–15.27; $I^2 = 0\%$), hematoma (OR, 0.71; 95% CI, 0.12–3.99; $I^2 = 71\%$), and wound dehiscence (OR, 0.75; 95% CI, 0.21–2.70; $I^2 = 0\%$). There was insufficient data concerning urinoma, graft loss, and need for reoperation.

Conclusions: The available evidence is weak. Our findings show that the use of intra-abdominal drains after kidney transplantation seems to have neither beneficial nor harmful effects on perirenal transplant fluid collection and other wound complications. The present study does not support the routine placement of surgical drains after kidney transplantation.

KEYWORDS: Contest PPCH, drainage, kidney transplantation, lymphocele, meta-analysis, surgical wound infection

STRESZCZENIE:

Wstęp: Zasadność rutynowego zakładania drenów chirurgicznych po przeszczepieniu nerki stanowi element toczącej się dyskusji.

Cel: Celem niniejszej pracy było przeprowadzenie przeglądu systematycznego i metaanalizy badań analizujących to zagadnienie oraz wykazanie, czy rutynowe zakładanie drenów przynosi korzyści wobec: profilaktyki wystąpienia zbiornika okołonerkowego, zakażenia miejsca operowanego, torbieli limfatycznej, krwiaka, przecieku moczu, rozejścia się rany pooperacyjnej, utraty graftu oraz konieczności reoperacji.

Metody: Wykorzystując model efektów losowych, przeprowadziliśmy metaanalizę nierandomizowanych badań porównujących dorosłych biorców nerki, u których zastosowano drenaż chirurgiczny z tymi, którzy go nie mieli, rozpatrując ryzyko wystąpienia zbiornika okołonerkowego oraz innych powikłań miejsca operowanego. Jakość badań oraz ryzyko błędu systematycznego oceniliśmy za pomocą narzędzia ROBINS-I i analizy asymetrii wykresów lejkowych.

Wyniki: Włączono pięć prac o umiarkowanym, wysokim lub bardzo wysokim ryzyku błędu systematycznego. Łącznie przeanalizowano 2094 dorosłych biorców nerki. Metaanaliza nie wykazała istotnych różnic pomiędzy pacjentami z drenażem i bez niego odnośnie do ryzyka wystąpienia: zbiornika okołonerkowego (iloraz szans [OR] 0,77; 95% przedział ufności [CI] 0,28–2,17; $I^2 = 72\%$), zakażenia miejsca operowanego (OR 1,64; 95% CI 0,11–24,88; $I^2 = 80\%$), torbieli limfatycznej (OR 0,61; 95% CI 0,02–15,27; $I^2 = 0\%$), krwiaka miejsca operowanego (OR 0,71; 95% CI 0,12–3,99; $I^2 = 71\%$) oraz rozejścia się rany pooperacyjnej (OR 0,75; 95% CI 0,21–2,70; $I^2 = 0\%$). Dane dotyczące pozostałych punktów końcowych były niewystarczające do przeprowadzenia analizy zbiorczej efektu.

Wnioski: Dostępne dowody są niskiej jakości. Ich ocena wykazała, że stosowanie drenażu chirurgicznego nie ma korzystnego ani szkodliwego wpływu na występowanie po transplantacji zbiornika okołonerkowego ani innych powikłań miejsca operowanego. Nasza analiza przemawia przeciwko rutynowemu stosowaniu drenów chirurgicznych u pacjentów poddawanych przeszczepieniu nerki.

SŁOWA KLUCZOWE: drenaż chirurgiczny, Konkurs PPCH, limfocele, metaanaliza, przeszczepienie nerki, zakażenie miejsca operowanego

In this systematic review and meta-analysis we summarize the most up-to-date evidence for and against the routine use of intra-abdominal drain following renal transplantation.

INTRODUCTION

Routine drain placement following renal transplantation has been practiced for decades to prevent perirenal transplant fluid collection. The purpose of this procedure is to drain lymph, blood, serous fluid, pus, or leaked urine from the space around the transplanted kidney in order to control and manage infections, wound dehiscence, worsened graft function and pain due to fluid compression [1, 2]. The use of immunosuppressive drugs in transplant recipients impairs wound healing, which may speak for prophylactic drainage placement [3–6]. On the other hand, inserting a drain carries the risk of developing complications from the foreign body left in the retroperitoneal space, including surgical site infection and wound dehiscence [7].

The need for routine drain placement was questioned lately for laparoscopic donor nephrectomy [8]. Similarly, the rationale of leaving peritoneal dialysis catheters in place after renal transplantation was also discussed [9]. Strong evidence based on randomized controlled trials or even comprehensive meta-analyses of non-randomized trials are nonetheless not available for routine surgical drainage following renal transplant procedures [10].

The aim of this study was to determine the impact of prophylactic use of surgical drains following kidney transplantation on perirenal transplant fluid collection and other wound complications. We conducted a systematic review and meta-analysis of non-randomized studies of intervention.

METHODS

Reporting guidelines and protocol registration

This meta-analysis was conducted in compliance with a prospectively written protocol that was listed in the PROSPERO database (CRD42021243074). We followed the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Statement when reporting the results of our study [11, 12].

Inclusion and exclusion criteria

Full-text articles with the main focus on assessing the impact of prophylactic intra-abdominal drainage following kidney transplantation in adult patients on perirenal transplant fluid collection and other wound complications deemed eligible for inclusion in our meta-analysis. At least one of the predefined endpoints had to be sufficiently reported in each publication. We excluded studies on non-human species or in the pediatric population, retracted or withdrawn papers, and articles without any control group.

Literature search

We searched PubMed and Embase with no language or publication year restrictions applied. Our search strategy is summarized in Tab. I. It was peer reviewed by a senior author with the Peer Review of Electronic Search Strategies (PRESS) checklist [13]. We additionally evaluated reference sections of the assessed full-text articles to find more studies potentially eligible for inclusion.

Data extraction

Two authors independently evaluated the records obtained from the bibliographic databases that were imported into Zotero version 5.0.96 (Center for History and New Media, Fairfax, Virginia, USA) [14]. After deduplication, the researchers identified eligible studies and extracted data into a standardized spreadsheet. Discrepancies were discussed and resolved by a consensus among all co-authors.

The following information was retrieved from the included articles: study type, publication year, country or countries where the study was conducted, number of participants, strategy for surgical drain placement and criteria for its removal, type of organ donors (living or deceased), definitions of primary and secondary endpoints, mean or median age, BMI, and serum albumin concentrations of participants, dialysis vintage, past transplantation history, history of diabetes mellitus, and immunosuppressive regimen details. Finally, the prevalence of perirenal transplant fluid collection, surgical site infection, lymphocele, hematoma, urinoma, wound dehiscence, death-censored graft failure, death-censored graft loss, and need for reoperation after renal transplantation was recorded.

Quality assessment

Individual study quality was assessed with the Risk Of Bias In Non-randomized Studies – of Interventions (ROBINS-I) tool [15]. The risk of publication bias was evaluated by the analysis of funnel plots' asymmetry.

Studied groups and endpoints

We compared adult renal transplant recipients who had a prophylactic intra-abdominal surgical drain placed during transplantation ("drained group") with those who had no drainage used ("drain-free group"). The primary endpoint was perirenal transplant fluid collection defined as lymphocele, seroma, urinoma, hematoma and/or abscess localized around the transplanted kidney at any post-transplant time [1]. Secondary endpoints included surgical site infection, lymphocele, hematoma, urinoma, wound dehiscence, death-censored graft failure, death-uncensored graft loss, and need for reoperation following renal transplantation.

Tab. I. Search strategy.

DATABASE	DATE OF SEARCH	SEARCH QUERY	SEARCH FILTERS	NUMBER OF RETRIEVED RECORDS
PubMed	3/22/2021	"Drainage"[Mesh] AND "Kidney Transplantation"[Mesh]	Human	499
Embase	3/22/2021	'kidney transplantation'/exp AND 'surgical drainage'/exp	-	838
Number of all found articles				1337
Number of all found articles with duplicates removed				1104

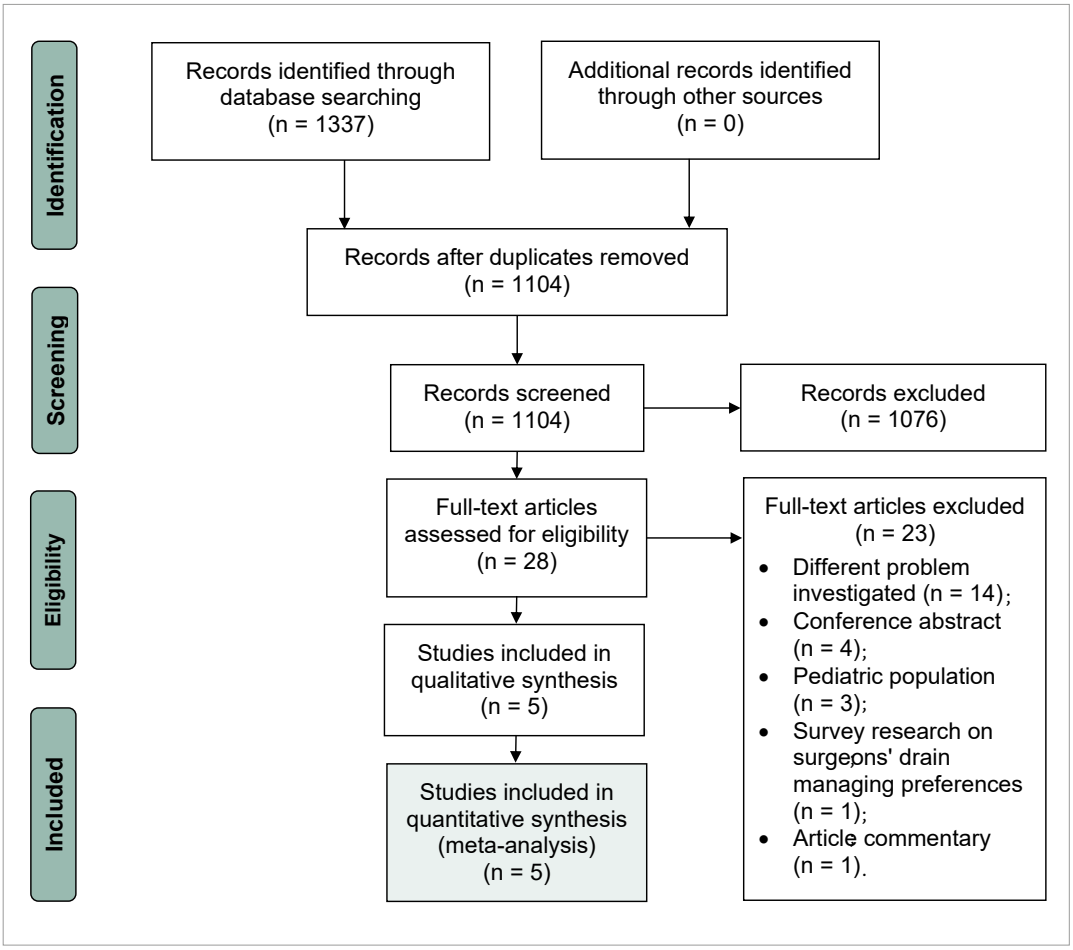

Fig. 1. PRISMA flow diagram.

Statistical analysis

We conducted a random-effects meta-analysis of non-randomized studies of interventions. Unadjusted odds ratios with 95% confidence intervals were calculated for each predefined endpoint and pooled using the Hartung-Knapp adjustment. We applied a continuity correction of 0.1 in studies with zero cell frequencies.

We assessed the between-study heterogeneity using Cochran's Q, Higgins' and Thompson's I^2, and tau-squared statistics.

We also reported adjusted odds ratios if these were available for individual studies. All analyses were completed using the meta [16], the matafor [17], and the robvis [18] packages in R version 4.0.4 (R Core Team, 2021) [19].

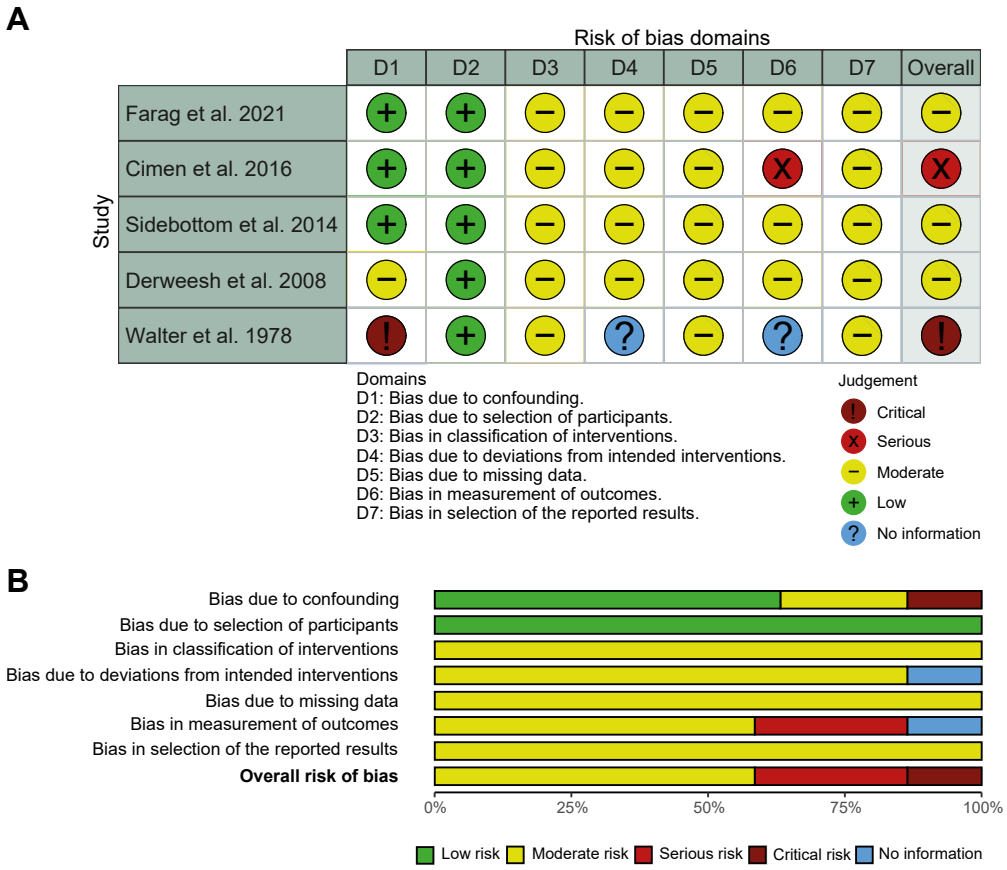

Fig. 2. Risk of bias charts: (A) "Traffic light" chart representing risk of bias of individual studies in seven domains; (B) weighted bar chart with cumulative risk of bias at each domain.

RESULTS

Study selection and characteristics

We found 1104 non-duplicate records that were evaluated by two independent researchers. The selection process is presented in Fig. 1. Five observational studies published between 1978 and 2021 were included in the final meta-analysis. They included a total of 2094 adult renal graft recipients. Baseline characteristics of these articles are summarized in Tab. II.

Risk of bias and study quality

Three studies were judged to be at moderate, one at serious, and another at critical overall risk of bias (Fig. 2.). Funnel plots' (Fig. 3.) asymmetry could be analyzed only visually due to inclusion of less than ten studies [20]. Publication bias cannot therefore be ruled out.

Strategy for surgical drain placement and removal

The decision to use a prophylactic intra-abdominal drainage after kidney transplantation was made according to the surgeon's preferences in almost all studies included in the meta-analysis [2, 21–23]. No specific algorithm nor guidance was followed by any of the authors. Walter et al. (1978) [23] avoided placing a drain if only possible, based on their observation that the drained patients more often develop wound infections. Drains were removed once output was less than 50 mL over 24 hours [2, 21, 22] or 48 hours [24].

Perirenal transplant fluid collection

The primary endpoint was evaluated by all included studies but its definition was slightly different in each of them (Tab. II.). There was no significant difference between the drained and drain-free patients concerning perirenal transplant fluid collection (pooled unadjusted odds ratio [OR], 0.77; 95% confidence interval [CI], 0.28–2.17;

Tab. II. Characteristics of the included studies.

STUDY	COUNTRY	NO. OF PARTICIPANTS	PRIMARY ENDPOINT	SECONDARY ENDPOINTS	DONOR TYPE	MEAN (SD) FOLLOW-UP, MONTHS	MEAN (SD) AGE		SEX, M/F		MEAN (SD)/MEDIAN [RANGE] BMI		DIABETES MELLITUS, N		PREVIOUS KIDNEY TRANSPLANT, N		MEAN (SD)/MEDIAN [RANGE] SERUM ALBUMIN, G/L	
							D	DF	D	DF	D	DF	D	DF	D	DF	D	DF
Farag et al. 2021 [21]	USA	500	wound complication within 12 months[a]	superficial wound complications, deep complications[b]	64.6% DD (D > DF, P < .001)	at least 12	55.7 (1.3)	49.2 (0.9)	72/40	243/145	27,5 (0.5)	26,4 (0.3)	49	103	8	31	N/A	N/A
Cimen et al. 2016 [22]	Canada	657	wound complication or perigraft collection within 1 month[c]	perigraft collections, wound complications	61.6% DD with no difference between the groups (P = .746)	1 (0)	49 (13)	50 (14)	232/142	181/102	27 [24–31]	27 [24-31]	82	70	41	25	38 [35–40]	38 [35–40]
Sidebottom et al. 2014 [2]	USA	680	major wound complication[d]	minor wound complication[e]	82.1% DD (D > DF, P < .001)	30 dni	55.2 (12.8)	52.4 (12.9)	N/A	N/A	27.9 (6.0)	27.2 (5.6)	237	74	N/A	N/A	38 (0.61)	40 (0.56)
Derweesh et al. 2008 [24]	USA	165	wound complication[f]	fluid collection, lymphocele intervention, DVT	40.0% DD with no difference between the groups (P = .250)	14.12 (4.1)	50.8 (13.0)	45.4 (14.2)	40/41	54/30	27,7 (4.9)	25,6 (8.4)	26	28	N/A	N/A	N/A	N/A
Walter et al. 1978 [23]	Denmark	92	wound infection	abscess formation	100% DD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[a]Subcutaneous seroma, surgical site infection, wound dehiscence without fascia disruption, hematoma, perirenal transplant fluid collections, lymphocele.

[b]Subcutaneous seroma, wound dehiscence, lymphocele, perirenal transplant fluid collection, hematoma, delayed graft function, graft loss within the first 12 post-transplant months. pierwszych 12 miesięcy po transplantacji.

[c]Dehiscence, evisceration, surgical site infection.

[d]Dehiscence, evisceration, surgical site infection, necrosis, incisional or ventral hernia.

[e]Seroma, hematoma, perirenal transplant fluid collection.

[f] Lymphocele, surgical site infection, incisional hernia.

NO. – number, SD – standard deviation, D – drained group, DF – drain-free group, M – male, F – female, BMI – body mass index, DD – deceased donor, N/A – no information, DVT – deep vein thrombosis.

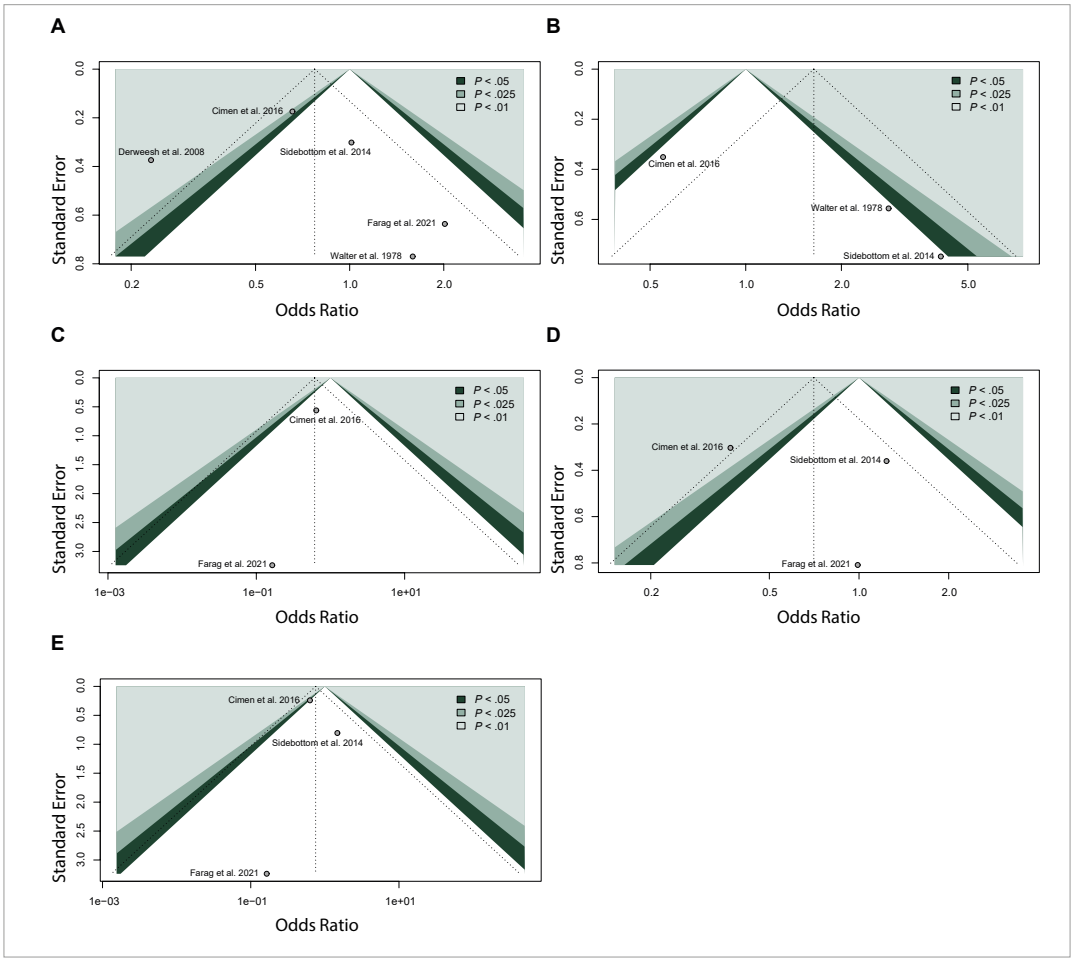

Fig. 3. Funnel plots for: (A) perirenal transplant fluid collection, (B) surgical site infection, (C) lymphocele, (D) hematoma, and (E) wound dehiscence. Each point represents an individual study.

I^2 = 72%, Fig. 4A.). Cimen et al. (2016) [22] reported that result after adjusting for age, sex, body mass index, reason of end stage renal disease, diabetes status, pre-transplant dialysis status, preoperative serum albumin level, and donor type (OR, 0.62; 95% CI 0.43–0.88; P = .008). Derweesh et al. (2008) [24] compared drain-free patients with the drained ones and adjusted that analysis for wound complication (defined as lymphocele, surgical site infection and/or incisional hernia) and immunosuppression type (sirolimus vs calcineurin inhibitor) revealing a significant association (OR, 3.30; 95% CI, 1.57–6.94; P = .002). However this result is problematic owing to inclusion of lymphocele as both a predictor and an outcome.

Secondary endpoints

Our random-effects meta-analysis revealed no statistically significant differences between the drained and drain-free adult renal graft recipients regarding surgical site infection (pooled OR, 1.64; 95% CI, 0.11–24.88; I^2 = 80%), lymphocele (pooled OR, 0.61; 95% CI, 0.02–15.27; I^2 = 0%), hematoma (pooled OR, 0.71; 95% CI, 0.12–3.99; I^2 = 71%), and wound dehiscence (pooled OR, 0.75; 95% CI, 0.21–2.70; I^2 = 0%). Results of the meta-analysis are presented in forest plots (Fig. 4.).

We could not calculate pooled results for other endpoints as these were reported in single studies. Only one study evaluated the occurrence of urinoma finding no significant differences between the groups (unadjusted OR, 0.50; 95% CI, 0.14–1.79; P = .285) [22]. Farag et al. (2021) [21] reported similar results concerning death-censored graft failure (unadjusted OR, 2.36; 95% CI, 0.65–8.51; P = .190) and death-uncensored graft loss (unadjusted OR, 1.45; 95% CI, 0.59–3.60; P = .418). No single study analyzed the need for reoperation. Cimen et al. (2016) [22] conducted a subgroup analysis of 225 patients who developed perirenal transplant fluid collection and/or wound complication showing no significant differences for drained and drain-free patients regarding the need for subsequent intervention (adjusted OR, 1.23; 95% CI, 0.61–2.46; P = .562).

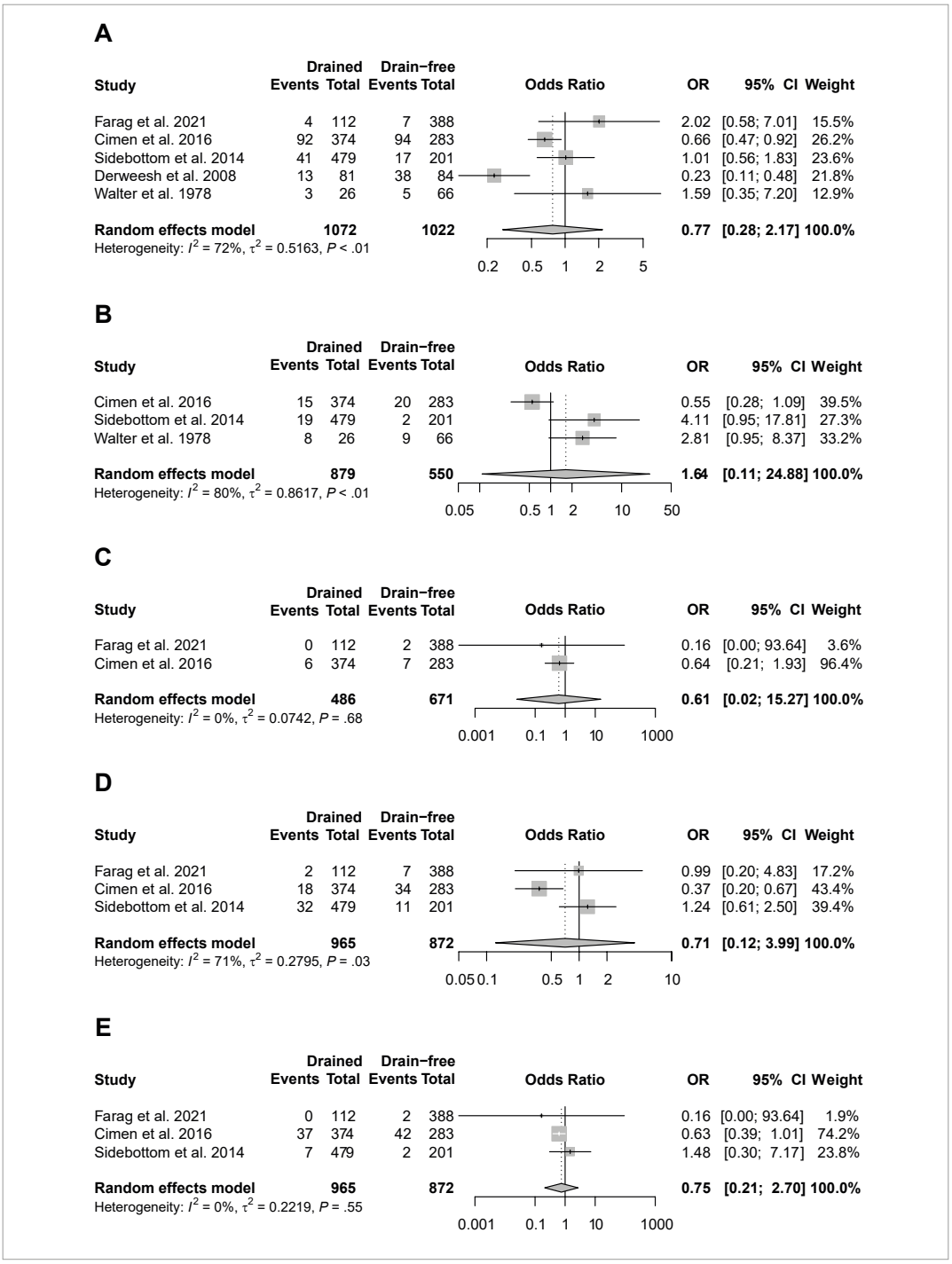

Fig. 4. Forest plots for: (A) perirenal transplant fluid collection, (B) surgical site infection, (C) lymphocele, (D) hematoma, and (E) wound dehiscence. CI – confidence interval.

DISCUSSION

In this meta-analysis, we comprehensively evaluated five observational studies at moderate to critical risk of bias. By combining the data of 2094 patients (1072 in the drained and 1022 in the drain-free group), we showed that there are no significant differences between the groups concerning perirenal transplant fluid collection, surgical site infection, lymphocele, hematoma, and wound dehiscence following renal transplantation. There was insufficient data to calculate pooled odds ratios for other outcomes (urinoma, death-censored graft failure, death-uncensored graft loss, and need for reoperation).

In a previous systematic review, D'Souza et al. (2019) [25] found a significant association between the drain-free approach and the occurrence of perirenal transplant fluid collection (risk ratio, 0.62; 95% confidence interval, 0.42–0.90; I^2 = 51%). The difference is most likely caused by inappropriately calculated numbers of events from data provided by Cimen et al. [22] who reported two slightly different values of unadjusted odds ratio regarding 186 patients with perirenal transplant fluid collection. Moreover, we excluded one study included in the work of D'Souza et al. (2019) [25] as its main scope was different from the use of surgical drains and the authors provided insufficient and inconsistent data to confidently use them in our meta-analysis [26].

A recent survey among 43 consultant transplant surgeons from Australia and New Zealand showed that they expect a prophylactic drainage to reduce the perirenal transplant fluid collection, help with the diagnosis of urine leak, or reduce the mass effect [10]. However, 30% of the respondents were uncertain about the rationale for the drain placement. Our analysis shows that prophylactic intra-abdominal surgical draining is not as effective in preventing the collection of fluid around the transplanted kidney as expected. On the other hand, it also did not confirm that drains significantly increase the rates of complications, including surgical site infection or wound dehiscence. For lymphocele formation there are alternative methods of prevention. Syversveen et al. (2011) [27] conducted a randomized controlled trial (NCT01206868) proving that prophylactic peritoneal fenestration reduces the occurrence of lymphocele. In that study, the authors did not routinely insert surgical drains.

A meta-analysis of randomized controlled trials showed that universal prophylactic double-J stenting reduces the incidence of major urological complications, including urine leak (risk ratio, 0.29; 95% confidence interval, 0.12–0.74, I^2 = 5%) [28]. The procedure is associated with a higher risk of urinary tract infection, therefore it is recommended to remove stents early, i.e. before the 15th postoperative day [29]. The fact of placing ureteric stents should be reported in future trials and considered as a potential confounder in the observational ones as it has an impact on perirenal transplant fluid collection. Only two studies included in our meta-analysis reported that variable. Derweesh et al. (2008) [24] stented all patients while Farag et al. (2021) [21] used an extravesical ureteroneocystostomy technique without ureteral stenting [30]. Owing to incomplete reporting, we were unable to determine the impact of this factor on the primary endpoint.

There are several aspects of the use of intra-abdominal drains in renal transplant recipients that we still are not clear about. In the analyzed studies, there was insufficient data concerning the need for reoperation, long-term graft survival or urinoma formation. Another factor, which was not investigated in any of the evaluated studies, was the potential increase in postoperative pain that is observed in drained patients undergoing other surgical procedures [29].

Limitations

Several limitations of our meta-analysis should be acknowledged. We included only five observational studies restricted by a severe risk of bias and incomplete reporting. To our knowledge, there is no single randomized controlled trial that is either published in a peer-reviewed journal or registered in any public registry of clinical trials, although if proceeded it could bring the most objective evidence [10].

Another potential limitation is related to the presence of moderate and substantial heterogeneity regarding some endpoints. Despite confirming that no outliers or influential cases were present in our analyses, we could not verify the source of heterogeneity. The evaluated studies differ in terms of inclusion criteria which resulted in the inclusion of diverse groups of patients.

The use of different definitions and criteria for the diagnosis of the evaluated endpoints in each study brings some uncertainty when providing the final conclusions. Finally, we calculated only unadjusted pooled results owing to the heterogeneity of study designs in the appraised articles.

CONCLUSION

The available evidence concerning the prophylactic use of intra-abdominal drainage after renal transplantation is very weak and limited to retrospective analyses. Our findings show that the routine placement of such drains has neither beneficial nor harmful effect on perirenal transplant fluid collection and other wound complications. The present study does not support the practice of utilizing surgical drains routinely in all renal transplant recipients. This conclusion should be confirmed in a randomized controlled trial.

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SYSTEMATIC REVIEWS AND META-ANALYSES

Peritoneal dialysis catheter removal at the time or after kidney transplantation: a systematic review and meta-analysis

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Abstract

Purpose An increasing number of patients treated with peritoneal dialysis eventually undergo kidney transplantation. Owing to opposing reports, we aimed to find evidence about the best time for peritoneal dialysis catheter removal in transplant patients.

Methods We conducted a systematic review and random effects meta-analysis of non-randomized studies of intervention comparing patients with peritoneal dialysis catheters left in place or removed during kidney transplantation in regard to the need for dialysis and occurrence of catheter-related complications. We searched (last update on 8 December 2021) PubMed, Embase, Scopus, and Web of Science for eligible studies. ROBINS-I tool and funnel plot asymmetry analysis were used to assess the quality of included articles.

Results Eight observational studies were evaluated. Five of them, which involved 338 patients, were included in a meta-analysis. All were at moderate to serious risk of bias. The odds of needing dialysis are more than twice as high for patients with peritoneal dialysis catheters left in situ (pooled odds ratio, 2.21; 95% confidence interval [CI], 1.03 to 4.73; $I^2 = 0\%$). No statistically significant difference was noted when adult and pediatric subgroups were compared ($Q = 0.13$, $P = .720$). More individuals with catheters left in place required dialysis (pooled prevalence, 20.9%; 95% CI, 13.6 to 30.7%; $I^2 = 59\%$ vs. 12.4%; 95% CI, 5.6 to 25.2%; $I^2 = 0\%$) and experienced catheter-related infections.

Conclusion Available evidence is scarce. Unless new data from a randomized controlled trial are available, the dilemma of peritoneal dialysis catheter removal cannot be solved.

Trial registration PROSPERO Protocol ID: CRD42020207707.

Keywords Peritoneal dialysis catheter · Catheter removal · Kidney transplantation · Delayed graft function

Introduction

Peritoneal dialysis is a renal replacement therapy that is often preferred by patients with end-stage renal disease as it usually has less impact on their daily routine than hemodialysis [1]. Peritoneal dialysis is also favored in the pediatric population. Although in many countries the peritoneal dialysis-first strategy is often a default policy nowadays, kidney transplantation is still considered a superior method that usually guarantees the best possible quality of life [2]. Therefore, an increasing number of patients undergoing peritoneal dialysis eventually receive their first renal graft. An ongoing debate concerns the management of peritoneal dialysis catheters during transplantation [3]. One of the questions that need to be answered is whether the catheter should be removed at the time or after the transplant procedure.

Current policies differ in many transplant centers. Practices range from routine catheter removal simultaneously with transplantation [4, 5] to postponing it until good renal function is achieved or until a particular postoperative time [6, 7]. The problem is mentioned briefly in the European Best Practice Guidelines (EBPG) for Peritoneal Dialysis from 2005 [8]. Over a decade ago, the EBPG Expert Group on Peritoneal Dialysis stated that leaving peritoneal dialysis catheters in situ for 3–4 months is acceptable even with a functioning renal graft, although quicker removal was advised if possible. However, evidence back then was poor

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and the methodology used to create these guidelines is not considered robust [9, 10].

To solve the dilemma of peritoneal dialysis catheter removal, several aspects should be considered. The first one is the choice of a proper measure to evaluate both interventions. The main argument for leaving catheters in place is having dialysis access ready to use in case of delayed graft function or graft failure [11]. Therefore, we believe that there is a need to compare the overall need for dialysis early after transplantation between the two groups of patients, with catheters left in situ and removed simultaneously with transplantation. Furthermore, the used dialysis modality should be evaluated to confirm the feasibility of peritoneal dialysis in such cases. Additionally, complications associated with each procedure should be analyzed. Finally, such factors as patients' quality of life and costs should be considered.

We aimed to evaluate available evidence about the peritransplant management of peritoneal dialysis catheters using a critical and systematic approach. We focused on the timing of their removal. A systematic review and random effects meta-analysis of non-randomized studies of intervention was conducted.

Materials and methods

Reporting guidelines and protocol registration

The study results are reported in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Statement and the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines [12, 13]. Our study conforms to the recommendations of the Study Center of the German Society of Surgery [14]. We followed a prospectively written protocol that is summarized and recorded in the PROSPERO database (CRD42020207707).

Inclusion and exclusion criteria

Articles were included in the systematic review if they compared or reported outcomes of leaving peritoneal dialysis catheters in situ with removing them at the time of surgery. Full-text peer-reviewed papers, as well as conference abstracts of acceptable quality, were evaluated. The exclusion was based on the following criteria: animal studies, no control group, non-English, retracted articles, reviews, editorials, and case reports or case series. Studies with numbers of patients needing post-transplant dialysis reported for both groups were considered for inclusion in a meta-analysis.

Studied groups and outcomes

The experimental group consisted of patients with the peritoneal dialysis catheter left in situ, whereas in the control group it was removed at the time of surgery. Additionally, adult and pediatric subgroups were distinguished. The main outcome was defined as the need for dialysis in the early period after transplantation — that is not later than within the first two postoperative months. Secondary endpoints included catheter-related complications (peritonitis, exit-site, inner cuff, and tunnel infections). In Table 1, we summarized the PICO (Population, Intervention, Comparison, Outcome) framework for this study.

Literature search

We searched (last update on 8 December 2021) PubMed, Embase, Scopus, and Web of Science databases for studies eligible for further investigation. The search strategy is reported in Table 2. No dates of coverage nor language restrictions were applied at this stage. Search queries were reviewed with the PRESS Peer Review Checklist [15]. All retrieved citations were exported, deduplicated, and processed using the Zotero 5.0.89 software (Center for History and New Media, Fairfax, Virginia, USA) [16]. Moreover, reference sections of evaluated papers were manually searched for additional records.

Data extraction

The search results were independently analyzed by two investigators. Discrepancies were resolved by discussion and consensus among all co-authors. The researchers extracted the following information: study design, publication year, a place where it was conducted, number of participants in each group, population studied (adult/pediatric), criteria for

Table 1 The PICO framework

Population	Adult and pediatric patients undergoing renal transplantation after being maintained on peritoneal dialysis
Intervention	Leaving the peritoneal dialysis catheter in situ during kidney transplantation
Comparison	Removing the peritoneal dialysis catheter at the time of kidney transplantation
Outcome	The need for dialysis in the early period after transplantation (not later than within the first two postoperative months), catheter-related complications (peritonitis, exit-site, inner cuff, and tunnel infections)

Table 2 Search strategy

Database	Date of search (repeated search)	Search query	Search filters	Number of found publications (repeated search)
PubMed	9/5/2020 (12/08/2021)	((Peritoneal Dialysis[MeSH Terms] AND (Catheters[MeSH Terms] OR Catheters, Indwelling[MeSH Terms])) OR "PD catheter") AND remov*	Human	491 (528)
Embase	9/5/2020 (12/08/2021)	'peritoneal dialysis catheter'/exp AND 'catheter removal'/exp	-	190 (234)
Scopus	9/5/2020 (12/08/2021)	TITLE-ABS-KEY ((peritoneal AND dialysis AND catheter) AND (catheter AND remov*) AND ((kidney OR renal) transplant*))	-	216 (236)
Web of Science	9/5/2020 (12/08/2021)	(peritoneal dialysis catheter) AND (catheter remov*) AND ((kidney OR renal) transplant*)	Search for "All Fields"	144 (168)
Number of all found articles				1041 (1166)
Number of all found articles without duplications				825 (915)

peritoneal dialysis catheter removal, number of events of needing post-transplant dialysis with details, and prevalence or ratios of surgical and infectious complications (including peritonitis and other catheter-related infections).

In addition, corresponding authors of two studies were contacted to obtain some missing data. Unfortunately, no response was received after making three attempts in each case.

Quality assessment

The risk of bias for observational studies was assessed using the ROBINS-I tool [17]. This method is recommended by the Cochrane Scientific Committee when non-randomized designs are applied for the investigation of interventions. Furthermore, funnel plots were visually checked for asymmetry that might indicate publication bias. The use of the Egger test would only be justified if at least ten studies were included in the meta-analysis [18]. A GRADE evidence profile was created in the GRADEpro GDT software (https://gradepro.org/) to rate the quality of evidence regarding the primary endpoint [19, 20].

Statistical analysis

For studies with the primary event data reported, unadjusted odds ratios with 95% confidence intervals were calculated and pooled using a random effects model and the Hartung-Knapp-Sidik-Jonkman adjustment [21]. The between-study heterogeneity was evaluated with I^2 statistics. A prediction interval was also calculated to estimate the true effect size if a new study was performed. Subgroup analysis was conducted to identify potential differences between the pediatric and adult populations. Meta-analysis of proportions with a random effects model was used to calculate the pooled prevalence of needing dialysis in each group with 95% confidence intervals. Additionally, frequencies of episodes of peritonitis and other catheter-related infections were estimated with this method. All analyses were completed using the meta [22], the matafor [23], the PRISMA2020 [24], and the robvis [25] packages in R 4.2.0 statistical environment (R Core Team, 2022) [26].

Results

Study selection and characteristics

We identified 915 non-duplicate records that were independently screened by two researchers. The selection process is shown in Fig. 1. No prospective studies were found. All articles included in this qualitative and quantitative synthesis were of retrospective cohort design. Forty-five percent (18/40) of papers were excluded due to the absence of a control group. It was either not present by design or results of comparators were simply not reported. Eight studies described in nine papers (one was a conference abstract by Warren et al. which was subsequently published as a full-text article [27]) were included in the final systematic review. Results from five of them could be synthesized in a meta-analysis. A total of 338 patients were evaluated by these publications. Their characteristics and main findings are summarized in Table 3.

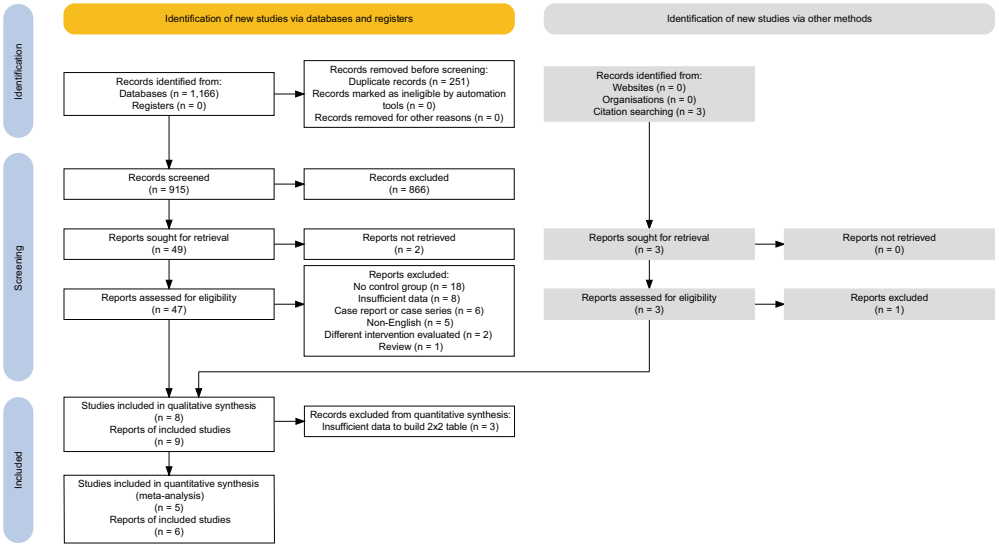

Fig. 1 PRISMA 2020 flow chart of the study screening and selection for the systematic review

Risk of bias and study quality

We used the ROBINS-I tool to assess the risk of bias in seven domains (Fig. 2). The reports were of moderate or low quality. Furthermore, a funnel plot was created (Fig. 3) but no formal test for its asymmetry was performed due to the inclusion of fewer than 10 studies. Therefore, publication bias cannot be excluded. Low heterogeneity ($I^2 < 25\%$) is present in the primary analysis regardless of the subgroup studied. The numbers of participants are small and insufficient in all papers to guarantee satisfactory power of the used statistical tests. All studies are with level 4 evidence according to the 2011 Oxford Centre for Evidence-Based Medicine Levels of Evidence [28].

The GRADE evidence profile

In Table 4, we report the GRADE evidence profile with explanations. Due to the presence of serious risk of bias, indirectness, very serious imprecision, and suspected existence of publication bias, the final certainty of evidence regarding the primary outcome was graded as very low [20, 29].

Peritransplant peritoneal dialysis management protocols

There are various standards adopted by transplantation centers regarding the management of patients undergoing renal transplantation after being maintained on peritoneal dialysis. Nevertheless, most authors agree that peritoneal dialysis catheters might be routinely removed at the time of surgery in living renal donor recipients due to a significantly lower risk of delayed graft function [11, 30–32]. In some studies, suspicion of a catheter-related (e.g., exit-site or tunnel) infection was classified as another indication for concurrent catheter removal [33–35]. Contrastingly, in some centers, such patients were temporarily excluded from the waiting list until recovery [30, 32]. A similar approach was implemented by most authors in regard to the presence of peritonitis. Safe waiting time from the recent incidence of peritonitis to transplantation was specified as between 1 and 3 weeks [32, 33].

The time to peritoneal dialysis catheter removal after successful transplantation was set at 3 months by Arbeiter et al. [34] and 8 to 12 weeks by O'Donoghue et al. [33]. Malagon and Hogg [30] did this before patients' discharge when stable graft function was confirmed. The actual interval times reported in these papers are summarized in Table 3.

Need for dialysis in the early period after transplantation

The main outcome that was analyzed in our study was the use of dialysis (any modality) up to 2 months after transplantation. By combining the data by meta-analysis with a random effects model, we calculated that odds of needing dialysis are more than twice as high for patients with the

Table 3 Studies included in the systematic review, their characteristics, and reported results

Study	Country	Number of living/deceased donor transplants	Mean/median age of patients, yr (SD)/[range]	Mean/median time to PDC removal, mo (SD)/[range]	Prevalence of peritonitis in the "in situ" group, % (*n*/*N*)	Prevalence of catheter-related infections in the "in situ" group, % (*n*/*N*)	Prevalence of catheter-related infections in the control group, % (*n*/*N*)	Successful use of the pretransplant PDC when dialysis was needed, % (*n*/*N*)
Adult patients								
Kwong et al. [11]	Canada	33/77	53.1 (13)[a]	N/A	1.1 (1/92)	N/A	0	80 (12/15)
Warren et al. [27]	Canada/UK	N/A	N/A	N/A	8.5 (10/118)	10.2 (12/118)	0	80 (12/15)[b]
Maiorca et al. [32]	Italy	0/34	39 (10)	17 (8) d	3.3 (1/30)	N/A	0	100 (6/6)
O'Donoghue et al. [33]	UK	0/241	Mean of 37.1	[0–371]	3.8 (9/234)	6.4 (15/234)	14.3 (1/7)	N/A
Pediatric patients								
Arbeiter et al. [34]	Austria	2/29	Mean of 6.8 [1–15]	Median of 3	11.1 (3/27)	18.5 (5/27)	0	N/A
Andreetta et al. [31]	Italy	9/71	Mean of 9.3 [1.7–21]	Mean of 80.3 [0–216] d	0[c]	0[c]	0[c]	100[d] (12/12)
Malagon and Hogg [30]	USA	Experimental group: 0/13; control group: 13/0	9 (4.2) [1–15]	Mean of 3.8 weeks [10 days–5 weeks]	7.7 (1/13)	15.4 (2/13)	7.7 (1/13)	N/A
Schärer and Fine [54]	Various countries[e]	N/A	All < 15	22 [2–113] d	9.4 (9/96)	N/A	N/A	N/A

Abbreviations: *N/A*, not available; *PDC*, peritoneal dialysis catheters; *SD*, standard deviation

[a]Calculated also for patients not receiving PD but reported in the study

[b]Five patients developed peritonitis, 3 others needed the conversion to hemodialysis due to dialysate-derived fluid leaks

[c]Six patients were lost to follow-up and their data were not provided — concern about the presence of bias due to missing data. Furthermore, 1 peritonitis case due to sepsis was not classified as catheter-related

[d]Additionally, 2 children restarted peritoneal dialysis at 4 and 12 months after surgery. Their pretransplant catheters were successfully used

[e]It was a questionnaire-based cooperative study involving respondents from the USA, Germany, Denmark, Canada, France, Israel, Finland, Switzerland, UK, Japan, Sweden, and the Netherlands

catheter left in situ (pooled unadjusted odds ratio, 2.21; 95% confidence interval, 1.03 to 4.73). However, given the prediction interval of 0.35 to 14.13, it is possible that in some future studies, the odds might as well be higher in the control group. None of the evaluated papers reported adjusted odds ratios. We did not find differences in the overall effect between the adult and pediatric subgroups ($Q = 0.13$, $P = 0.720$). The results of this analysis are presented in a forest plot (Fig. 4).

The prevalence of needing dialysis (within the first two postoperative months) in the experimental group was 20.9%; 95% confidence interval, 13.6 to 30.7% while for those with the catheter removed, it was 12.4%; 95% confidence interval, 5.6 to 25.2% (Fig. 5). There was a noticeable difference between the pediatric and adult populations in the group with peritoneal dialysis catheters left in place ($Q = 8.52$, $P = 0.004$; Fig. 5a).

When dialysis was necessary in the group with patients from the "in situ" group, the peritoneal dialysis catheter utilization was feasible in most cases (Table 3). However, this information was reported only in half of the evaluated papers.

Prevalence of peritonitis and other catheter-related infections

Pooled incidence of peritonitis in patients whose catheters were left in situ is 6.3%; 95% confidence interval, 4.0 to 10.0% (a study by Andreetta et al. [31] was excluded from this calculation owing to concern of bias due to missing data, Fig. 6a). For all catheter-related infections (including peritonitis as well as exit-site or tunnel infections), the pooled frequency was 10.2%; 95% confidence interval, 6.2 to 16.1% (Fig. 6b). These complications were rare in

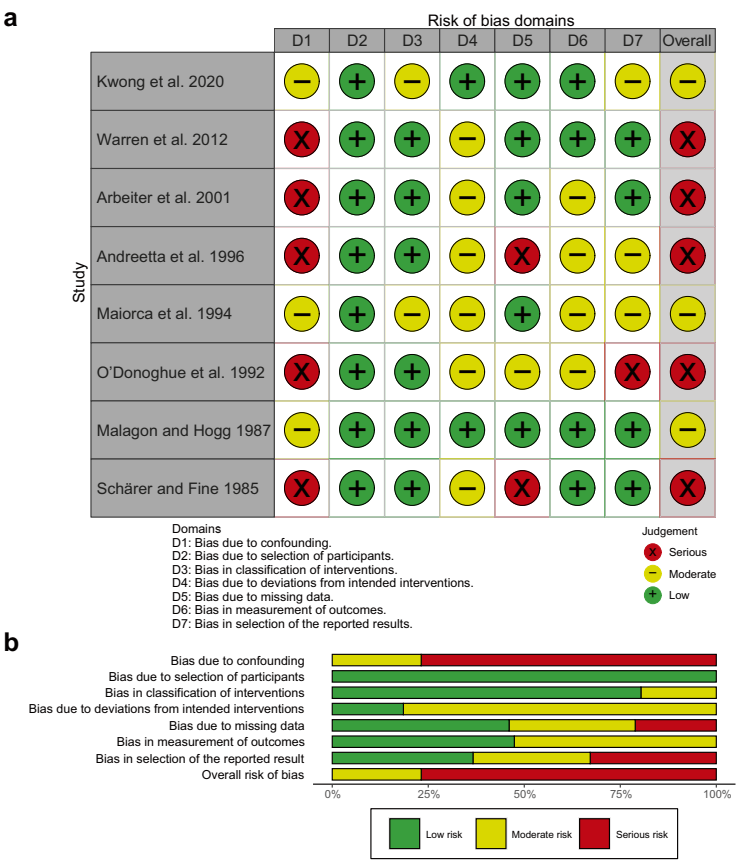

Fig. 2 "Traffic light" (**a**) and weighted bar (**b**) risk of bias charts for studies included in the systematic review

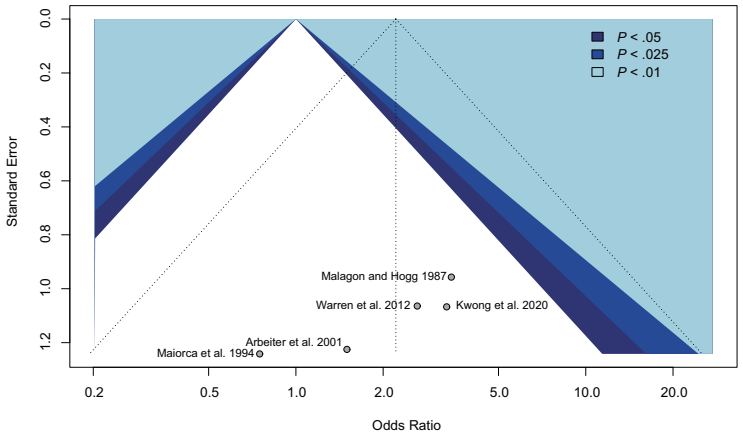

Fig. 3 Funnel plot for the assessment of publication bias

Table 4 The GRADE evidence profile

Certainty assessment								№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations		PDC left in situ	Control	Relative (95% CI)	Absolute (95% CI)		
The need for dialysis in the early period after transplantation (not later than within the first two postoperative months)													
5	Observational studies	Serious[a]	Not serious[b]	Serious[c]	Very serious[d]	Publication bias strongly suspected[e]		50/280 (17.9%)	6/58 (10.3%)	OR 2.21 (1.03 to 4.73)	100 more per 1000 (from 3 to 250 more)	⨁◯◯◯ Very low	Important

Abbreviations: *CI*, confidence interval; *OR*, odds ratio

[a]Based on the ROBINS-I tool assessment

[b]Low heterogeneity ($I^2 < 25\%$) was present regardless of the subgroup studied

[c]Due to differences between study populations and in outcome measures

[d]Fewer than 300 patients for each outcome

[e]Publication bias cannot be excluded based on the visual inspection of funnel plot asymmetry

individuals with the catheter removed at the time of transplantation. O'Donoghue et al. [33] with Malagon and Hogg [30] described only single such cases (Table 3).

Discussion

In this systematic review, we summarized the current evidence on the peritransplant management of patients with peritoneal dialysis catheters. The quality of available data is poor and the clinical question of whether peritoneal dialysis catheters should be removed at the time of surgery or not cannot be definitely answered. However, experience emerging from the published articles might be useful for clinicians and patients in the decision-making process.

The lack of evidence-based guidelines leads to the presence of varying policies adopted by different centers and specialists. Some routinely leave the catheters in situ [4, 5, 36–40] while others remove them as a rule during the transplant procedure [6, 7]. There are certain situations when indwelling peritoneal catheters should be removed before or at the time of kidney implantation, including infectious (peritonitis, exit-site/tunnel/inner cuff infection), non-infectious and mechanical (broken catheter, catheter migration, pericatheter leak, flow dysfunction, peritoneal loss of function, peritoneal membrane breach, pleuri-peritoneal communication, sclerosant peritonitis), and some rare complications (allergic reaction, organ erosion, severe infusion/pressure pain, hemoperitoneum) [41, 42]. Additionally, some authors suggest that their immediate removal ought to be considered in living donor procedures that are associated with a lower risk of delayed graft function [3, 11, 30, 31]. Some protocols of the evaluated studies had already implemented that as a rule, which resulted in the different prevalence of living donor recipients in the experimental and the control groups. We suspect that it may be a confounding factor, but its true effect could not be formally determined. Maiorca et al. [32] analyzed only deceased donor transplants. It is the only study with odds of needing dialysis lower for patients with peritoneal dialysis catheters left in situ (Fig. 4). However, the control group consisted of only four patients. Moreover, Malagon and Hogg [30] described removing the catheter only in living-donor kidney recipients. None of them had delayed graft function but two developed surgical complications which finally led to the need for dialysis. Other identified indications for simultaneous catheter removal included concurrent renal and pancreas transplantation as well as having peritoneum compromised for other reasons [3, 11, 43].

It is believed that leaving a peritoneal catheter in situ can be considered when the probability of its subsequent use is substantial. It applies mainly to deceased donor transplant recipients in whom the prevalence of delayed graft function is between 10 and 30% [44]. The risk is even higher for

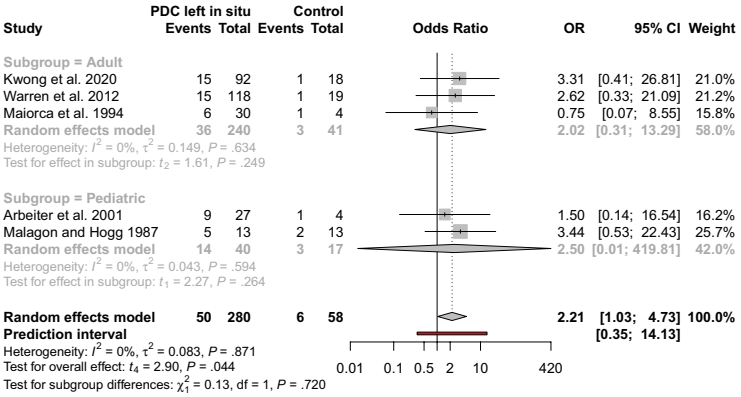

Fig. 4 Forest plot with the subgroup analysis. Non-adjusted odds ratios for the need of dialysis in patients with PD catheter left in situ (the experimental group) and those after its removal at the time of kidney transplantation (the control group). *PDC*, peritoneal dialysis catheter

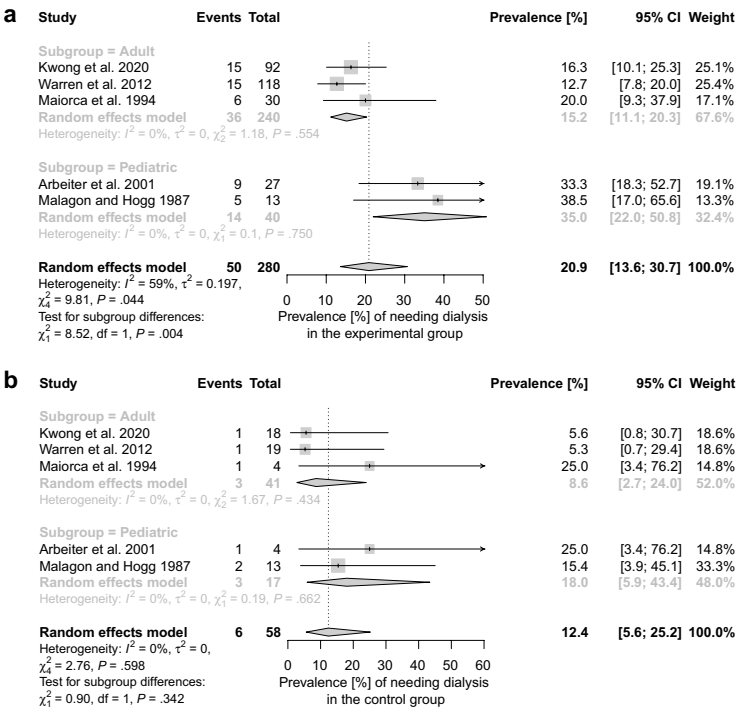

Fig. 5 Forest plots showing the pooled prevalence of needing dialysis by patients in the experimental (**a**) and control (**b**) groups

organs from extended criteria donors [35]. However, there is no consensus on how long the removal should be postponed (some studies evaluated by us report that peritoneal dialysis catheters were used mostly within the first post-transplant month [30, 34, 40]). Extended time is associated with more complications, mainly infectious, that in this group are particularly dangerous owing to immunosuppressive therapy [7, 27, 34, 45]. In our meta-analysis, we calculated that pooled prevalence of catheter-related infections in patients with Tenckhoff catheters left intact was 10.2%; 95% confidence

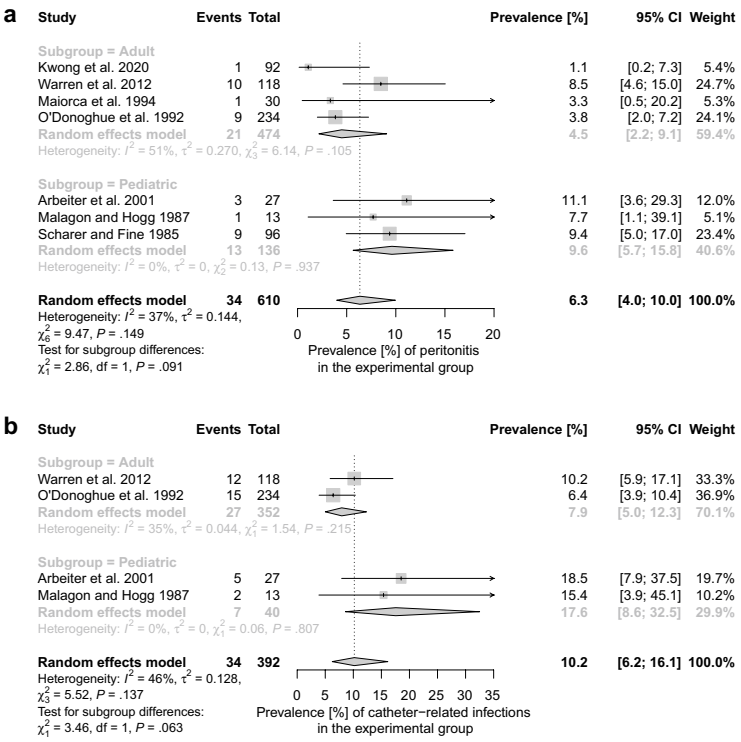

Fig. 6 Forest plots showing the pooled prevalence of peritonitis (**a**) and catheter-related infections (**b**) in patients with peritoneal dialysis catheters left in place after kidney transplantation

interval, 6.2 to 16.1% (Fig. 6b). Owing to data incompleteness, we could not evaluate the correlation between the time for which catheters were left in place and the incidence of catheter-related infections. Some authors still argue that in many cases these conditions (peritonitis, exit-site, and tunnel infections) can be managed with antibiotics and a sensible number of patients without complications still benefit from resuming peritoneal dialysis in case of early graft failure [33, 46]. However, no objective (medical and economic) data are available to support this opinion.

In a recent commentary on a case–control study by Gardezi et al. [47], Issa and Lakhani [48] proposed an algorithm for the management of peritoneal dialysis catheter in patients undergoing renal transplantation. These experts suggest leaving peritoneal dialysis catheters in place only when (1) delayed graft function is highly expected and (2) peritoneum breach as well as catheter-related infection is absent. Otherwise, it should be removed at the time of transplant or before hospital discharge. Nevertheless, the latter exposes the patient to the risk of additional surgical procedures. Moreover, the methods to predict delayed graft function in individual patients are still a matter of debate. Issa and Lakhani propose the use of Kidney Donor Profile Index (KDPI) along with several other predictive factors (such as long cold ischemia time and recipient's history of obesity, diabetes mellitus, prior allosensitization, long dialysis vintage, and waiting time) [48]. However, predictive models for delayed graft function are not well clinically validated. Furthermore, KDPI was not meant and developed to predict delayed graft function. The available evidence shows that these two factors are not even well correlated [49, 50]. The discussed algorithm should be precisely investigated in a prospective randomized clinical trial.

Using random effects meta-analysis, we calculated that patients requiring post-transplant dialysis more likely had their dialysis catheters left intact during transplantation than those not needing it (pooled unadjusted odds ratio, 2.21; 95% confidence interval, 1.03 to 4.73, Fig. 4). This finding suggests that protocols followed by the centers, from which the data were obtained, are effective to a certain extent. More individuals with peritoneal dialysis catheters left in situ needed dialysis (pooled prevalence, 20.9%; 95% confidence interval, 13.6 to 30.7% vs. 12.4%; 95% confidence interval, 5.6 to 25.2%, Fig. 5), as expected.

When dialysis was needed early after transplantation and a peritoneal dialysis catheter had not been removed at the time of surgery, some studies report that in up to 80–100% of cases peritoneal dialysis was feasible [11, 27, 31, 32]. However, in the group studied by Warren et al. [27], in five of such patients, the peritonitis occurred, and three others had to be converted to hemodialysis. In a report by Rizzi et al. [51] who analyzed 313 patients whose catheters were left during transplantation, almost 16% of them required dialysis. Among them, only 33% could benefit from peritoneal dialysis access being available — others were referred to hemodialysis. Taking into account that only for a few studies are these data known, the high prevalence of these catheters' utilization might be overestimated. In one study (excluded from the final analysis due to lack of a control group), patients requiring dialysis right after transplantation were electively hemodialyzed even with a peritoneal dialysis catheter left in situ [35]. Only those with primary non-function were transferred to peritoneal dialysis immediately (2.5%, 3/120). Such an approach stands against the fact that peritoneal dialysis catheters might be safely used early after renal transplantation [45, 52].

Patients whose peritoneal catheters had been removed at the time of transplantation might also require dialysis. They are usually treated with hemodialysis which could possibly lead to some complications. However, no undesired events were reported in the analyzed studies [11, 27]. Furthermore, McGregor [3] pointed out that many patients undergoing renal transplantations have a central line placed by an anesthesiologist. In such cases, it is relatively simple and safe to replace it with a dialysis line when necessary. Some individuals may as well be managed with peritoneal dialysis. Malagon and Hogg [30] described two living-donor graft recipients who needed dialysis because of surgical complications (kidney laceration in one case and vascular damage in the second). They had new peritoneal dialysis catheters placed during their grafts' repair surgeries and the therapy was uneventful.

The discussion about the timing of indwelling peritoneal catheter removal involves consideration of some costs and benefits. Most patients with such dialysis access left in situ during transplantation eventually require a second intervention to take it out. There are various complications linked to the presence of a foreign body in the abdomen. It is not always feasible to perform peritoneal dialysis even with the Tenckhoff or similar catheter available, as discussed above. The benefits are avoiding potential problems associated with vascular access for hemodialysis, the possibility of quick resumption to peritoneal dialysis in case of temporal or permanent graft failure, and having a route ready to drain potential ascites. However, owing to the unpleasant experience with catheter-related complications in renal graft recipients with catheters left in place, some authors declared to switch to a routine of removing them at the time of transplantation [3, 27]. As the certainty of the available is very low, we believe that ultrasound examination should be considered in select uncertain cases [53].

Limitations

This study is limited by the lack of high-quality evidence. Our synthesis was based on retrospective imbalanced studies of moderate or low quality. We summarized their findings in a meta-analysis including only 338 patients. We were only able to obtain odds ratios that were not adjusted for any of the previously identified candidate confounders. We also found relatively old articles which might not well represent current standards of care. Our report proves that further evidence is urgently needed to answer the clinical dilemma of peritransplant peritoneal dialysis catheter management. The medical community might benefit from our experience when designing future trials. As we demonstrated, there are numerous potential confounders to be controlled for when conducting retrospective studies about this problem. Taking into account that 45% of the excluded papers were lacking a control group, it is important to avoid this approach, if not justified. However, it is highly desirable in this case to design and conduct high-quality and adequately powered randomized controlled trial in both the adult and pediatric populations.

Conclusion

In conclusion, the evidence supporting the choice to remove or to leave peritoneal dialysis catheters in situ during renal transplantation is very weak. Unless supportive data are available, preferably from a randomized controlled trial, the dilemma of peritoneal dialysis catheter removal remains unsolved.

Authors' contributions PD and MZ designed this study. MZ and JN searched medical databases for eligible articles and extracted the data. PD contacted corresponding authors to obtain missing data. MZ analyzed the data statistically. All authors interpreted the results and wrote this manuscript.

Declarations

Competing interests The authors declare no competing interests.

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AHEAD OF PRINT

Peritoneal dialysis catheter removal at the time or after kidney transplantation: A multicenter cardinality-matched cohort study

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Abstract

Background. Evidence regarding the optimal timing of peritoneal dialysis catheter (PDC) removal in renal graft recipients is limited. While some centers opt for removal during the transplant procedure, others defer catheter removal to various time points post-transplantation.

Objectives. In this multicenter cardinality-matched cohort study, we aimed to determine the optimal timing of PDC removal in patients undergoing kidney transplantation.

Materials and methods. Data from 324 patients were collected across 5 centers. We compared patients who had catheters removed during renal transplant (the PDC-free group) with those who had them removed after the procedure (the PDC group), matched 1:2 by age, sex, body mass index (BMI), living, and extended criteria donor statuses. We evaluated: 1) the need for dialysis within 2 post-transplant months, 2) a composite endpoint of catheter-related infection, peritonitis and/or surgical site infection, and 3) the length of hospitalization.

Results. After cardinality matching, the groups were well-balanced across all matching covariates. Postoperative dialysis was required in 14% of patients, with no statistically significant difference observed between the PDC-free and PDC groups (19% vs 12%; odds ratio (OR) = 1.94; 95% confidence interval (95% CI): 0.78–4.81; p = 0.152). Of the 14 patients in the PDC group who required dialysis postoperatively, only 3 were managed with peritoneal dialysis. No statistically significant difference was noted for the composite endpoint (8.6% vs 6.2%; OR = 0.74; 95% CI: 0.20–2.77; p = 0.656). Hospitalization was significantly longer in patients from the PDC group (median [interquartile range (IQR)]: 11 [9–15] vs 9 [7–12]; BM = –3.036; p = 0.003).

Conclusions. This study did not demonstrate any benefits associated with delaying PDC removal in renal graft recipients. On the contrary, postponing removal was linked to prolonged hospitalization.

Key words: kidney transplantation, peritoneal dialysis, delayed graft function, catheter-related infections

Highlights

- No clear evidence exists on the optimal timing for peritoneal dialysis catheter removal in kidney transplant recipients.
- This is the first multicenter, cardinality-matched cohort study comparing outcomes of peritoneal dialysis catheter removal at the time of transplantation versus delayed removal.
- Study results do not support routine delayed peritoneal dialysis catheter removal after kidney transplantation.
- Peritoneal dialysis catheter management in renal transplant patients should follow an individualized approach, based on comprehensive risk–benefit analysis and patient-centered care.

Background

The perioperative care of peritoneal dialysis patients undergoing renal transplantation involves addressing various challenges across the preoperative, intraoperative and postoperative phases.[1] These include but are not limited to optimizing dialysis, controlling the increased risk of catheter-related infections, including peritonitis, balancing fluid volume and nutritional statuses, monitoring surgical wound healing, ensuring rejection surveillance, and establishing alternative acute or chronic renal replacement therapy in case of graft failure or loss.[2] Another dilemma that transplant surgeons face is related to providing peritoneal dialysis catheter (PDC) management that is most beneficial for the renal recipient. The problem can be summarized by the clinical question of whether PDCs should be left intact or removed during the transplant procedure.[3]

Unfortunately, there is currently no consensus or robust evidence to guide transplant teams on the optimal timing for PDC removal in renal graft recipients.[3,4] Different centers and individual transplant surgeons follow various policies. These include routine removal of the catheters at the time of transplant[3–8] or postponing it until various postoperative time points.[9,10] The European Best Practice Guidelines for peritoneal dialysis suggest they can be left intact for around 3–4 months following transplantation even if good graft function is observed.[11] However, these guidelines, published in 2005, have never been updated (also by other peritoneal dialysis expert groups or societies) and faced criticism due to their methodological constraints.[12]

A recent systematic review and meta-analysis concerning 8 non-randomized studies of interventions did not provide a definitive answer to the question about optimal catheter removal in renal graft recipients due to the high risk of bias of the included studies.[13] It showed that several factors should be taken into account when planning perioperative and post-transplant catheter management, i.e., the risk of early graft dysfunction requiring renal replacement therapy (including acute and chronic dialysis), the risk of infectious or other catheter-related complications, as well as the patient's preferences.

According to Gardezi et al.,[14] patients receiving peritoneal dialysis are more likely to undergo kidney transplantation compared to those on hemodialysis. Similar trends are also observed in Poland where around 4% (4.24% in 2021 and 4.17% in 2022) of dialyzed patients are treated with peritoneal dialysis.[15] Taking that into account, there is an increasing need to provide objective evidence to help clinicians and patients plan optimal dialysis catheter management to ensure the best possible transplant outcome, including quality of life, and potentially reduce the number of subsequent hospitalizations and costs.

Objectives

The objective of this retrospective cohort study was to determine the optimal timing of PDC removal in renal graft recipients by comparing patients with catheters removed at the time of and after kidney transplantation, concerning the incidence of requiring dialysis after the procedure, infectious complications and the length of hospitalization.

Materials and methods

Study design

We conducted a multicenter retrospective cardinality-matched cohort study in peritoneal dialysis patients undergoing kidney transplantation. The reporting of this study conforms to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) and Strengthening the Reporting of Cohort Studies in Surgery (STROCSS) 2021 guidelines.[16,17]

Ethical approval

Ethical approval and informed consent collection were waived by the local Ethics Committee of the Medical University of Warsaw, Poland (decision No. AKBE/26/2021) due to the retrospective character of this study. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Setting and participants

Retrospective data concerning adult (≥18 years old) renal graft recipients previously managed with peritoneal dialysis were collected from patient's medical records across 5 kidney transplant centers in Poland. Patients transplanted between 2010 and 2021 were considered eligible for inclusion, ensuring at least 1 year of follow-up. We excluded patients with PDCs removed more than 1 day before the transplant procedure, those who underwent multiorgan transplantation, or individuals with Bricker ileal conduit urinary diversion. Patients with unknown group assignment (no information on whether the PDC was removed at the time or after kidney transplantation) or with missing matching variables were also excluded from the final analyses.

Both deceased donor (all after brain death) and living donor renal transplant procedures were included in the study. The PDC removal timing was at the discretion of the transplant surgeon or other treating physician. Some of them preferred removing the catheters at the time of transplantation, while others postponed it. The achievement of stable graft function most commonly defined the time of delayed removal.

Variables

Medical records from transplant wards and outpatient clinics were searched to collect recipients' and donors' age, sex, body mass index (BMI), subjects' cumulative dialysis vintage (in months), and number of episodes of peritonitis before and after transplantation. Donor characteristics, including extended criteria and living donor status, were identified. Renal graft's cold ischemia, vascular anastomosis and operative times (all in minutes), graft storage modality (including simple cold storage, hypothermic machine perfusion and their combination), and PDC placement site were extracted. Information about the use of central line catheters during surgery, surgical drainage placement, as well as length of hospitalization and surgical drainage use (both in days) were collected. Data concerning intraoperative peritoneum breaches, ascites, urinary leakage, urinary tract infections, catheter-related infections, delayed graft function (defined as the need for dialysis within 7 post-transplant days), types of dialysis used following surgery, and peritoneal dialysis removal time after transplantation (in days), and 1-year graft survival were evaluated.

Study endpoints

The primary endpoint was the incidence of needing dialysis within 2 post-transplant months.[13] Secondary objectives included a composite endpoint defined as the incidence of catheter-related infection, peritonitis and/or surgical site infection, as well as the length of hospitalization.

Cardinality matching

All patients were assigned to the group of recipients whose PDCs were removed at the time of renal transplantation (the PDC-free group) or after the procedure (the PDC group). Cardinality matching[18] was used to match patients 1:2 by 5 covariates, i.e., kidney recipient's age, sex, BMI, living, and extended criteria donor statuses. These factors were selected based on the discussion and consensus among the co-authors, following the evaluation of a web of causation and literature search (to identify factors affecting both the peritoneal dialysis removal and the need for dialysis early after transplantation). Cardinality matching uses advanced programming techniques to find the largest matched sample balanced by prespecified covariates without relying on, and thus overcoming some limitations of, the propensity scores or coarsened covariate values.[19–21] The matching was performed using the MatchIt package[22] in R with the optimization performed by the HiGHs optimization solver.[23] An imbalance between the groups was considered when absolute mean differences were greater than 0.1.

Study size

Assumptions for sample size calculation were based on the study by Kwong et al.[24] and the recent meta-analysis of observational studies.[13] Setting α error at 0.05, β error at 0.2, the allocation ratio 1:2 and assuming the proportion for the primary endpoint at 0.19 in the PDC and 0.05 in the PDC-free group, we calculated the required sample size of 186 (62 subjects in the PDC and 124 in the PDC-free group). The calculations were performed using a priori sample size calculation for Fisher's exact test in G*Power v. 3.1.9.7 (Heinrich Heine University, Düsseldorf, Germany, 2020).[25]

Statistical analyses

Continuous variables were summarized using means with standard deviations (SDs) or medians with interquartile ranges (IQRs), depending on whether the normal distribution was determined using the QQ plot, histogram and the Lilliefors test assessment. The Lilliefors test was given priority over other assessments when evaluating the distribution of continuous data. Categorical covariates were expressed as the number of observations and percentages. No imputation was used to replace missing data (missing data were deleted pairwise). Differences between the groups for categorical variables were evaluated using Fisher's exact (when an expected value was less than 5) or χ^2 tests of independence, as appropriate. For continuous variables, the permuted Brunner–Munzel test was used.

In the matched cohort, the average marginal treatment effect was evaluated with G-computation using robust confidence intervals.[26] For the primary and secondary

composite endpoints, logistic regression models with the matching variables as covariates, and matching weights included, were created. The results were presented using odds ratios (ORs) and robust 95% confidence intervals (95% CIs). Assumptions of the logistic regression models were verified using the Box–Tidwell test, Variance Inflation Factor evaluation and Cook's distance analysis. The Bonferroni correction was applied to account for multiple comparisons. A two-sided p-value less than 0.0167 (to account for the multiple tests performed) was considered statistically significant. All calculations, statistical tests and visualizations were performed using the MatchIt,[22] HiGHS,[23] cobalt,[27] ggplot2,[28] easyalluvial,[29] tableone,[30] and marginaleffects[31] packages in R v. 4.3.2 (R Foundation for Statistical Computing, Vienna, Austria).

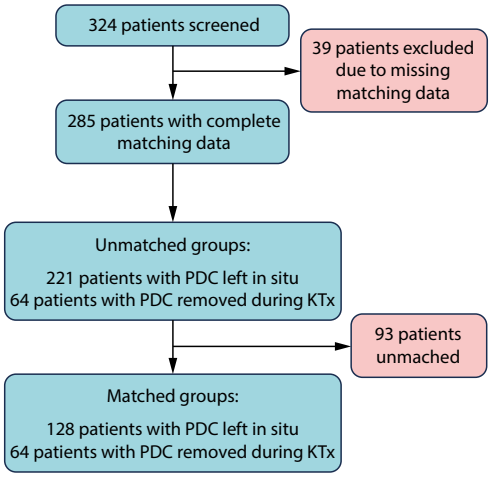

Fig. 1. Study flowchart

PDC – peritoneal dialysis catheter; KTx – kidney transplantation.

Results

Sample characteristics

We collected data from 324 patients from 5 transplant centers. After excluding those with missing data for the matching or grouping variables, 324 were considered eligible for inclusion. In the final analysis, 64 patients from the PDC-free group were matched 1:2 with 128 patients assigned to the PDC group (a total sample size of 192). The flow of patients in the study is summarized in Fig. 1.

After the cardinality matching was conducted, 2 groups balanced (absolute standardized mean difference (SMD) <0.1) in terms of all matching variables were established (Fig. 2,3). The studied population consisted of 47% of females (48% in the subgroup of kidney recipients who had their PDCs removed after and 45% in those with catheters removed at the time of surgery). The operative time was longer in patients with catheters removed at the time of surgery (median [IQR]: 150 [130–181] vs 130 [105–156] min; BM = 3.403, p = 0.002). The peritoneum was left intact following the procedure in 66% (84/128) of subjects from the PDC group and 64% (41/64) of those from the PDC-free group (χ^2_1 = 0.046, p = 0.830). A central venous catheter was inserted more often in the PDC-free group (90% vs 53%; χ^2_1 = 25.991, p < 0.001). Surgical drainage was utilized

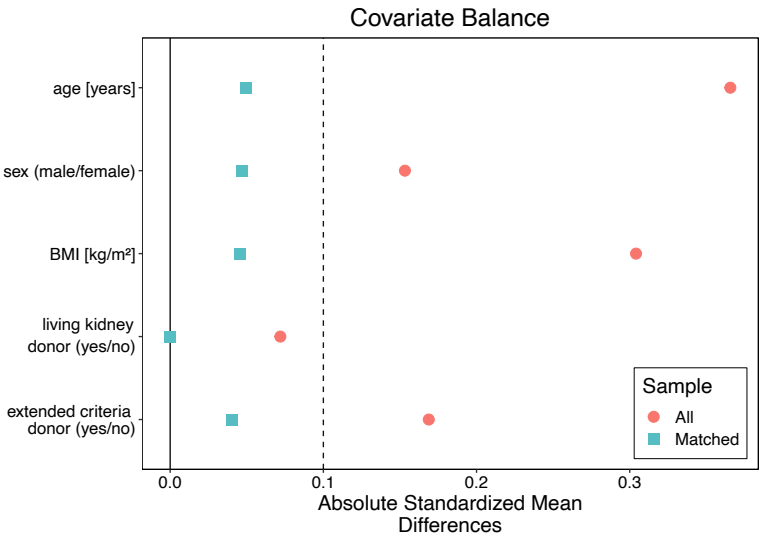

Fig. 2. Absolute standardized mean differences before and after cardinality matching

BMI – body mass index.

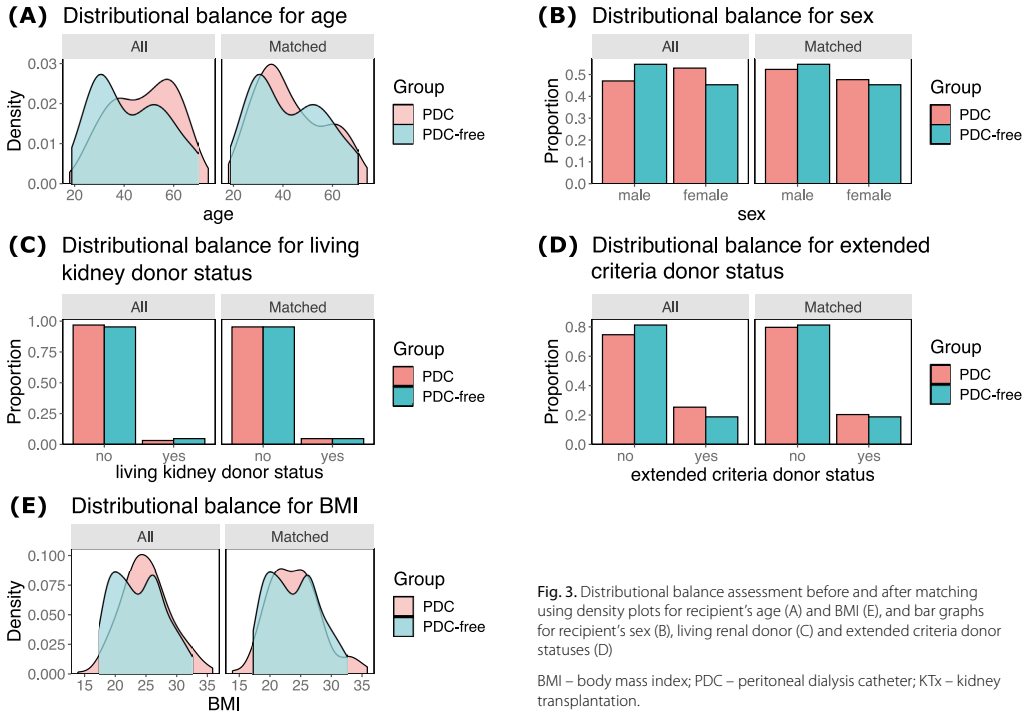

Fig. 3. Distributional balance assessment before and after matching using density plots for recipient's age (A) and BMI (E), and bar graphs for recipient's sex (B), living renal donor (C) and extended criteria donor statuses (D)

BMI – body mass index; PDC – peritoneal dialysis catheter; KTx – kidney transplantation.

in 97% of subjects (98% in the PDC and 95% in the PDC-free group; p = 0.336). The median [IQR] time to PDC removal in the PDC group was 64 [42–97] days (the shortest time was 6 days and the longest one 243). Key baseline characteristics of the studied population are summarized in Table 1, while operative and postoperative characteristics are presented in Table 2.

Primary and secondary endpoints

The primary endpoint, defined as the need for dialysis within 2 post-transplant months was observed in 19% of patients from the PDC-free and 12% of patients from the PDC group, with no statistically significant difference noted between the groups (OR = 1.94; 95% CI: 0.78 – 4.81; p = 0.152, Table 3). Only 3 out of 14 subjects with PDCs available underwent peritoneal dialysis (Table 2). Similarly, no clinically and statistically significant difference was identified for the secondary composite endpoint of the incidence of catheter-related infections, peritonitis and/or surgical site infections. It was detected in 6.2% of patients with PDCs removed at the time of transplant and in 8.6% of recipients with catheters removed after the surgery (OR = 0.74; 95% CI: 0.20 – 2.77; p = 0.656, Table 4). These outcomes are presented graphically in Fig. 4 and Fig. 5. No significant differences were also identified when catheter-related infections other than peritonitis, peritonitis and surgical site infections were evaluated separately (Table 2).

The length of hospitalization was statistically significantly shorter in the PDC-free group (median [IQR], 9 [7–12] vs 11 [9–15] days; BM = –3.036, p = 0.003).

Discussion

In this pragmatic cardinality-matched cohort study, we showed that there was no statistically significant difference in the incidence of needing dialysis within the first 2 post-transplant months between patients whose PDCs were left in situ during kidney transplantation and those whose catheters were removed at the time of the procedure. Accordingly, we could conclude that the current decision-making based solely on the surgeon's discretion is not optimal and fails to predict which patients could potentially benefit from postponing the catheters' removal. Therefore, we seek to determine more objective factors to guide the medical practice on the optimal peritransplant management of peritoneal dialysis patients.

Interestingly, in our study, more patients had their Tenckhoff catheters left in place than removed at the time of transplantation. A similar proportion was

Table 1. Baseline demographic and clinical characteristics of patients before and after matching

Variable		Unmatched comparisons				Matched comparisons			
		overall (n = 285)	PDC group (n = 221)	PDC-free group (n = 64)	ASMD	overall (n = 192)	PDC group (n = 128)	PDC-free group (n = 64)	ASMD
Recipient's age* [years]		48 [35–58]	49 [37–58]	40 [31–54]	0.384	40 [32–54]	40 [33–53]	40 [31–54]	0.051
Recipient's sex: Female*		146/285 (51%)	117/221 (53%)	29/64 (45%)	0.153	90/192 (47%)	61/128 (48%)	29/64 (45%)	0.047
Recipient's BMI* [kg/m^2]		24.8 (3.9)	25.1 (3.9)	23.9 (4.0)	0.306	24.0 (4.0)	24.1 (4.1)	23.9 (4.0)	0.045
Dialysis vintage [months]		19 [12–36]	21 [12–36]	16 [10–25]	0.372	17 [11–33]	18 [12–36]	16 [10–25]	0.256
Donor's age [years]		48 [35–57]	48 [34–57]	48 [37–54]	0.075	48 [35–56]	48 [34–56]	48 [37–54]	0.010
Donor's sex: Female		85/284 (30%)	68/221 (31%)	17/63 (27%)	0.084	55/191 (29%)	38/128 (30%)	17/63 (27%)	0.060
Donor's BMI [kg/m^2]		25.4 [23.1–27.7]	25.6 [23.1–27.7]	25.1 [23.1–27.7]	0.035	25.1 [22.9–27.5]	25.1 [22.9–27.4]	25.1 [23.1–27.7]	0.043
Living renal donor*		10/285 (3.5%)	7/221 (3.2%)	3/64 (4.7%)	0.078	9/192 (4.7%)	6/128 (4.7%)	3/64 (4.7%)	<0.001
Extended criteria donor*		68/285 (24%)	56/221 (25%)	12/64 (19%)	0.159	38/192 (20%)	26/128 (20%)	12/64 (19%)	0.039
Cold ischemia time† [min]		1211 (551)	1286 (533)	1005 (552)	0.520	1159 (559)	1259 (542)	1005 (552)	0.465
Episodes of peritonitis before KTx'	0	229/265 (86%)	173/202 (86%)	56/63 (89%)	0.109	158/183 (86%)	102/120 (85%)	56/63 (89%)	0.121
	1	26/265 (9.8%)	21/202 (10%)	5/63 (7.9%)		17/183 (9.3%)	12/120 (10%)	5/63 (7.9%)	
	2	6/265 (2.3%)	5/202 (2.5%)	1/63 (1.6%)		4/183 (2.2%)	3/120 (2.5%)	1/63 (1.6%)	
	3	4/265 (1.5%)	3/202 (1.5%)	1/63 (1.6%)		4/183 (2.2%)	3/120 (2.5%)	1/63 (1.6%)	
PDC site: Right		68/228 (30%)	48/179 (27%)	20/49 (41%)	0.299	50/149 (34%)	30/100 (30%)	20/49 (41%)	0.228

Continuous variables were summarized using means (standard deviation (SD)) or medians (interquartile range (IQR)), while the categorical ones as n (%). PDC – peritoneal dialysis catheter; KTx – kidney transplantation; ASMD – absolute standardized mean difference (calculated using the tableone package in R); BMI – body mass index. * Matching covariates. † Data were missing for 31 subjects from one of the transplant centers participating in the study.

presented in a study by Warren et al,.[5] who analyzed data from 2 centers in the UK. Unfortunately, it is impossible to retrospectively evaluate why this approach was preferred. What could give some hints is the longer cold ischemia time in the PDC group (Table 2) which, however, was not associated with a higher risk of needing dialysis early after transplantation. Nevertheless, feasible is the evaluation of whether attempts of peritoneal dialysis following transplantation were successful. The results are not very promising. Only 3 out of 14 patients (3 out of 27 in the unmatched cohort, Table 2) requiring dialysis underwent peritoneal dialysis despite having Tenckhoff catheters left intact during their transplant procedures. Reports based on large databases prove that there is potential to use peritoneal dialysis more frequently. In France, according to a report by the Biomedicine Agency from 2013, only 5.1% of patients with failed allografts receive peritoneal dialysis[32] while in the USA this figure was at 16% (data from the United States Renal Data System).[33] Furthermore, the patients' preferences are also important to consider when selecting between various dialysis modalities following graft failure. These are highly individualized and usually depend on various factors, including, i.a., individual circumstances, medical history, lifestyle considerations, experience, expectations, and perceptions.[34] Nevertheless, this is also influenced by the actual availability of both dialysis modalities and whether patients are provided by their healthcare providers or insurers with the option to choose between them.

Assuming that both the clinical team and the patient would consider having a PDC left in place during the transplant procedure, a question remains: How to predict the risk of needing dialysis after the procedure? There are 2 main different scenarios when dialysis might be needed shortly after kidney transplantation, i.e., in case of delayed graft function or primary non-function/early graft loss. Unfortunately, the process of restarting any type of dialysis after kidney transplant failure is not well addressed in clinical guidelines.[35] In the meta-analysis of 8 non-randomized studies of intervention from 2022, the pooled prevalence of needing dialysis early after transplantation for any reason was 15.2% (95% CI: 11.1–20.3%) in patients with PDCs removed at the time of transplantation and 8.6% (95% CI: 2.7–24%) in the group with Tenckhoff catheters removed after surgery.[13] A similar trend was noted in the current study (19% vs 12%), despite cold ischemia time being longer in the PDC group (Table 1). Over a decade ago, a good and practical concept of using web-based calculators to predict delayed graft function was proposed by Irish et al.[36] A similar tool could be developed to help predict primary non-function. Considering the better availability of high-volume real-world data and recent advancements in calculation techniques, we recommend revisiting this idea and creating newer validated predictive models. Bearing in mind the high variability in population characteristics among various continents and countries, it would be appropriate to include as diverse and big a population as possible.

Another dilemma that might appear is whether it is safe to proceed with peritoneal dialysis shortly after kidney

Table 2. Operative and post-transplant characteristics of the patients

Variable		Unmatched comparisons				Matched comparisons			
		overall (n = 285)	PDC group (n = 221)	PDC-free group (n = 64)	ASMD	overall (n = 192)	PDC group (n = 128)	PDC-free group (n = 64)	ASMD
Graft storage modality'	simple cold storage	183/275 (67%)	139/215 (65%)	44/60 (73%)	0.223	122/185 (66%)	78/125 (62%)	44/60 (73%)	0.259
	hypothermic machine perfusion	90/275 (33%)	74/215 (34%)	16/60 (27%)		62/185 (34%)	46/125 (37%)	16/60 (27%)	
	simple cold storage/ hypothermic machine perfusion	2/275 (0.7%)	2/215 (0.9%)	0/60 (0%)		1/185 (0.5%)	1/125 (0.8%)	0/60 (0%)	
Anastomosis time [min]		35 [30–41]	35 [29–41]	33 [30–40]	0.100	33 [30–40]	35 [29–40]	33 [30–40]	0.190
Operative time [min]		135 [105–160]	130 [105–155]	150 [130–181]	0.517	135 [105–160]	130 [105–156]	150 [130–181]	0.565
Intact peritoneum after KTx		189/284 (67%)	148/220 (67%)	41/64 (64%)	0.068	125/192 (65%)	84/128 (66%)	41/64 (64%)	0.033
Central line used during KTx		178/276 (64%)	121/213 (57%)	57/63 (90%)	0.827	121/184 (66%)	64/121 (53%)	57/63 (90%)	0.918
Surgical drainage used after KTx		276/283 (98%)	215/219 (98%)	61/64 (95%)	0.162	186/191 (97%)	125/127 (98%)	61/64 (95%)	0.179
Length of surgical drainage use [days]		3 [2–4]	3 [2–4]	3 [2–5]	0.225	3 [2–4]	3 [2–4]	3 [2–5]	0.361
Length of hospitalization† [days]		11 [8–15]	12 [9–17]	9 [7–12]	0.408	10 [8–14]	11 [9–15]	9 [7–12]	0.274
Infectious complications*		29/285 (10%)	25/221 (11%)	4/64 (6.2%)	0.180	15/192 (7.8%)	11/128 (8.6%)	4/64 (6.2%)	0.090
Urinary tract infection		66/273 (24%)	53/210 (25%)	13/63 (21%)	0.110	38/186 (20%)	25/123 (20%)	13/63 (21%)	0.008
Surgical site infection		17/275 (6.2%)	14/212 (6.6%)	3/63 (4.8%)	0.080	10/187 (5.3%)	7/124 (5.6%)	3/63 (4.8%)	0.040
Episodes of peritonitis after KTx	0	263/272 (97%)	201/210 (96%)	62/62 (100%)	0.299	180/183 (98%)	118/121 (98%)	62/62 (100%)	0.225
	1	9/272 (3.3%)	9/210 (4.3%)	0/62 (0%)		3/183 (1.6%)	3/121 (2.5%)	0/62 (0%)	
PDC-related infection other than peritonitis after KTx		8/274 (2.9%)	7/212 (3.3%)	1/62 (1.6%)	0.109	4/185 (2.2%)	3/123 (2.4%)	1/62 (1.6%)	0.059
Ascites		3/276 (1.1%)	3/213 (1.4%)	0/63 (0%)	0.169	3/187 (1.6%)	3/124 (2.4%)	0/63 (0%)	0.223
Urinary leakage		13/280 (4.6%)	6/218 (2.8%)	7/62 (11%)	0.339	9/190 (4.7%)	2/128 (1.6%)	7/62 (11%)	0.405
Delayed graft function		36/284 (13%)	25/220 (11%)	11/64 (17%)	0.167	23/192 (12%)	12/128 (9.4%)	11/64 (17%)	0.232
Needing dialysis within 2 post-transplant months‡		41/281 (15%)	29/218 (13%)	12/63 (19%)	0.156	27/192 (14%)	15/128 (12%)	12/64 (19%)	0.197
Use of peritoneal dialysis after KTx	hemodialysis	36/39 (92%)	24/27 (89%)	12/12 (100%)	0.500	23/26 (88%)	11/14 (79%)	12/12 (100%)	0.739
	peritoneal dialysis	3/39 (7.7%)	3/27 (11%)	0/12 (0%)		3/26 (12%)	3/14 (21%)	0/12 (0%)	
Graft functioning 1 year after KTx		240/261 (92%)	189/207 (91%)	51/54 (94%)	0.122	163/174 (94%)	112/120 (93%)	51/54 (94%)	0.046
PDC removal time [days]		–	69 [42–100]	–	–	–	64 [42–97]	–	–

Continuous variables were summarized using means (standard deviation (SD)) or median (interquartile range (IQR)) while the categorical ones as n (%). PDC – peritoneal dialysis catheter; KTx – kidney transplantation; ASMD – absolute standardized mean difference (calculated using the tableone package in R); BMI – body mass index. * the composite secondary endpoint defined as the incidence of catheter-related infections, peritonitis, and/or surgical site infection; † the secondary endpoint; ‡ the primary endpoint.

transplantation. Potentially high risk of peritoneal breaches might be concerning to surgeons. In our study, despite grafts being implanted extraperitoneally, the peritoneum was assessed by surgeons to be intact in around 65% of cases, without any notable differences between the evaluated groups. According to Issa and Lakhani,[37] a compromised peritoneum is an indication to remove the PDC during a renal transplant. Nevertheless, in the absence of contraindications, the evidence about peritoneal dialysis initiation shortly after transplantation is compelling and suggests that such treatment is safe.[38] Furthermore, a randomized controlled trial (RCT) proved that it is feasible and safe to use PDCs even immediately after insertion.[39] In that study, no relevant differences were noted when patients with urgent and delayed utilization groups were compared regarding catheter-related complications and catheter survival within 1 year following the insertion. Another doubt might be related to the concern of potential infectious complications, including catheter-related infections and peritonitis.[4,5] The results of our study did not show such trends which is consistent with other reports.[13] We did not identify clinically relevant increased rates of peritonitis shortly after transplantation among patients with catheters left in situ. However, we were not able to evaluate long-term results.

Unfortunately, there is still insufficient evidence available to compare the 2 approaches to peritransplant PDC management in terms of the patient's outcomes, including

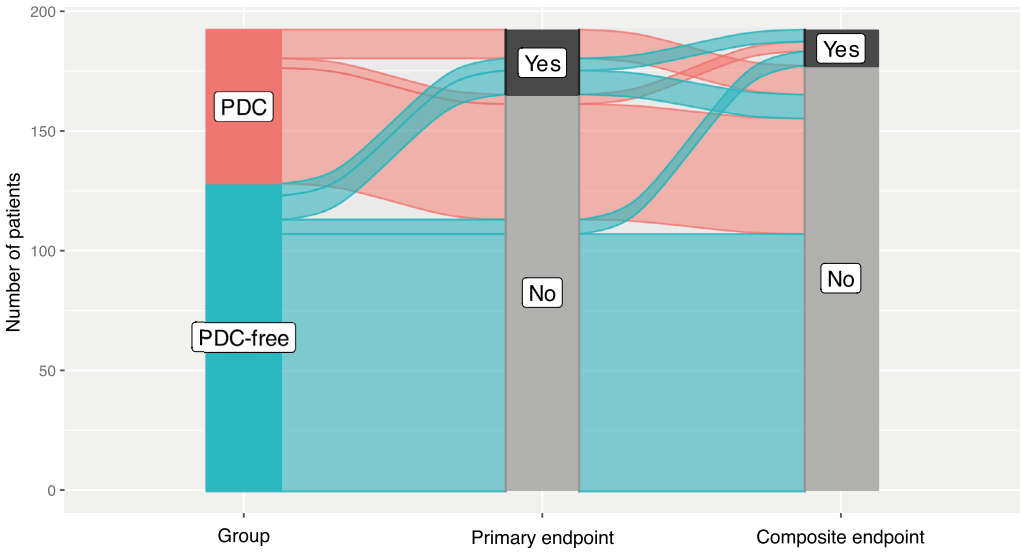

Fig. 4. Alluvial diagram summarizing rates for the primary and secondary composite endpoints. Number of flows: 7. Maximum weight of a single flow: 55.7%

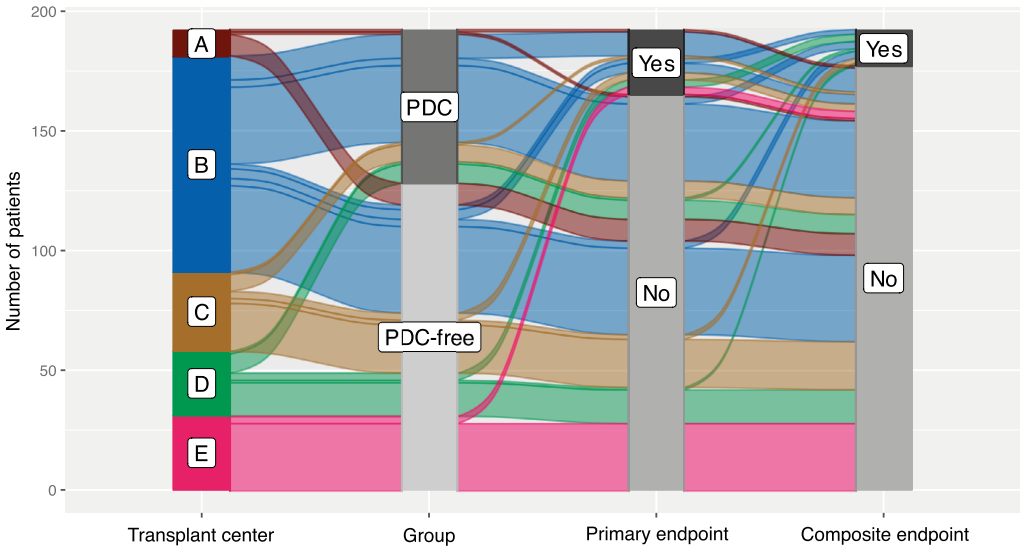

Fig. 5. Alluvial diagram summarizing rates for the primary and secondary composite endpoints, split by the participating transplant center. Number of flows: 22. Maximum weight of a single flow: 18.8%

overall graft survival and quality of life, as well as short and long-term costs. We noticed that the removal of PDCs during surgery prolongs the procedures by around 20 min. The costs to the healthcare system can go up when the catheters are left intact due to the need for subsequent hospitalizations and procedures required to eventually remove them. Costs and additional risks might be also related to potential complications associated with such interventions, including those related to the use of general anesthesia that might be used in some cases. Unfortunately, the retrospective nature of data collection and the variability in local treatment practices limited our ability to evaluate such complications in detail. However, what was identified in our study is that patients with catheters left

Table 3. Logistic regression model for the primary endpoint analysis

Covariate	OR	95% CI	p-value
Peritoneal dialysis catheter removal			
After kidney transplant	–	–	0.152
At the time of kidney transplant	1.94	0.78–4.81	
Recipient's age*	1.00	0.93–1.08	0.963
Recipient's sex*			
Male	–	–	0.768
Female	1.24	0.29–5.26	
Recipient's BMI*	1.09	0.88–1.35	0.442
Living kidney donor*			
No	–	–	0.539
Yes	3.17	0.08–126.31	
Extended criteria donor*			
No	–	–	0.319
Yes	2.64	0.39–17.89	

*Matching variables. OR – odds ratio; 95% CI – 95% confidence interval; BMI – body mass index.

Table 4. Logistic regression model for the composite secondary endpoint analysis

Covariate	OR	95% CI	p-value
Peritoneal dialysis catheter removal			
After kidney transplant	–	–	0.656
At the time of kidney transplant	0.74	0.20–2.77	
Recipient's age*	0.96	0.90–1.10	0.928
Recipient's sex*			
Male	–	–	0.217
Female	0.30	0.04–2.05	
Recipient's BMI*	1.00	0.74–1.35	0.993
Living kidney donor*			
No	–	–	<0.001
Yes	8.2×10^{-7}	1.5×10^{-8} –4.4×10^{-5}	
Extended criteria donor*			
No	–	–	0.192
Yes	6.11	0.40–92.40	

*Matching variables. OR – odds ratio; 95% CI – 95% confidence interval; BMI – body mass index.

in situ stayed statistically significantly longer in the hospital after their transplant procedures. The hospitalization prolongation was about 2 days, which for patients on immunosuppression may be considered clinically significant due to increased risk of hospital-acquired infections. This outcome has an uncertain origin and, to our knowledge, was not described before. We hypothesize that it might be related to the desire to observe such patients more closely for signs of potential catheter-related infections early after transplantation. It could also be related to delayed graft function or the need for dialysis before the initial discharge. However, delayed graft function was more frequent in the PDC-free group (17% vs 9.4%, Table 2). It is also possible that it was due to some other unidentified factors.

With an increasing number of patients using peritoneal dialysis worldwide, the dilemma of Tenckhoff catheter removal in such patients might become more frequent and put a more noticeable burden on healthcare systems in the future. What is worth pointing out is that based on various, often negative experiences, some authors declared to switch to a routine of removing PDCs during kidney transplantation.[3–5]

Limitations

The present study study is limited by its retrospective design. This issue was mitigated by the use of cardinality matching, which yielded satisfactory results in terms of getting balanced groups. Nevertheless, the risk of unmeasured confounding persists.[19] Despite including patients from 5 transplant centers and setting a broad data collection period, the sample size was not very big. This proves that although an RCT would be the best method to answer the studied dilemma, it requires a large number of participating sites and countries and/or a long enrollment period which would significantly increase its potential costs. In contrast, no external funding was needed to complete this matched cohort study which to some extent emulates a true RCT.[19,40] Moreover, cardinality matching is thought to bring some advantages in the setting of a small sample size when compared to other observational data analysis methods.[41] Our data can be used to power a prospective study. What should be considered in future research that could not be evaluated in ours are patient-reported outcomes, including quality of life and satisfaction assessments.

Conclusions

We did not identify any significant benefits from postponing PDC removal in patients undergoing kidney transplantation. Neither clinically nor statistically significant differences were noted for the need for dialysis within 2 post-transplant months when patients with catheters removed at the time and after the procedure were compared. Postponed catheter removal was not associated with an increased rate of infectious complications. However, it was associated with prolonged hospitalization. An individual approach based on a detailed risk-benefit assessment and patient preferences should be taken into account when planning PDC management in renal graft recipients.

Data Availability Statement

The datasetssupporting the findings of the current study are openly available in the Open Science Framework (OSF) repository at DOI 10.17605/OSF.IO/8A4RW.

Consent for publication

Not applicable.

Use of AI and AI-assisted technologies

Not applicable.

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Podsumowanie i wnioski

Wyniki omawiane w przedstawionym cyklu trzech publikacji przyczyniają się do rozwoju wiedzy o optymalnym postępowaniu okołooperacyjnym u pacjentów poddawanych przeszczepieniu nerki. W szczególności dostarcza on danych, które mogą pomóc klinicystom ocenić, czy zasadne jest rutynowe stosowanie profilaktycznego drenażu chirurgicznego po przeszczepieniu nerki, a także podjąć decyzję, kiedy usunąć cewnik do dializ otrzewnowych u biorców graftu nerkowego.

Pierwsza praca [1] porównywała biorców nerki z założonym drenem chirurgicznym po przeszczepieniu z grupą osób bez drenażu. Analiza wyników tego badania nie wykazała istotnej statystycznie różnicy dla żadnego z ocenianych punktów końcowych: częstości występowania zbiorników okołonerkowych (iloraz szans [OR] 0,77; 95% przedział ufności [CI] 0,28-2,17), zakażeń miejsca operowanego (OR 1,64; 95% CI 0,11-24,88), torbieli limfatycznych (OR 0,61; 95% CI 0,02-15,27), krwiaka (OR 0,71; 95% CI 0,12-3,99), a także rozchodzenia się brzegów rany pooperacyjnej (OR 0,75; 95% CI 0,21-2,70). Ze względu na braki danych nie uzyskano zbiorczych wyników dla takich powikłań, jak przeciek moczu, utrata czynności przeszczepionej nerki, utrata graftu, czy reoperacja.

W drugim artykule [2] porównano pacjentów, u których odroczono usunięcie cewnika do dializ otrzewnowych z pacjentami, u których usunięto go jednoczasowo z przeszczepieniem nerki. Metaanaliza wykazała iloraz szans dla pierwszorzędowego punktu końcowego w postaci potrzeby dializy we wczesnym okresie potransplantacyjnym: OR 2,21; 95% CI 1,03-4,73. Stosując metaanalizę proporcji, wyliczono zbiorczą częstość zapalenia otrzewnej (6,3%; 95% CI 4,0-10,0%) oraz zakażeń związanych z cewnikiem do dializ otrzewnowych (10,2%; 95% CI 6,2-16,1%) u pacjentów, którym nie usunięto go w czasie przeszczepienia nerki. Za pomocą narzędzia GRADE (ang. Grading of Recommendations Assessment, Development and Evaluation) [19] poziom dowodu oceniono na bardzo niski.

W trzeciej pracy [3] będącej wieloośrodkowym retrospektywnym badaniem kohortowym porównywano pacjentów, którym cewnik do dializ otrzewnowych usunięto w czasie operacji przeszczepienia nerki z pacjentami, u których tego dokonano w późniejszym okresie. Nie wykazano istotnej statystycznie różnicy w konieczności dializoterapii w ciągu pierwszych dwóch miesięcy po przeszczepieniu (OR 1,94; 95% CI 0,78-4,81; p=0,152) ani częstości zakażeń związanych z cewnikiem, zapalenia otrzewnej i/lub zakażeń miejsca operowanego (OR 0,74; 95% CI 0,20-2,77; p=0,656). W badaniu tym wykazano, że pacjenci z cewnikiem usuniętym jednoczasowo z transplantacją nerki mieli istotnie statystycznie krótszy czas hospitalizacji (mediana [przedział międzykwartylowy], 9 [7-12] vs. 11 [9-15] dni; BM=-3,036, p=0,003).

Wyniki te pozwalają wysunąć następujące wnioski:

1. Wyniki przeglądu systematycznego z metaanalizą wykazały niewystępowanie istotnego klinicznie zarówno korzystnego jak i niekorzystnego wpływu na pojawienie się zbiornika okołonerkowego, torbieli limfatycznych, krwiaka, a także rozchodzenia się brzegów rany pooperacyjnej jako potencjalnych następstw stosowania profilaktycznego drenażu chirurgicznego po przeszczepieniu nerki. Przemawia to przeciwko jego rutynowemu stosowaniu.

2. Analiza danych z przeglądu systematycznego z metaanalizą nieinterwencyjnych badań obserwacyjnych oraz wieloośrodkowego retrospektywnego badania kohortowego wykorzystującego cardinality matching nie wykazała istotnych korzyści wynikających z rutynowego odraczania usunięcia cewnika do dializ otrzewnowych u dorosłych biorców nerki przeszczepionej. Decyzja o czasie usunięcia takiego cewnika wymaga indywidualnego podejścia do sytuacji danego pacjenta, jednak jego usunięcie podczas operacji transplantacji nerki pozwala uniknąć dodatkowych hospitalizacji i ryzyk z tym związanych.
3. Zaobserwowano pozytywną korelację między krótszym czasem hospitalizacji a usuwaniem cewnika do dializ otrzewnowych jednoczasowo z przeszczepieniem nerki.

Oświadczenie Komisji Bioetycznej przy Warszawskim Uniwersytecie Medycznym

Komisja Bioetyczna
przy Warszawskim Uniwersytecie Medycznym

Tel.: 022/ 57 - 20 -303
Fax: 022/ 57 - 20 -165

ul. Żwirki i Wigury nr 61
02-091 Warszawa

e-mail: komisja.bioetyczna@wum.edu.pl
www.komisja-bioetyczna.wum.edu.pl

Warszawa, dnia 08 luty 2021r.

AKBE/26 / 2021

Dr hab. n. med. Piotr Domagała
Katedra i Klinika Chirurgii Ogólnej i Transplantacyjnej
Instytut Transplantologii
ul. Banacha 1a
02-097 Warszawa

OŚWIADCZENIE

Niniejszym oświadczam, że Komisja Bioetyczna przy Warszawskim Uniwersytecie Medycznym w dniu 08 luty 2021 r. przyjęła do wiadomości informację na temat badania pt.:"Usuwanie cewnika dializacyjnego w trakcie lub po przeszczepieniu nerki: jednoośrodkowe badanie kliniczno-kontrolne."
Przedstawione badanie nie stanowi eksperymentu medycznego w rozumieniu art. 21 ust. 1 ustawy z dnia 5 grudnia 1996 r. o zawodach lekarza i lekarza dentysty(Dz.U. z 2018 r. poz. 617) i nie wymaga uzyskania opinii Komisji Bioetycznej przy Warszawskim Uniwersytecie Medycznym, o której mowa w art. 29 ust. 1 ww. ustawy.

Przewodnicząca Komisji Bioetycznej

Prof. dr hab. n. med. Magdalena Kuźma –Kozakiewicz

Oświadczenia wszystkich współautorów publikacji

Warszawa , 22/01/2024

lek. Joanna Nowaczyk

OŚWIADCZENIE

Jako współautor pracy pt. **Prophylactic intra-abdominal drainage following kidney transplantation: a systematic review and meta-analysis** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zaplanowanie koncepcji, zbieranie danych, wstępną analizę, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 20%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **60%**,
Obejmował on: zaplanowanie koncepcji i metodologii pracy, przeprowadzenie przeglądu literatury, zbieranie danych, analizę statystyczną, interpretację wyników oraz napisanie manuskryptu.

Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Joanna Nowaczyk (22.01.2024 10:42 GMT+1)

(podpis oświadczającego)

Warszawa , 28/01/2024

dr hab. n. med. Piotr Domagała

OŚWIADCZENIE

Jako współautor pracy pt. **Prophylactic intra-abdominal drainage following kidney transplantation: a systematic review and meta-analysis** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zaplanowanie koncepcji, zbieranie danych, wstępną analizę, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 20%.

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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

.....

(podpis oświadczającego)

Warszawa , 19/01/2024

lek. Joanna Nowaczyk

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a systematic review and meta-analysis** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: przeprowadzenie przeglądu literatury, zbieranie danych, wstępną analizę, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 15%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **65%**,
Obejmował on: zaplanowanie koncepcji i metodologii pracy, przeprowadzenie przeglądu literatury, zbieranie danych, analizę statystyczną, interpretację wyników oraz napisanie manuskryptu.

Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Joanna Nowaczyk (19.01.2024 18:11 GMT+1)

(podpis oświadczającego)

Warszawa , 28/01/2024

dr hab. n. med. Piotr Domagała

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a systematic review and meta-analysis** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zaplanowanie koncepcji i metodologii, wstępną analizę, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 20%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **65%**,
Obejmował on: zaplanowanie koncepcji i metodologii pracy, przeprowadzenie przeglądu literatury, zbieranie danych, analizę statystyczną, interpretację wyników oraz napisanie manuskryptu.

Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

.....

(podpis oświadczającego)

Warszawa 03.02.2024
(miejscowość, data)

Piotr Niecikowski
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **15%**,
Obejmował on: zaplanowanie koncepcji i metodologii pracy, przeprowadzenie przeglądu literatury, zbieranie danych, analizę statystyczną, interpretację wyników oraz napisanie manuskryptu.

Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Piotr Niecikowski
(podpis oświadczającego)

Warszawa , 05/02/2024

prof. dr hab. n. med. Magdalena Durlik

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **15%**,
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

M.Durlik
M.Durlik (05.02.2024 09:42 GMT+1)

(podpis oświadczającego)

Warszawa , 22/01/2024

lek. Joanna Nowaczyk

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Obejmował on: zaplanowanie koncepcji i metodologii pracy, przeprowadzenie przeglądu literatury, zbieranie danych, analizę statystyczną, interpretację wyników oraz napisanie manuskryptu.

Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Joanna Nowaczyk (22.01.2024 10:52 GMT+1)

(podpis oświadczającego)

Warszawa , 24/01/2024

Jan Broda

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **15%**,
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Jan Broda 24.01.2024 10:50 GMT+1)

(podpis oświadczającego)

W-wa 23/01/24
(miejscowość, data)

BARTOSZ FORONCEWICZ
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Prof. dr hab. n. med.
Bartosz Foroncewicz
Kierownik Kliniki Chorób Wewnętrznych
Nefrolog, Transplantolog

(podpis oświadczającego)

Warszawa , 07/02/2024

prof. dr hab. n. med. Krzysztof Mucha

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Krzysztof Mucha 7/2/2024
Krzysztof Mucha 7/2/2024 (07.02.2024 13:47 GMT+1)

(podpis oświadczającego)

Katowice, 08/02/2024r.
(miejscowość, data)

Monika Nidera
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Nidera
(podpis oświadczającego)

Katowice 23.01.24
(miejscowość, data)

Robert Król
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

(podpis oświadczającego)

Poznań , 01/02/2024

dr n. med. Honorata Stadnik

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Honorata Stadnik
Honorata Stadnik (01.02.2024 19:19 GMT+1)

(podpis oświadczającego)

Poznań , 22/01/2024

prof. dr hab. n. med. Marek Karczewski

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Marek Karczewski (22.01.2024 11:57 GMT+1)

(podpis oświadczającego)

Kraków , 23/01/2024

dr n. med. Tomasz Kruszyna

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Tomasz Kruszyna (23.01.2024 00:51 GMT+1)

(podpis oświadczającego)

Kraków , 23/01/2024

lek. Bogdan Niekowal

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Bogdan Niekowal
Bogdan Niekowal (23.01.2024 22:48 GMT+1)

(podpis oświadczającego)

Wrocław , 05/02/2024

Justyna Korus

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Justyna Korus (05.02.2024 00:16 GMT+1)

(podpis oświadczającego)

Wrocław , 23/01/2024

dr hab. n. med. Dorota Kamińska, prof. UMW

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **15%**,
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Dorota Kamińska
Dorota Kamińska (23.01.2024 21:07 GMT+1)

(podpis oświadczającego)

Wrocław , 22/01/2024

prof. dr hab. n. med. Magdalena Krajewska

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Magdalena Krajewska
Magdalena Krajewska (22.01.2024 15:53 GMT+1)

(podpis oświadczającego)

Warszawa , 29/01/2024

prof. dr hab. n. med. Maciej Kosieradzki

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zbieranie danych, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **15%**,
Obejmował on: zaplanowanie koncepcji i metodologii pracy, przeprowadzenie przeglądu literatury, zbieranie danych, analizę statystyczną, interpretację wyników oraz napisanie manuskryptu.

Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

Maciej Kosieradzki
Maciej Kosieradzki (29.01.2024 12:25 GMT+1)

(podpis oświadczającego)

Warszawa , 28/01/2024

dr hab. n. med. Piotr Domagała

OŚWIADCZENIE

Jako współautor pracy pt. **Peritoneal dialysis catheter removal at the time or after kidney transplantation: a mulicenter cardinality-matched cohort study** oświadczam, iż mój własny wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: zaplanowanie koncepcji i metodologii, wstępną analizę, interpretację wyników oraz napisanie manuskryptu.
Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Wkład lek. **Michała Zawistowskiego** w powstawanie publikacji określam jako **15%**,
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Jednocześnie wyrażam zgodę na wykorzystanie w/w pracy jako część rozprawy doktorskiej lek. Michała Zawistowskiego

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(podpis oświadczającego)

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