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PERITONEAL DIALYSIS AND PERITONITIS : A SYSTEMATIC REVIEW

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Abstract

The chronic kidney disease (CKD) epidemic is a problem that affects people all over the world. The incidence and frequency of renal failure have both been on the increase, and this trend has been seen in a variety of different countries. Renal failure is correlated with unfavorable outcomes and high costs. Patients who have chronic kidney disease should have an early diagnosis and treatment of the underlying cause, as well as secondary preventative measures, if possible. This action may halt, or at the very least, significantly slow down the course of the illness. Patients who need urgent medical care for their CKD should spend their attention on the following: delaying or halting the course of CKD, detecting and treating pathological symptoms of CKD, and timely planning for long-term renal replacement therapy. Peritoneal dialysis, sometimes referred to as PD, is a treatment for kidney failure in which the lining of the abdomen, commonly referred to as the belly, is used in order to filter blood internally inside the body. This treatment is frequently referred to as "belly dialysis." Infection of the peritoneum is a common and potentially life-threatening complication of peritoneal dialysis (PD). Despite the fact that there were a significant number of individuals suffering from peritonitis, the rates of recurrence, relapse, and repetition were very low. The vast majority of individuals who had peritonitis for the first time were able to achieve a full recovery from the illness. Gram-positive peritonitis was most often caused by S. epidermidis, E. faecalis, and E. coli, whereas gram-negative peritonitis was most frequently caused by E. coli. Gram-positive bacteria are the main cause of PD-associated peritonitis. Although the incidence of PD-associated peritonitis is high, they have a high cure rate.

Keyword: *Chronic Kidney Disease (CKD); Infection; Peritoneal Dialysis; Peritonitis*

INTRODUCTION

Chronic kidney disease, often known as CKD, is an umbrella term that refers to a decline in kidney function of any severity, including mild, moderate, and severe chronic kidney impairment. Chronic kidney disease (CKD) is a global issue for public health. In many different nations, there has been a rise in the incidence and frequency of renal failure, which is associated with poor outcomes and expensive expenses.[1] The number of patients with chronic kidney failure in Indonesia continues to increase and it is estimated that the growth is around 10% every year. Currently there is no epidemiological study on the prevalence of chronic kidney disease in Indonesia. From data from several nephrology centers in Indonesia, it is estimated that the prevalence of chronic kidney disease is between one hundred and one hundred fifty per one million population.[2]

According to research conducted by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), one in ten persons in the United States is affected by CKD at some point in their lives.[3] Early diagnosis and treatment of the underlying cause and/or secondary prevention is very important in patients with CKD. This step can delay or possibly stop the progression of the disease. Patients in need of prompt medical management of CKD should focus on the following: delaying or stopping CKD progression, diagnosing and treating pathological manifestations of CKD, and timely planning for long-term renal replacement therapy.[4,5]

The process of kidney dialysis may be divide into two categories: hemodialysis and peritoneal dialysis. There are benefits and drawbacks associated with each kind of renal replacement treatment. The choice of dialysis modality is influenced by a variety of factors, including the patient's ability to tolerate large amounts of fluid, comorbid conditions, socio-economic status, dialysis center, patient's home situation, and the surgical method utilized by the clinician. Other factors include availability and convenience.[6]

Peritoneal dialysis, also known as PD, is a therapy for kidney failure in which the lining of the abdomen, sometimes known as the belly, is used to filter blood internally inside the body. This process is referred to as lining the peritoneum by medical professionals. PD allows patients to retain their liberty while receiving dialysis treatment in the convenience of their own homes. The outcomes of patients are comparable to those who are treated with HD as their mode of dialysis, and the overall cost to the system is much lower. Not only may the education of patients and implementation of a PD-first strategy in all patients commencing dialysis save financial resources in the ever-growing cost of ESRD treatment, but it can also enhance patient experience and mortality rates.[7,8] In peritoneal dialysis, infectious complications and non-infectious complications are distinguished. Infections associated with peritoneal dialysis include peritonitis, infection near the catheter exit, and infection of the tube tunnel. Catheter malfunction or blockage, external leaks, abdominal wall abnormalities, scrotal edema, pleural-peritoneal fistulas, failure ultrafiltration, and encapsulated peritoneal sclerosis are noninfectious consequences of peritoneal dialysis.[9,10] Peritonitis is a frequent and serious peritoneal dialysis complication (PD). The International Society for Peritoneal Dialysis (ISPD) has published detailed recommendations on the prevention and treatment of PD-associated peritonitis, but clinical practice varies significantly between dialysis units.[11]

This article investigate the association between peritoneal dialysis and peritonitis.

METHODS

Protocol

The Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 checklist served as the framework for the development of the standards that governed the conduct of this systematic review.

Eligibility Criteria

This systematic review was created to examine articles on "peritoneal dialysis"; and "peritonitis". These are the subjects covered in the study that was considered. The following requirements must be met for your work to be taken into account: 1) Articles must be available online in their entirety; 2) Articles must be written in English; and 3) Articles must have been published after 2017, but prior to the preparation of this systematic review. Textual contributions of the following sort will not be accepted under any circumstances: 1) Editorial letters, 2) submissions without a Digital Object Identifier(DOI), and 3) article reviews and comparable submissions.

Search Strategy

The search for papers to be included in the systematic review began on 20 November 2022 using the PubMed and SagePub databases with the search terms on "peritoneal dialysis"; and "peritonitis". Where ((("peritoneal dialysis"[MeSH Terms] OR ("peritoneal"[All Fields] AND "dialysis"[All Fields]) OR "peritoneal dialysis"[All Fields]) AND ("peritoneally"[All Fields] OR "peritoneum"[MeSH Terms] OR "peritoneum"[All Fields] OR "peritoneal"[All Fields] OR "peritonism"[All Fields] OR "peritonitis"[MeSH Terms] OR "peritonitis"[All Fields])) AND (2017:2022[pdat]) is used as search keywords.

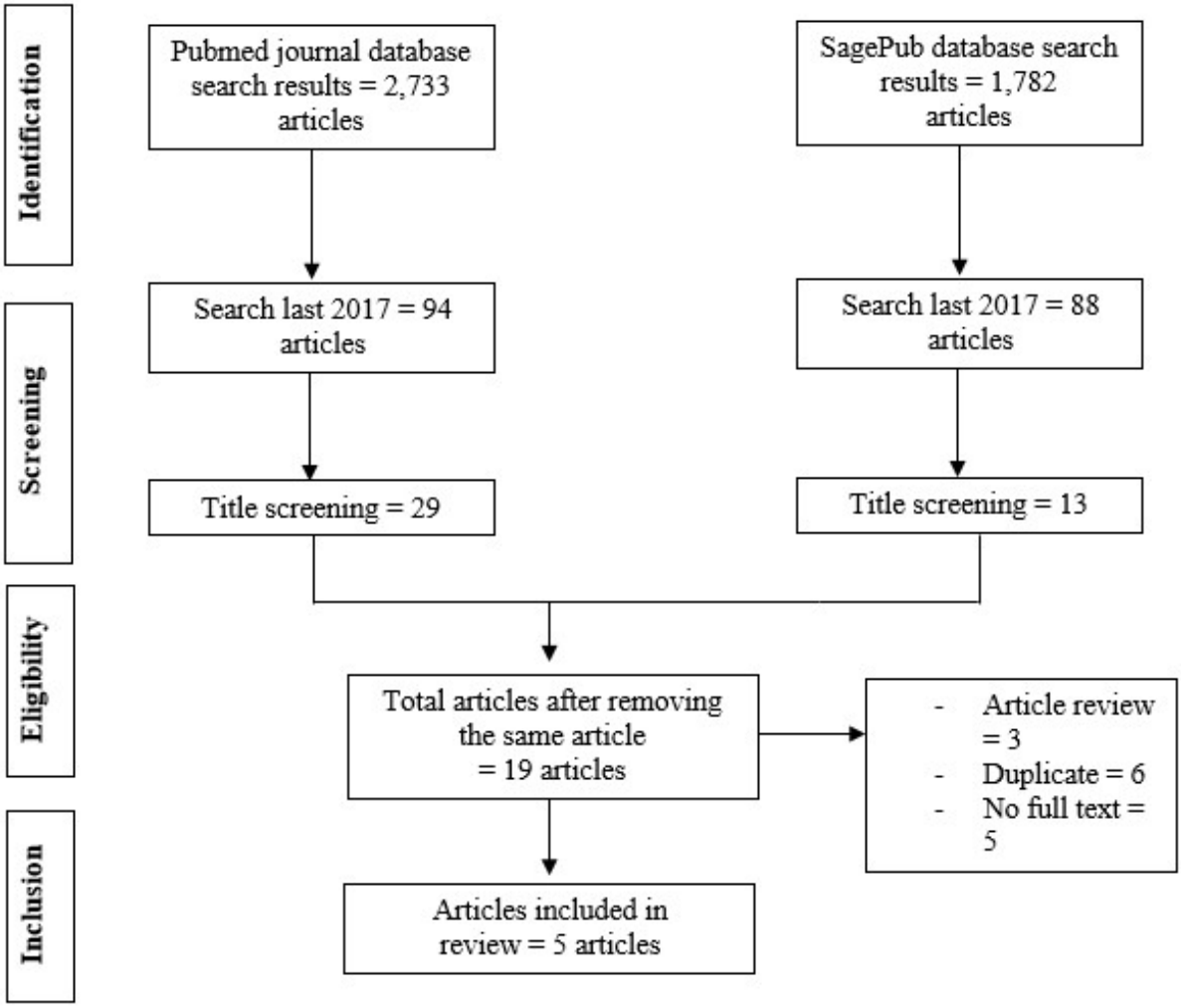

Figure 1. Article search flowchart

Data retrieval

The author of the study updated the inclusion and exclusion criteria after doing a literature review and analyzing the titles and abstracts of previously published studies. Only research studies that satisfied each and every criteria were considered throughout the development of the systematic review. Each study's title, author, publication date, study location of origin, research study design, and research variables may be gathered.

Quality Assessment and Data Synthesis

The authors performed their own independent evaluations of a subset of the research included in the titles and abstracts of the papers to decide which studies were suitable for consideration. The complete texts of the studies that meet the criteria for inclusion in the systematic review will then be examined to identify which research may be utilized for the purposes of the review.

RESULT

Study showed peritonitis occurred at a rate of 0.47 incidents per patient year. Gram-positive bacteria were the most common causal pathogens (53.5%). Infection was cured in 84.9% of peritonitis episodes, catheter removal in 11.3% of episodes, and mortality occurred in 3.8% of peritonitis episodes. A Kaplan-Meier analysis and log-rank test indicated that the group with peritonitis lived substantially longer than the group without peritonitis. When compared to the peritonitis-free group, the peritonitis group had a 67% lower risk of patient death (hazard ratio: 0.33, 95% CI 0.19-0.57, P=0.000).[12]

Table 1. The litelature include in this study

Author	Origin	Method	Sample Size / Characteristic	Result
Pavlina, 2021[12]	North Macedonia	Retrospective study	159 patients	Peritonitis occurred at a rate of 0.47 incidents per patient year. Gram-positive bacteria were the most common causal pathogens (53.5%). Infection was cured in 84.9% of peritonitis episodes, catheter removal in 11.3% of episodes, and mortality occurred in 3.8% of peritonitis episodes. A Kaplan-Meier analysis and log-rank test indicated that the group with peritonitis lived substantially longer than the group without peritonitis. When compared to the peritonitis-free group, the peritonitis group had a 67% lower risk of patient death (hazard ratio: 0.33, 95% CI 0.19-0.57, P=0.000).
Htay, 2017[13]	Australia	Retrospective study	9,362 patients	Technique failure was less likely in centers with more peritoneal dialysis patients (>29%; adjusted hazard ratio, 0.83; 95% confidence interval, 0.73 to 0.94) and more likely in smaller centers (16 new patients per year; adjusted hazard ratio, 1.10; 95% confidence interval, 1.00-1.21) and centers with fewer patients achieving target baseline serum phosphate levels (40%; adjusted hazard ratio, 1.15; 95% confidence interval, 1.00-4,00 death-censored method failure, center target phosphate was not substantially linked.
Xu, 2020[14]	China	RCT	150 patients	The technique inspection group showed a lower risk of first non-enteric peritonitis than the usual care group, while the oral education group did not show a significant benefit. The incidence of first non-enteric peritonitis in the usual care group (0.07/patient-year) was significantly higher than that in the technique inspection group (0.02/patient-year; P < 0.01) but was comparable with that in the oral education group (0.06/patient-year). Transfer to haemodialysis and all-cause mortality were not significantly different between the groups.
Hu, 2018[15]	China	Single-center cohort study	218 patients	Enterococcus peritonitis rose from 15.1% to 27.3%. Cardiovascular disease, under 55 yo, non-independent operator, low potassium, and high calcium-phosphate product were linked with peritonitis. Time to 1st episode adversely correlated with peritonitis rate (r=-0.291, P=0.001). Time to 1st episode was not associated with patient survival (P=0.151). High peritonitis patients had lower technique survival (P <0.001).
Zelenitsky, 2017[16]	Canada	Retrospective study	539 patients	In 85% of cases, a single organism caused peritonitis, and 44% involved staphylococci. 58% versus 24% of monomicrobial PDRP infections involved gram-negative organisms. 2005-2014 saw stable antimicrobial resistance. Staphylococcus epidermidis and other coagulase-negative staphylococci were 57% methicillin-resistant. MRSA accounted for 11% of S. aureus peritonitis, compared with 2% in our 1991-1998 study. Escherichia coli ciprofloxacin resistance increased from 3% to 24% between 2005 and 2014.

Htay study showed technique failure was less likely in centers with more peritoneal dialysis patients (>29%; adjusted hazard ratio, 0.83; 95% CI, 0.73-0.94) and more likely in smaller centers (16 new patients per year; aHR, 1.10; 95% CI = 1.00-1.21)and centers with fewer patients achieving target baseline serum phosphate levels (40%; aHR = 1.15; 95% CI : 1.00 to For death-censored method failure, center target phosphatewas not substantially linked. Infection, social reasons, mechanical causes, or mortality were linked with center size, percentage of PD patients, target phosphate accomplishment, automated PD exposure, icodextrin usage, and antifungal use. Adjusting for patient-specific characteristics and center-specific factors lowered method failure risks by 28% and 53%, respectively.[13]

Other study in China showed the technique inspection group showed a lower riskof first non-enteric peritonitis than the usual care group, while the oral education group did not show a significant benefit. The incidence of first non-enteric peritonitis in the usual care group (0.07/patient-year) was significantly higher than that in the technique inspection group (0.02/patient-year; P < 0.01) but was comparable with that in the oral education group (0.06/patient-year). Transfer to haemodialysis and all-cause mortality were not significantly different between the groups.[14]

Hu, *et al* study showed occurrence of enterococcus peritonitis increased from 15.1% of the first to 27.3% of the later episodes. Multivariate logistic regression showedthat the presence of cardiovascular disease, age ≤55, non-independent operator, lower values of potassium and higher values of calcium-phosphate product were associated with peritonitis. Spearman analyses indicated that the time to the 1st episode was negatively related to the peritonitis rate (r=-0.291, P=0.001). Time-dependent Cox regression showed no association between the time to the 1st episode and patient survival (P=0.151).Patients with a high peritonitis rate (HPR) demonstrated worse technique survival (P<0.001).[15]

Study in Cana showed 85% of the patients, new episodes of peritonitis were related with a single organism, and staphylococci were implicated in 44% of those instances. Compared to monomicrobial infections, polymicrobial PDRP was found to include gram-negative organisms 58% of the time, while only 24% of monomicrobial infections did. Between the years 2005 and 2014, antimicrobial resistance remained basically unchanged. It was shown that 57% of Staphylococcus epidermidis were resistantto methicillin, whereas only 20% of other coagulase-negative staphylococci were resistant. Only 11% of S. aureus peritonitis was caused by methicillin-resistant Staphylococcus aureus (MRSA), although our prior analysis of PDRP from 1991 to 1998found that 2% of S. aureus peritonitis was caused by MRSA. The percentage of Escherichia coli strains that are resistant to ciprofloxacin rose from 3% in our earlier research to 24% between 2005 and 2014.[16]

DISCUSSION

Chronic kidney disease, often known as CKD, is an umbrella term that refers to a decline in kidney function of any severity, including mild, moderate, and severe chronic kidney impairment. There are about 3.8 million individuals throughout the globe who have reached the terminal stage of renal disease and need dialysis in order to live. It is estimated that around 11% of patients receiving dialysis are treated with peritoneal dialysis. The evaluation focuses on the more practical issues of providing medical attention to individuals in this category.[17]

Peritonitis is a frequent and serious peritoneal dialysis complication (PD). In morethan 15% of PD patients, peritonitis is the direct or significant contributing cause of mortality. Furthermore, a single episode of severe peritonitis or repeated episodes of peritonitis typically results in decreased peritoneal ultrafiltration capacity and is the leading cause of conversion to long-term hemodialysis.[13,18] Under the auspices of the International Society for Peritoneal Dialysis, guidelines on the treatment and prevention of PD-associated peritonitis have been published and amended on a regular basis throughout the last 30 years (ISPD).[19,20]

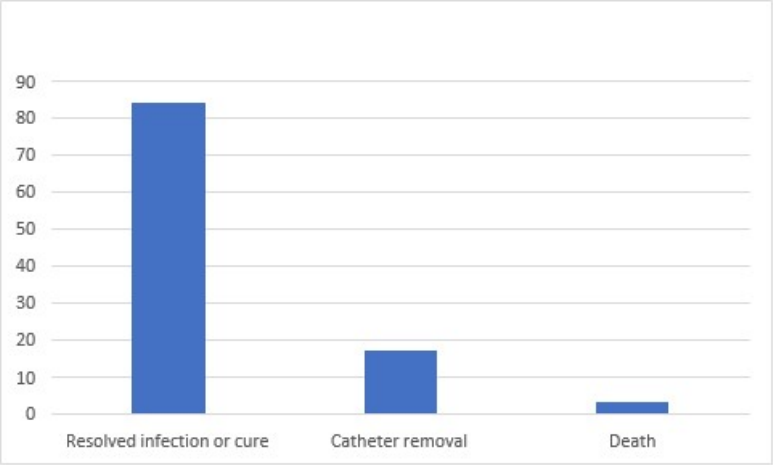

Figure 2. Outcome of a patient with peritonitis associated with PD

One set of recommendations focused on the treatment of PD-associated peritonitisand catheter-related infections, while the second set of recommendations focused on preventing these conditions. These sets of recommendations were included in the version from 2010.[20] However, in the most recent edition (2016), the guidelines for the treatment and prevention of PD-associated peritonitis were integrated into a single set. In 2017, a separate set of recommendations about catheter-related infections was issued. Due to the fact that they each prioritize various things, the exact suggestions that they provide are not completely consistent with one another.[21] Although technique inspection showed a trend toward reducing the risk of non-enteric PD-related peritonitis, neither technique inspection nor oral education significantly altered the risk of all-cause peritonitis compared with standard care. This was the case despite technique inspection showing a reduction in the risk of non-enteric PD-related peritonitis.[14]

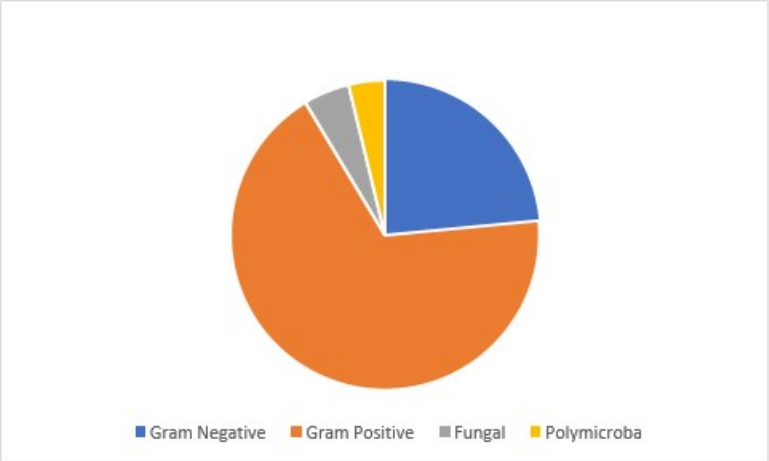

Figure 3. Causes of PD-associated peritonitis

The rates of recurrence, relapse, and repetition were rather low despite the fact that there was a relatively large number of peritonitis patients. Complete cures were attained for the majority of patients who had their first episode of peritonitis. According to the findings of our research, the patient survival rate was equivalent between those whohad a greater and lower rate of peritonitis; however, patients who had HPR had a lower technique survival rate. 75% of the patients who switched to permanent HD had experienced peritonitis, and the relatively high rate of hospital admissions in

patients withperitonitis episodes also implies an adverse effect from peritonitis. Patients who switchedto permanent HD also had a higher rate of hospital admissions than patients without peritonitis episodes.[15]

The most common types of peritonitis that we saw at our facility were caused by S. epidermidis, E. faecalis, and E. coli for gram-positive peritonitis, and by E. coli for gram-negative peritonitis. S. epidermidis was the primary gram-positive bacteria that caused peritonitis, while E. coli was responsible for the majority of the gram-negative cases that occurred. These findings are in line with the findings of more recent research. The fact that S. epidermidis is almost always found in situations of contact contamination indicates that there is an immediate and critical need to increase the quality of patient training and retraining on aseptic technique. Another result that has been made that is cause for worry is the upward trend of enterococcus peritonitis as well as the prevalenceof VRE. These findings suggest that gastrointestinal issues and the study of bacterial sensitivity patterns should get a greater amount of attention.[16,22,23]

When a PD patient presents with clinical characteristics consistent with PD- associated peritonitis, empirical antibiotic treatment should be initiated, covering both Gram-positive and Gram-negative pathogens (including Pseudomonas species). Intraperitoneal is preferable. Preventing subsequent fungal peritonitis requires antifungalprophylaxis, especially oral nystatin. Antibiotic medication may be changed based on PDeffluent Gram stain or culture and sensitivity findings. ISPD's current guidelines includedose details for each antibiotic. Depending on the organism, antibiotics last 2-3 weeks. Refractory, relapsing, or fungal peritonitis requires catheter removal and hemodialysis. After peritonitis resolves, some patients might have a replacement PD catheter. Refractory exit site or tunnel infections should also be removed. After improvements in clinical management, PD-associated peritonitis has decreased globally, supporting its usage as a first-line dialysis modality.[24]

CONCLUSION

Gram-positive bacteria are the main cause of PD-associated peritonitis. Althoughthe incidence of PD-associated peritonitis is high, they have a high cure rate.

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