ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Epidemiology Of Continuous Ambulatory Peritoneal Dialysis [CAPD] Peritonitis In A Tertiary Care Hospital – A Two Years Prospective Study.

Suwarna Uday Phute[1], Seema Umesh Kulkarni[2], and Vaibhav Vitthalrao Rajhans[3]*.

[1]Associate Professor Department of Microbiology, R K Damani Medical College ShriRamchandra Institute of Medical Sciences, Chhatrapati Sambhajinagar, Maharashtra, India.
[2]Assistant Professor Department of Microbiology, R K Damani Medical College ShriRamchandra Institute of Medical Sciences, Chhatrapati Sambhajinagar, Maharashtra, India.
[3]Professor and Head, Department of Microbiology, R K Damani Medical College ShriRamchandra Institute of Medical Sciences, Chhatrapati Sambhajinagar, Maharashtra, India.

ABSTRACT

Continuous Ambulatory Peritoneal Dialysis (CAPD) is an established treatment option for patients with End-Stage Renal Disease. About 2,50,000 patients with End-Stage Renal Disease are being treated with peritoneal dialysis worldwide. CAPD associated peritonitis is a serious complication of CAPD. A two years prospective study was performed to know the epidemiology bacteriological causality of CAPD peritonitis in a tertiary care hospital. A total of 312 patients undergoing CAPD were observed for two years. Thirty-two (32) patients fulfilling the screening criteria for CAPD peritonitis were included in the study. Thirty-seven (37) episodes of CAPD peritonitis were reported during the two years duration. Demographic data of these patients was recorded. Culture of CAPD effluent and antibiotic susceptibility were performed as per the standard guidelines. The antibiotic susceptibility data was analysed by WHONET 5.6 software. Out of 37 CAPD peritonitis episodes, incidence of CAPD peritonitis was more in female patients (64.86 %) and in the age group of 60-70 years (32.43%). Culture was positive in 25 episodes (67.25%). Out of 25, Gram positive cocci were isolated in 14 samples (56%) whereas Gram negative bacilli were isolated in 11 samples (44%). Coagulase negative *Staphylococcus species* was the commonest Gram-positive isolate. Members of *Enterobacteriaceae* family were the commonest Gram-negative isolates. The Gram-positive cocci were most sensitive to Cefoxitin and Linezolid (100%) followed by Erythromycin, Clindamycin and Penicillin G (95%). Gram negative bacilli were most sensitive to Ceftazidime, Cefepime, Piperacillin-Tazobactum and Imipenem (95%) followed by Polymyxin B (92%). There was catheter loss in one patient with infection due to multi-drug-resistant *Pseudomonas aeruginosa* and the patient was shifted to hemodialysis. There was no infection related mortality during the study period. Severe and prolonged CAPD peritonitis can lead to peritoneal membrane failure. A positive CAPD fluid culture & antibiotic susceptibility play a crucial role for efficient management of CAPD peritonitis.
Keywords: peritonitis, effluent culture, isolates

https://doi.org/10.33887/rjpbcs/2024.15.6.63

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Continuous Ambulatory Peritoneal Dialysis (CAPD) is an established treatment option for patients with End-Stage Renal Disease (ESRD). [1] More than 2.5 million people have ESRD across the globe.[2] About 2,50,000 patients with ESRD are being treated with peritoneal dialysis (PD) worldwide. PD is cost-effective. It offers a better quality of life as compared to haemodialysis. Moreover, in some settings, it may be the only available treatment option. In developing countries, PD is preferred.[3] CAPD associated peritonitis is a serious complication of PD. It causes alterations of the peritoneal membrane and peritoneal adhesions. This can make long-term treatment with PD, challenging. CAPD associated peritonitis leads to significant morbidity in the patients, increased treatment costs, transfer to haemodialysis and death.[4] The prevalence of PD-related peritonitis is up to 30% – 40% in patients during their course on dialysis.[5] Worldwide, the most common organisms associated with PD peritonitis reported are coagulase negative *Staphylococcus species* (CONS) and *Staphylococcus aureus*. Amongst the other pathogens are streptococci, *Enterobacteriaceae*, non-fermenting gram-negative bacilli and gram-positive bacilli.[6,7] The International Society for Peritoneal Dialysis (ISPD) recommends that antibiotic therapy to be adjusted based on culture results after initial empiric therapy.[8]

The current study was performed in a tertiary care hospital in Marathwada region of Maharashtra, India on the patients with CAPD.

Aims & objectives

- To derive demographic data of CAPD peritonitis.
- To establish bacteriological profile of peritonitis in CAPD patients.
- To derive antibiogram of the organisms isolated in this study.

MATERIALS AND METHODS

This was a prospective study in a tertiary care hospital at Chhatrapati Sambhajinagar, Maharashtra, India. Study duration was two years.

Signs and symptoms of CAPD peritonitis [9, 10] were noted. These were cloudy dialysis effluent, abdominal pain and tenderness, fever, nausea, vomiting, chills, erythema at the catheter site, discharge at the catheter site, catheter malfunction and drainage problems.

Following criteria were decided for the selection of patients for the study. [9, 10]

All cases meeting the diagnostic criteria for peritonitis.

- Diagnostic criteria were defined as presence of minimum three signs/symptoms related to CAPD effluent/ catheter and minimum two general signs/symptoms.
- Patients not on antibiotics at the time of specimen collection.
- CAPD effluent microscopy showing polymorphonuclear cells > 5/high power field (HPF).

Details of the patients like age, sex, duration of CAPD & ~~no.~~ number of peritonitis episodes were noted. CAPD effluent specimen was collected from the CAPD bag under all aseptic precautions.

Gram stain of primary smear of CAPD effluent was performed. Zeihl-Neelson stain for acid fast bacilli and KOH mount for detection of fungal elements were also done on the CAPD effluent.

Specimen inoculation on the culture media was performed as per the ISPD guidelines.[8]

If growth was observed in culture plates, Gram staining of the smear of colony was done to confirm the isolate as Gram positive coccus or Gram-negative bacillus. Identification of the organism was done by conventional method using biochemical tests. Catalase, coagulase, modified oxidase tests were performed for the identification of isolated Gram-positive cocci (GPC). Tests used for the identification of isolated Gram-negative bacilli (GNB) were motility, catalase, oxidase, Indole, Methyl red, Voges-Proskauer, Citrate, Triple sugar iron agar and urease.[11] Antibiotic susceptibility testing (AST) was performed by conventional method on Muller Hinton agar as per the CLSI guidelines.[12,13]

The antibiotics discs (Hi-Media) used for AST of GPC were Penicillin G, Cefoxitin, Linezolid, Co-trimoxazole, Chloramphenicol, Ofloxacin, Erythromycin, Clindamycin and Gentamicin. Antibiotic discs used for GNB were Cefuroxime-Na, ceftazidime, Cefepime, Ofloxacin, Piperacillin + tazobactum, Polymyxin B, doxycycline, Aztreonam, Co-trimoxazole, Cefotaxime, Amoxycillin-clavulanic acid and Imipenem.[12,13]

AST Data analysis was performed by WHONET 5.6 software.

OBSERVATIONS AND RESULTS

A total of 312 patients on CAPD were observed for peritonitis episodes over a duration of two years. Out of 312 patients, 37 episodes of CAPD peritonitis, fulfilling the defined selection criteria, were included in this prospective study.

Total number of patients included in the study were 32. Out of 32, in one female patient, four episodes and in two female patients, two episodes of CAPD peritonitis occurred during the study period.

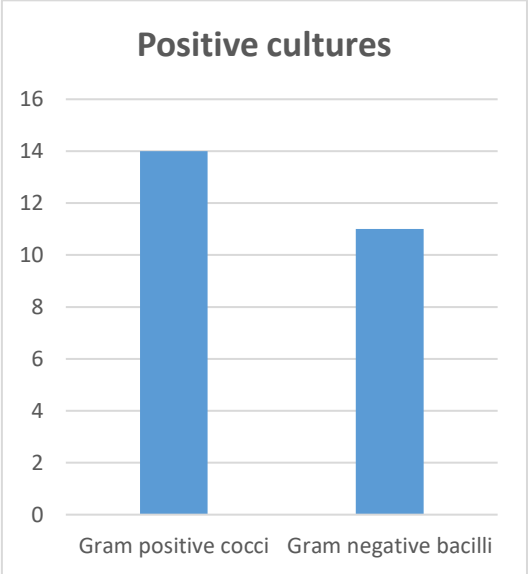
Table 1: Shows the age and sex wise distribution of CAPD peritonitis episodes.

Age group in years	Female	Male	Total
10-20	2	0	2
20-30	0	1	1
30-40	2	0	2
40-50	6	0	6
50-60	6	3	9
60-70	7	5	12
70-80	1	4	5
Total	24	13	37

Incidence of CAPD peritonitis was more in female patients (64.86 %). The highest number of CAPD peritonitis episodes was seen in the 60-70 years age group (32.43%).

Bar diagram 1 shows the culture positive CAPD effluent samples.

Bar Diagram 1

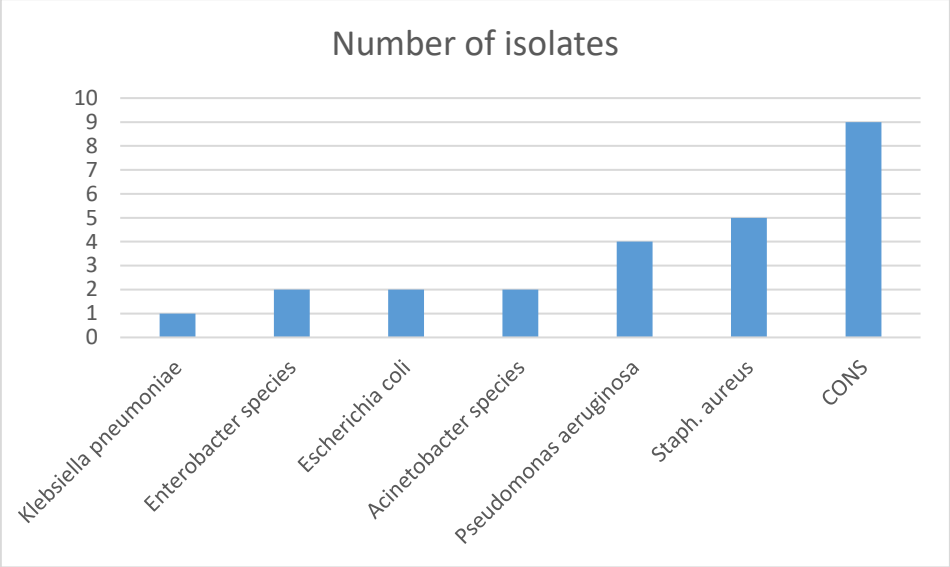


Out of 37 CAPD peritonitis effluent cultures, bacterial growth was observed in 25 samples (culture positivity 67.5%). Out of 25, GPC were isolated in 14 samples (56%) whereas GNB were isolated in 11 samples (44%).

ISSN: 0975-8585

Bar diagram 2 depicts various organisms isolated in CAPD peritonitis episodes.

Bar Diagram 2



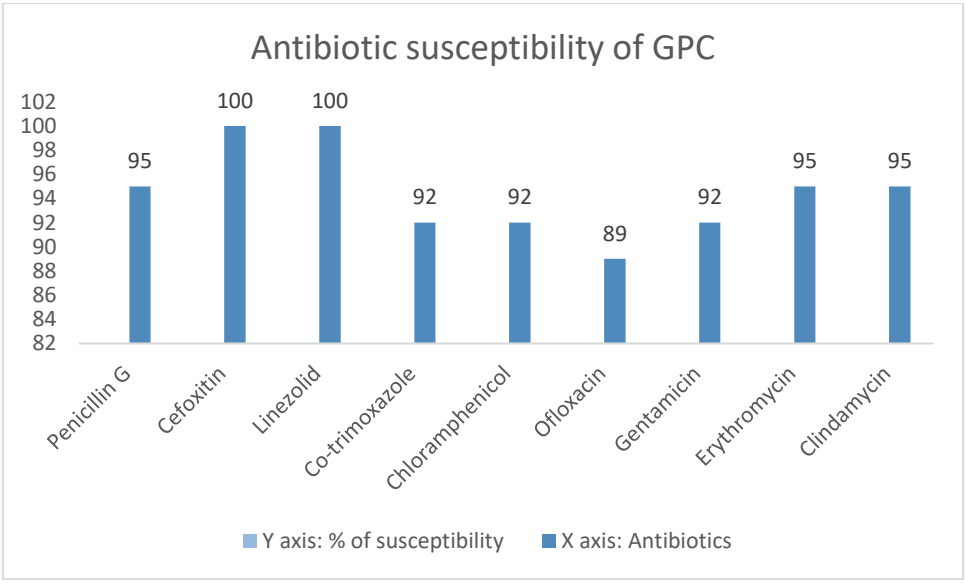
Coagulase negative *Staphylococcus species* was the commonest isolate (9 episodes i.e. 24.32%) followed by *Staphylococcus aureus* (5 episodes i.e. 13.51%) amongst the 25 culture positive samples.

No acid-fast bacilli in the Z-N stain or fungal elements in the KOH mount were detected of these CAPD peritonitis effluent samples.

Antibiotic susceptibility of the CAPD peritonitis isolates was as following.

Bar diagram 3 depicts the antibiotic susceptibility of isolated GPC.

Bar Diagram 3: Antibiotic susceptibility of GPC

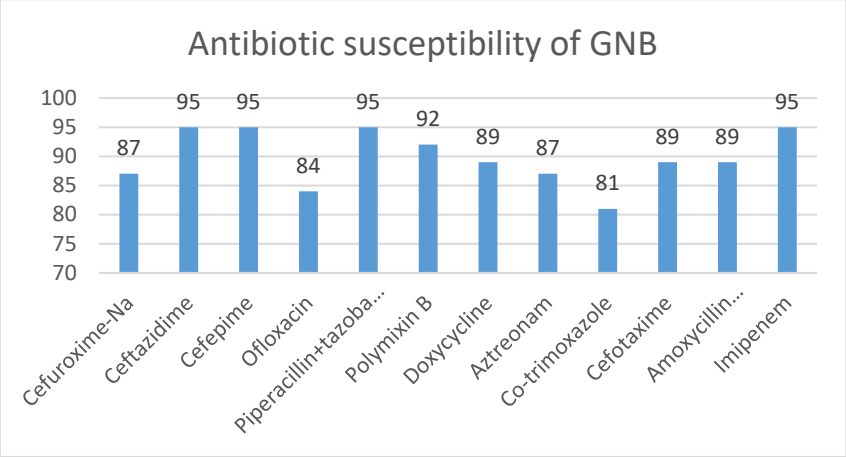


Overall, the isolated GPC were susceptible to most of the antibiotics tested. There was not a single methicillin resistant *Staphylococcus* isolate. Inducible Clindamycin resistant was not detected in any of the isolated GPC.

ISSN: 0975-8585

Bar diagram 4 depicts Antibiotic susceptibility of GNB isolated in CAPD peritonitis episodes.

Bar Diagram 4: Antibiotic susceptibility of GNB



Many isolated GNBs were susceptible to most of the antibiotics tested.

Antibiotic treatment was de-escalated from empirical to first line or second line antibiotics as per the antibiotic susceptibility report.

There were two multidrug resistant (MDR) *Pseudomonas aeruginosa* (*P. aeruginosa*) isolates. One MDR *P. aeruginosa* isolate was sensitive to Polymyxin B. Hence antibiotic treatment was escalated to Polymyxin B and the patient responded to the treatment. In the other case of CAPD peritonitis due to MDR *P. aeruginosa,* there was catheter loss (2.7%) and the patient was shifted to hemodialysis.

Mortality due to CAPD peritonitis or any other infection was 0% during the study period. Only one patient of CAPD peritonitis was shifted to hemodialysis due to catheter loss.

DISCUSSION

Peritonitis is still the leading cause of technique failure in patients on CAPD and switching the patient to hemodialysis. The incidence of peritonitis depends on various factors. These are age, race, educational background, environment, care of catheter site, immunity of the patient and the type of dialysis system used. But the outcome depends on the organisms isolated. [7,14]

In our study, out of 312 patients on CAPD, 37 episodes of peritonitis episodes were recorded. Davanport observed 863 patients on peritoneal dialysis for 2 years. They have recorded 1467 episodes of peritonitis in their study.[4] Vikrant et al have reported 36 episodes of CAPD peritonitis in 25 patients during their study period of 1.5 years.[7] Shrivastav et al, have reported 85 CAPD peritonitis episodes in 200 patients on CAPD.[15] Prasad et al, screened 211 patients for incidence of peritonitis over a period of nine years. They have reported 303 CAPD peritonitis episodes during their study period.[16] Sood et al, reported 88 episodes of CAPD peritonitis in 334 CAPD patients in a retrospective study of three years.[17]

In our study, the incidence of CAPD peritonitis episodes was more in female patients 64.86%. The highest number of CAPD peritonitis episodes were seen in the age group of 60-70 years (32.43%). In a study by Sood et al, incidence of CAPD peritonitis was more in male patients & the mean age for CAPD peritonitis episodes was 55 years.[17]

In our study, the culture positivity was 67.5%. Tanratananon et al, evaluated three different methods to improve culture-negative peritoneal dialysis-related peritonitis. Highest culture positivity in their study was 64.76% for.[18] Iyer et al, performed CAPD effluent culture by ISPD guidelines. The highest culture positivity of CAPD effluent in their study was 73%.[19] In a study by Vyver et al, there was a 51% culture-positivity in the CAPD effluent culture.[20]

In our study, the commonest isolate was coagulase negative *Staphylococcus species* (24.32%) followed by *Staphylococcus aureus* (13.51%), *Pseudomonas aeruginosa* (16%), *Acinetobacter species* (8%), *Escherichia coli* (8%), *Enterobacter species* (8%), *Klebsiella pneumoniae* (4%).

Abraham et al, performed an observational multi-centric study in India. Organisms isolated in the cumulative study data were Gram-negative (47.8%), Gram-positive (36.7%), fungal (13.3%) and *Mycobacterium tuberculosis* (2.2%).[1]Vikrant et al, have reported *Staphylococcus aureus* as the most common isolate (22.2%) followed by coagulase negative Staphylococcus species (19%) from the culture of CAPD peritonitis effluent.[7] Akoh has quoted that coagulase negative *Staphylococcus species* are the predominant causative agents for CAPD associated peritonitis followed by *Staphylococcus aureus*, worldwide. [10] Shrivastav et al, have reported fungal organisms as the commonest pathogen (11%), grown in culture, causing CAPD peritonitis followed by *Escherichia coli* (2.4%) & *Acinetobacter species* (2.4%) in their study.[15] Prasad et al, have described Gram-positive cocci, gram-negative bacilli, fungi and *Mycobacterium tuberculosis* isolates as the causative agents of CAPD peritonitis in their study. The commonest pathogens reported by them were CONS (23.4%), *Escherichia coli* (10.6%), *Pseudomonas aeruginosa* (8.6%), *Acinetobacter species* (5.6%), *S. aureus* (4.6%) and *Enterococcus species* (4.3%).[16]

Overall antibiotic susceptibility of the Gram-positive cocci, isolated in our study, was Cefoxitin (100%), Linezolid (100%), Erythromycin (95%), Clindamycin (95%), Penicillin G (95%), Co-trimoxazole (92%), Chloramphenicol (92%), Gentamicin (92%) and Ofloxacin (89%). There was no methicillin resistant *Staphylococcus species*. Inducible clindamycin resistance was not detected. Prasad et al, have reported the antibiotic resistance of GPC in their study. The resistance was the highest for Amoxycillin (CONS – 66.2%, *S. aureus* – 57.1%) followed by Gentamicin (CONS – 33.8%, *S. aureus* – 57.1%) and Ciprofloxacin (CONS – 25.3%, *S. aureus* - 35.7%). For *Enterococcus species* the highest resistance was for Ciprofloxacin (92.3%) followed by Gentamicin (84.6%).[16]

Gram negative bacilli isolated in our study were the most susceptible to Imipenem (95%), Ceftazidime (95%), Cefepime (95%), Piperacillin-Tazobactam (95%) followed by Polymyxin B (92%). The least antibiotic susceptibility was for Co-trimoxazole (81%) followed by Ofloxacin (84%). Prasad et al, have reported antibiotic resistance separately for *Enterobacteriaceae*, *Acinetobacter* and *Pseudomonas aeruginosa* separately. The highest antibiotic resistance for *Enterobacteriaceae* isolates was for Ciprofloxacin (76.1%) followed by Ceftriaxone (54.3%) and Ceftazidime (54.3%). For *Acinetobacter* isolates in their study, the highest resistance was for Ceftazidime (82.3%) followed by Ceftriaxone (64.7%) and Amikacin (47%). For *Pseudomonas aeruginosa*, the antibiotic resistance was the highest for Tobramycin (38.3%) followed by Amikacin (34.6%) and Piperacillin-Tazobactum (34.6%).[16-20]

In our study, there were two MDR *Pseudomonas aeruginosa* isolates. One of the isolates was susceptible only to Polymyxin B. The antibiotic therapy was escalated to Polymyxin B and the patient responded well. For the other MDR *Pseudomonas aeruginosa* isolate, there was catheter loss. The patient was shifted to haemodialysis. There was no infection related mortality in our study.

Infection-related mortality in PD is -around 18%. Less than 4% mortality is directly related to peritonitis.[1] Davenport has reported PD infection related mortality as 3.5 % in a two years study.[4] Vikrant et al, have reported 5.5% CAPD related infection mortality.[7] In the study by Prasad et al, there was catheter loss due to GPC infection and GNB infection was in 20 (19.6%) 36 (40.4%) respectively. They have reported shift to haemodialysis in 6 patients with GPC infection (5.8%) and 9 patients with GNB infections (10.1%). Infection related mortality was l.

CONCLUSION

Although Peritoneal dialysis is the affordable method for ESRD, severe and prolonged CAPD peritonitis can lead to peritoneal membrane failure. It ultimately may lead to changing the treatment of the patient to hemodialysis. Timely help of microbiological investigations like CAPD fluid culture & AST report can prove very essential for targeted antibiotic therapy to save the peritoneal membrane. Also, it reduces the infection related morbidity and mortality.

REFERENCES

[1] Abrahaham G, Gupta A, Prasad K , Rohit A, Bhalla A K, Billa , Chakravarti R, Das T, Dhinakaran T, Dutta A R, Giri P, Gokulnath, Jeloka T, Sampath K, Marwaha Raghavan R V, Ravichandran R, Rohit R, Sarkar C N, Singh N S K. Microbiology, clinical spectrum and outcome of peritonitis in patients undergoing peritoneal dialysis in India: results from a multicentric, observational study. Indian J Med Microbiol 2017 Oct-Dec; 35(4):491-498. doi: 10.4103/ijmm.IJMM_17_392.

[2] Liyanage T, Ninomiya T, Jha V, Neal B, Patrice H M, Okpechi I, Zhao v, Jicheng L, Garg A X, Knight J, Rodgers A, Gallagher M, Kotwal S, Cass A, Perkovic V. Worldwide access to treatment for end-stage kidney disease: A systematic review. Lancet. 2015; 385(9981):1975-82.

[3] Li PK, Chow K M, Luijtgaarden M W M V, Johnson D W, Jager K J, Mehrotra R, Naicker S, Filho Roberto P, Yu X Q, Lameire N. Changes in the worldwide epidemiology of peritoneal dialysis. Nat Rev Nephrol. 2017; 13(2):90-103.

[4] Davenport A. Peritonitis remains the major clinical complication of peritoneal dialysis: the London, UK, peritonitis audit 2002-2003. Perit Dial Int 2009; 29(3): 297–302. 2.

[5] Perl J, Harel Z, Nessim S. Peritoneal fluid analysis in peritoneal dialysis–associated peritonitis. JAMA. 2022;328(21):2157–2158. https://doi.org/10.1001/jama. 2022.21289

[6] Munib S. Continuous ambulatory peritoneal dialysis. Gomal J Med Sci 2006; 4:82–5.

[7] Vikrant S, Guleria R C, Kanga A, Verma B S, Singh D, Dheer S K. Microbiological aspects of peritonitis in patients on continuous ambulatory peritoneal dialysis. Indian Journal of Nephrology. January 2013 / Vol 23 / Issue 1.12-16

[8] Philip K T L, Kai M C. , Yeoungjee C, Stanley F, Ana E F, Tess H, Talerngsak K , Yong-Lim K, Magdalena M, Jolanta M, Mehrotra R, Ikechi G O, Jeff P, Beth P, Naomi R, Isaac T, Jennifer K-W W, Xueqing Y, Johnson D W. ISPD peritonitis guideline recommendations: 2022 update on prevention and treatment. Peritoneal Dialysis International 2022, Vol. 42(2) 110–153

[9] Salzer W L. Peritoneal dialysis-related peritonitis: challenges and solutions. International Journal of Nephrology and Renovascular Disease 2018:11 173–186.

[10] Akoh J A. Peritoneal dialysis associated infections: An update on diagnosis & management. World J Nephrol 2012 August 6; 1(4): 106-122. ISSN 2220-6124 (online)

[11] District laboratory practice in tropical countries Part 2, 2nd edition, Monica Cheesbrough, Kirby-Bauer method, Page 139.

[12] Clinical and Laboratory Standards Institute.M100 Performance Standards for Antimicrobial Susceptibility Testing. 30th Edition. 2020.

[13] Clinical and Laboratory Standards Institute.M100 Performance Standards for Antimicrobial Susceptibility Testing. 31st Edition. 2021.

[14] Prasad N, Gupta A, Sharma RK, Prasad KN, Gulati S, Sharma AP. Outcome of gram-positive and gram-negative peritonitis in patients on continuous ambulatory peritoneal dialysis: A single-center experience. Perit Dial Int 2003;23:S144-7.

[15] Srivastava A K, Ghosh I, Sonawane S. Clinical profile and microbiological spectrum of patients with continuous ambulatory peritoneal dialysis-associated peritonitis at a tertiary care center. Med J Armed Forces of India 2023 Dec;79(Suppl 1):S175-S180.

[16] Prasad K N, Singh K, Rizwan A, Mishra P, Tiwari D, Prasad N, Gupta A. Microbiology And Outcomes Of Peritonitis In Northern India. Perit Dial Int 2014; 34(2):188–194. doi:10.3747/pdi.2012.00233.

[17] Sood V, Vivek K, Ramachandran R, Gupta S, Gautam V, Rathi M, Kohli H S, Gupta K L. Incidence, Microbiological Spectrum and Outcomes of Infective Peritonitis in Chronic Peritoneal Dialysis Patients. J Clin Nephrol Ren Care 2020, 6 (1):049. DOI: 10.23937/2572-3286.1510049

[18] Tanratananon D, Deekae S, Raksasuk S, Srithongkul T. Evaluation of different methods to improve culture-negative peritoneal dialysis-related peritonitis: A single-center study. Annals of Medicine and Surgery 2021 Feb 13;63:102139. doi: 10.1016/j.amsu.2021.01.087

[19] Iyer R N, Reddy A, Gande S, Aiyangar A. Evaluation of different culture methods for the diagnosis of peritonitis in patients on continuous ambulatory peritoneal dialysis. Clinical Microbiology and Infection: 20 (5); 0294-0296.

[20] Vyver J A, Thomas T. Improving peritoneal dialysis fluid culture-positivity yield from 2022-2023. Southern African Journal of Infectious Diseases (S Afr J Infect Dis). 2024; 39(1), a684. https://doi.org/10.4102/ sajid.v39i1.684.