www.bdd.rdplf.org Volume 5, n° 4, December 2022
https://doi.org/10.25796/bdd.v4i4.73553
ISSN 2607-9917

Bulletin de la Dialyse à Domicile

Seasonal variations of enteric peritonitis in Belgium and France : from RDPLF data

(Variation saisonnière des péritonites entériques en Belgique et France : d'après les données du RDPLF)

Pacha Bakhtar [1], Evelyne Maillart [2], Collart Frédéric [1], Verger Christian [3]

[1]Service de Néphrologie-Dialyse, CHU-Brugmann, ULB, Bruxelles, Belgique
[2]Service des Maladies Infectieuses, CHU-Brugmann, ULB, Bruxelles, Belgique
[3]RDPLF, Pontoise (France)

Pour citer : Bakhtar P, Maillart E, Collart F, Verger C. Seasonal variations of enteric peritonitis in Europe: from RDPLF data. Bull Dial Domic;5(4):1-9.
Available from: https://doi.org/10.25796/bdd.v4i4.73553

Note : cette publication est bi-linguale. Texte français disponible au même url : https://doi.org/10.25796/bdd.v4i4.73553

Summary

Little information is available on the seasonal ecology of germs responsible for peritoneal dialysis peritonitis. We performed a retrospective study based on RDPLF data covering the last 20 years and 20411 episodes of peritonitis.

We show that the percentage of enteric peritonitis is highest in summer, lowest in winter and identical in spring and autumn. This higher proportion of organisms of enteric origin in summer has itself tended to increase in recent years.

We postulate that a food contamination by enteric germs associated with an increased bacterial translocation at the level of the digestive tract itself favoured by constipation, as well as changes of the food nature could be responsible for this phenomenon.

These seasonal variations may suggest that probabilistic initial antibiotic therapy should be adapted in cases of suspected peritonitis before the results of bacteriological analysis.

Résumé

Peu d'informations sont disponibles sur l'écologie saisonnière des germes responsables des péritonites en dialyse péritonéale. Nous avons réalisé une étude rétrospective à partir de la base de données du RDPLF portant sur les 20 dernières années et 20411 épisodes de péritonites.

Nous montrons une proportion de péritonites à germes entériques plus élevée en été, la plus faible en hiver et identique au printemps et en automne. Cette proportion de germes d'origine entérique plus élevée en été a elle même tendance à augmenter ces dernières années.

Nous postulons qu'une contamination alimentaire par des germes entériques associée à une translocation bactérienne accrue au niveau du tube digestif, elle-même favorisée par la constipation et des changements saisonniers d'alimentation pourrait être responsable de ce phénomène.

Ces variations saisonnières pourraient suggérer d'adapter l'antibiothérapie probabiliste lors d'une suspicion de péritonite, avant les résultats de l'analyse bactériologique.

Key words : peritoneal dialysis, seasonal variation, peritonitis, enteric peritonitis

Mots clés : dialyse péritonéale, variation saisonnière, péritonite, peritonite entérique

journal officiel du Registre de Dialyse Péritonéale de Langue Française RDPLF www.rdplf.org

www.bdd.rdplf.org Volume 5, n° 4, December 2022
https://doi.org/10.25796/bdd.v4i4.73553
ISSN 2607-9917

INTRODUCTION

Peritonitis related to peritoneal dialysis has long been considered as the Achilles heel of peritoneal dialysis. Today, they represent 14% and 26% of the causes of transfer to hemodialysis centers in France and Belgium respectively, and 3% and 2% of deaths [1]. Moreover, the identification of the causative organism varies from 10% to 50% from one center to another [2]. The ISPD has published a recommendation on the first choice of antibiotic before knowing the organism [3], recently synthesized by Taghavi and Dratwa [4]. However, these recommendations do not take into account the time of year of peritonitis occurrence. For example, we do not know whether the epidemics of gastroenteritis each year have an influence on the ecology of peritonitis, and therefore whether the choice of probabilistic antibiotic therapy depending on the time of year should vary. There are previous studies of seasonal variations in peritoneal dialysis-related peritonitis, but these are generally small series from a single center with limited numbers of patients over short periods of time. The RDPLF has been recording peritonitis in French-speaking countries for more than 30 years . Our objective is therefore to evaluate, over a long period of time, the seasonal variations of bacterial ecology during peritoneal dialysis-related peritonitis in Belgium and France, with a particular analysis of seasonal variations of organisms known to be of enteric origin.

PATIENTS AND METHODS

We performed an observational cohort study to measure variations in the bacterial ecology of peritonitis in peritoneal dialysis in metropolitan France and Belgium in the French Language Peritoneal Dialysis Registry (RDPLF). The RDPLF database is declared to the Commission Nationale de L'Information et des Libertés under the number: 11950164795. The data were exported to an independent file after total and irreversible anonymization. As the data were retrospective from a registry, the written consent of the patients was not necessary for the study. The design and functioning of the RDPLF have been described elsewhere [1].

The variable of interest in this study is the germ responsible for peritonitis in peritoneal dialysis, as recorded by the nurses and physicians of the participating centers, based on the results of their respective bacteriology laboratory.

We selected from the RDPLF database the centers in Belgium and France, which have similar climatic conditions; the French-speaking regions in the south were excluded because of very different climatic conditions. We studied all reported peritonitis from 2000 to 2019.

The description of treatment is not available in the database, but we postulated that the average treatment duration is 2 weeks. As the ISPD definition of recurrence [3] is the occurrence of peritonitis within 4 weeks of stopping treatment we defined as recurrence any peritonitis with the same germ occurring within 6 weeks of the date of the previous episode.

In order to keep only the germs clearly identified according to their seasonal frequencies, we deleted the episodes of cloudy fluid related to a hemoperitoneum, an eosinophilic reaction, aseptic chylous peritonitis, peritonitis without identified germ, and recurrences. In total we retained 20411 episodes.

journal officiel du Registre de Dialyse Péritonéale de Langue Française RDPLF www.rdplf.org

We classified the germs as enteric or not following the classification previously described [5]. The season of reporting of the infections was calculated according to their dates and classified as winter, spring, summer, autumn. The percentages of peritonitis related to the same type of germ were calculated for each season by dividing the number of germs of a given type by the total number of germs encountered during each season.

Patients were grouped according to age (<44 years, 45-64 years, 65-84 years, 85 years and older), type of peritonitis (enteric and non-enteric), modified Charlson score (<4, 4-8, >8) [6], diabetic status, and causative germ (E. coli, enterococcus). In each category the seasonality of enteric peritonitis was studied.

Statistics:

Results are presented as percentages of peritonitis by season. The chi2 test was applied to the observed numbers of peritonitis. A p<.05 was considered statistically significant. Tests performed on Medcalc Statistical Software.

Similar results being observed over the last 20 years and the last 10 years, we limited the study in groups of patients to this second period for which we have the Charlson score of the patients.

RESULTS

Over the 10 as well as the last 20 years, the percentage of enteric peritonitis is lowest in winter, identical in autumn and spring and highest in summer: winter 25%, spring 27%, summer 29%, autumn 27% (χ^2=24.1; p<0.001). Seasonal differences were as follows: fall-winter ,p=0.016; fall-spring, NS; fall-summer, p=0.009; winter-spring, p=0.043, winter-summer, p<.001; spring-summer, p=0.008.

Figure 1 shows the seasonal variations of enteric peritonitis by 2-year periods for the last 20 years, showing that the rate of enteric peritonitis is always the highest in summer except for the period 2004-2005.

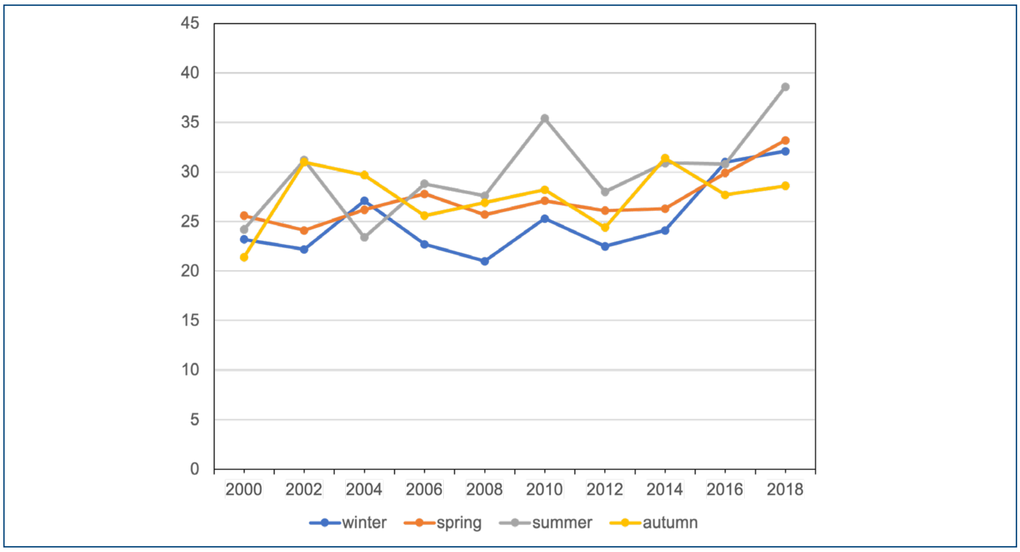

Figure1. Seasonal peritonitis percentages per period of two years from 2000 – 2020. The highest summer values were observed for years 2004 and 2006

journal officiel du Registre de Dialyse Péritonéale de Langue Française RDPLF www.rdplf.org

Study in subgroups of patients over the last 10 years:

Effect of age:
Seasonality is found in the youngest (<44years,χ^2=10, p<.02) and 65-84 (χ^2=12.4 p<.01) but not in the 45-64 group (χ^2=5.8 NS) nor in patients >85 (χ^2=6.7 NS)

Effect of comorbidities:
Charlson score does not influence the epidemiology of enteric peritonitis, none of the groups are significant (<4, 4-7, >7)

Effect of diabetes:
Seasonality is found in non-diabetics (χ^2=14.4 p<.001) but not in diabetics (χ^2=5.75, NS)

Responsible germ:
No seasonality is demonstrated for E Coli and Enterobacter

DISCUSSION

The data in the literature are poor concerning the seasonal variations of peritonitis in patients treated with peritoneal dialysis. We therefore conducted a retrospective registry study in order to shed more light on this subject, which, to our knowledge, is the first study of this type carried out in European countries.

The data in the literature concerning seasonal variations in peritonitis are quite divergent. Cho Y et al (8), in their multicenter study conducted in Australia, did not show any seasonal variation in peritonitis, even if they concluded that there was a seasonal effect of certain germs in the occurrence of peritonitis; for example, a peak of gram-negative germs in peritonitis in summer. But they do not specify the type of germ in question in their finding and we know that enterobacteria (gram negative) are one of the causes of peritonitis in summer. Furthermore, we must also keep in mind that the Australian climate is considered a tropical climate where the separation between seasons can be difficult. Núñez-Moral M et al (9) obtained similar results in their single-center study conducted in Spain.

Other investigators such as Kim et al (3) and Szeto et al (10) have demonstrated a significant seasonal variation in peritonitis with a high incidence during the hot and humid months of the year. They further advocate that maintaining a dry environment can help avoid peritoneal dialysis treatment failures in tropical climates. Zeng Y et al (11) confirm the data expressed by the others above and demonstrate the higher incidence of PE in summer but fail to reach a statistically significant threshold because of the small size of their cohort.

Our study is in agreement with the results of Zeng Y et al, and confirms the seasonality of peritonitis. The peak incidence of peritonitis was observed in summer and then a stabilization was noticed during the fall and spring seasons. Finally, a significant decline in peritonitis frequencies was observed in winter. When comparing the different seasons, we did not find a statistically significant difference between autumn and spring while it remained significant for the other seasons. On the other hand, the difference was highly significant between summer and winter.

journal officiel du Registre de Dialyse Péritonéale de Langue Française RDPLF www.rdplf.org

We note that during the second decade of the XXI century, Europe has experienced a real climatic change with well-defined separations between the seasons. Hot summer seasons with multiple heat waves and cold winters leading to a change in the lifestyle of patients. This results in a higher consumption of cold and raw food during the summer months, thus favoring intestinal infections during this period of the year (10). One explanation for the increase in peritonitis during the summer may be higher episodes of gastroenteritis with diarrhea (12). This finding is also put forward by other authors such as Elshafie et al (13) who consider diarrhea as an important source of peritonitis in PD patients.

In addition, CKD patients treated with dialysis are considered to be immunocompromised. A state of undernutrition, such as that caused by vomiting and diarrhea during episodes of gastroenteritis, further weakens the defense of these patients against pathogenic bacteria and thus may facilitate their passage to the peritoneal cavity. Szeto et al (14) and Shu et al (15) show that a hypokalemic state associated with undernutrition in these patients leads to excessive proliferation and stasis of enterobacteria in the intestines. A state of hypokalemia can also lead to a slowing of intestinal peristalsis and constipation, thus facilitating the migration of these enteric germs towards the peritoneum.

Guo, Qunying et al (16) highlight the important role of hypervolemia on the increased incidence of peritonitis in patients treated by PD. It is well known that dialysis patients, treated by PD or hemodialysis, are frequently in a state of fluid overload and this is even more so during the summer when fluid intake increases for everyone. Our results support these explanations by showing a higher incidence of peritonitis in summer. However, we cannot confirm the hypothesis of greater hypervolemia in summer without studying other parameters such as bioimpedancemetry, episodes of dyspnea, edema or cardiac decompensation in these patients. Experimental studies also point to the hypothesis of translocation of enteric germs in the absence of abdominal pathology (17-18).

Enteric germs can be divided into two large families: enterococci, gram positive, whose most frequent germs are Enterococcus faecalis and Enterococcus faecium, and enterobacteria, gram negative, characterized mainly by Escherischia Coli (E. Coli) and Klebsiella Pneumonaie in peritonitis (11-19-20). Some authors have established the seasonal character of gram-negative enterobacteria with a peak of infection observed in summer (8-11) while other researchers such as Buttigieg J et al (21) do not obtain the same results.

The evaluation of germs in our study did not show any seasonality for peritonitis. But we are forced to mention that contrary to other authors our research was essentially focused on enterococci and Escherischia coli. In our understanding this result is logical because the incidence of gram-positive peritonitis has been decreasing in the last years due to better connection systems and therapeutic education programs for patients and health professionals (12-22). Bronikowski et al (23) demonstrate that the ideal temperature for in vitro multiplication of E. Coli is 35-36°C, but in Europe and more specifically in the regions considered in our study, these temperatures are rarely reached even in summer, except during heat waves.

Some authors consider diabetes as an independent risk factor for peritonitis and poor prognosis in patients treated by peritoneal dialysis (24-25). In our study, the seasonality of peritonitis is found in non-diabetic patients with a higher incidence in summer. This is not surprising because

journal officiel du Registre de Dialyse Péritonéale de Langue Française RDPLF www.rdplf.org

we know that diabetics are more likely to have gram-positive peritonitis, especially with Staphylococcus, whereas non-diabetics are more likely to have gram-negative peritonitis such as E.Coli (26). The prevalence of E. Coli increases strongly during the months of the year when temperatures are high.

Similarly, our results also show a seasonal influence of E.coli in young patients with an age < 44 years. This could be explained by the fact that compared to elderly patients, they pay less attention to their food hygiene and therefore would more easily consume food contaminated by enteric germs. Another explanation may be that younger patients are more independent and therefore more likely to enjoy swimming in summer when we know that the prevalence of enteric germs such as E. Coli increases.

Strengths and weaknesses

This is a registry study over a long period of time and a large number of peritonitis but other studies are necessary to confirm certain hypotheses such as hypervolemia and intra-abdominal translocation of germs in order to elucidate their exact role in the physiopathology of enteric peritonitis.

CONCLUSION

The frequency of enteric peritonitis varies according to the seasons in the French-speaking regions of Western Europe, with a higher incidence in summer and a lower incidence in winter. The incidence of enteric peritonitis is similar in autumn and spring. We postulate that food contamination by enteric germs associated with increased bacterial translocation in the gastrointestinal tract favored by constipation is responsible for this phenomenon. These seasonal variations may suggest that probabilistic initial antibiotic therapy should be adapted to season in cases of suspected peritonitis before the results of bacteriological analysis.

.

Declaration of interest

The authors declare that they have no conflict of interest in this article.

Role de chaque auteur

PB : redaction de l’article ; EM : lecture critique, conseils et hypothèses bactériologique, FC : analyse statistique, CV : conception de l’étude, extraction des données et rédaction des méthdes.

Financement : cette étude n’a béneficié d’aucun financement

Numero ORCID :
Pacha Bakhtar : https://orcid.org/0000-0001-5619-3305
Evelyne Maillart: https://orcid.org/0000-0002-5354-068X
Frederic Collart : https://orcid.org/0000-0003-1673-5450
Christian Verger : https://orcid.org/0000-0002-8009-5366

RÉFÉRENCES

journal officiel du Registre de Dialyse Péritonéale de Langue Française RDPLF www.rdplf.org

1 -Verger C, Fabre E, Veniez G, Padernoz MC. Synthetic 2018 data report of the French Language Peritoneal Dialysis and Home Hemodialysis Registry (RDPLF). Bull Dial Domic [Internet]. 2019 Apr. 10; 2(1):1-10. doi: https://doi.org/10.25796/bdd.v2i1.19093

2 -Verger C, Veniez G, Dratwa M. Variability of aseptic peritonitis rates in the RDPLF. Bull Dial Domic [Internet]. 2018 Jun. 13 1(1):9-13. doi: https://doi.org/10.25796/bdd.v1i1.30

3 -Li PK, Chow KM, Cho Y, Fan S, Figueiredo AE, Harris T, Kanjanabuch T, Kim YL, Madero M, Malyszko J, Mehrotra R, Okpechi IG, Perl J, Piraino B, Runnegar N, Teitelbaum I, Wong JK, Yu X, Johnson DW. ISPD peritonitis guideline recommendations: 2022 update on prevention and treatment. Perit Dial Int. 2022 Mar;42(2):110-153. doi: https://doi.org/10.1177/08968608221080586

4 -Taghavi M, Dratwa M. Overview of ISPD 2022 guideline recommendations for peritonitis prevention and treatment. Bull Dial Domic [Internet]. 2022 Jun. 15; 5(2):93-103. Doi : https://doi.org/10.25796/bdd.v5i2.66753

5 -Forté V, Novelli S, Zaidan M, Snanoudj R, Verger C, Beaudreuil S. Microbiology and outcomes of polymicrobial peritonitis associated with peritoneal dialysis: a register-based cohort study from the French Language Peritoneal Dialysis Registry (RDPLF). Nephrol Dial Transplant. 2022 Sep 21;doi: https://doi.org/10.1093/ndt/gfac267

6 - Fried L, Bernardini J, Piraino B. Charlson comorbidity index as a predictor of outcomes in incident peritoneal dialysis patients. Am J Kidney Dis. 2001 Feb;37(2):337-42. doi: 10.1053/ajkd.2001.21300. PMID: 11157375.

7 - Kim MJ, Song JH, Park YJ, Kim GA, Lee SW. The influence of seasonal factors on the incidence of peritonitis in continuous ambulatory peritoneal dialysis in the temperate zone. Adv Perit Dial. 2000;16:243-7. PMID: 11045303.

8 - Cho Y, Badve SV, Hawley CM, McDonald SP, Brown FG, Boudville N, Wiggins KJ, Bannister KM, Clayton PA, Johnson DW. Seasonal variation in peritoneal dialysis-associated peritonitis: a multi-centre registry study. Nephrol Dial Transplant. 2012 May;27(5):2028-36. doi: 10.1093/ndt/gfr582. Epub 2011 Oct 6. PMID: 21980154.

9 - Núñez-Moral M, Sánchez-Álvarez JE, González-Díaz I, Peláez-Requejo B, Quintana-Fernández A, Rodríguez-Suárez C. Seasonal variations, and influence of the weather on the appearance of peritoneal infection. Nefrologia. 2014 Nov 17;34(6):743-8. English, Spanish. doi: https://doi.org/10.3265/nefrologia.pre2014.jul.12420

10 - Szeto CC, Chow KM, Wong TY, Leung CB, Li PK. Influence of climate on the incidence of peritoneal dialysis-related peritonitis. Perit Dial Int. 2003 Nov-Dec;23(6):580-6. PMID: 14703200.

11 - Zeng Y, Jiang X, Feng S, Jiang L, Wang Z, Shen H, Jiang S. The influence of seasonal factors on the incidence of peritoneal dialysis-associated peritonitis. Ren Fail. 2020 Nov;42(1):807-817. doi: 10.1080/0886022X.2020.1804401. PMID: 32781861; PMCID: PMC7472476.

journal officiel du Registre de Dialyse Péritonéale de Langue Française **RDPLF** www.rdplf.org

12 - Szeto CC, Chow VC, Chow KM, Lai RW, Chung KY, Leung CB, Kwan BC, Li PK. Enterobacteriaceae peritonitis complicating peritoneal dialysis: a review of 210 consecutive cases. Kidney Int. 2006 Apr;69(7):1245-52. doi: 10.1038/sj.ki.5000037. PMID: 16467787.

13 - Elshafie SS, Asim M, Ashour A, Elhiday AH, Mohsen T, Doiphode S. Campylobacter peritonitis complicating continuous ambulatory peritoneal dialysis: report of three cases and review of the literature. Perit Dial Int. 2010 Jan-Feb;30(1):99-104. doi: 10.3747/pdi.2008.00227. PMID: 20056988

14 - Szeto CC, Chow KM, Kwan BC, Leung CB, Chung KY, Law MC, Li PK. Hypokalemia in Chinese peritoneal dialysis patients: prevalence and prognostic implication. Am J Kidney Dis. 2005 Jul;46(1):128-35. doi: 10.1053/j.ajkd.2005.03.015. PMID: 15983966.

15 - Shu KH, Chang CS, Chuang YW, Chen CH, Cheng CH, Wu MJ, Yu TM. Intestinal bacterial overgrowth in CAPD patients with hypokalaemia. Nephrol Dial Transplant. 2009 Apr;24(4):1289-92. doi: https://doi.org/10.1093/ndt/gfn617. Epub 2008 Nov 7. PMID: 18997162

16 - Guo Q, Lin J, Li J, Yi C, Mao H, Yang X, Yu X. The Effect of Fluid Overload on Clinical Outcome in Southern Chinese Patients Undergoing Continuous Ambulatory Peritoneal Dialysis. Perit Dial Int. 2015 Dec;35(7):691-702. doi: 10.3747/pdi.2014.00008. Epub 2015 Jul 7. PMID: 26152580; PMCID: PMC4690624

17 - Schweinburg FB, Seligman AM, Fine J. Transmural migration of intestinal bacteria; a study based on the use of radioactive Escherichia coli. N Engl J Med. 1950 May 11;242(19):747-51. doi: 10.1056/NEJM195005112421903. PMID: 15412704.

18 - Mora EM, Cardona MA, Simmons RL. Enteric bacteria and ingested inert particles translocate to intraperitoneal prosthetic materials. Arch Surg. 1991 Feb;126(2):157-63. doi: 10.1001/archsurg.1991.01410260041006. PMID: 1825166.

19 - Yip T, Tse KC, Ng F, Hung I, Lam MF, Tang S, Lui SL, Lai KN, Chan TM, Lo WK. Clinical course and outcomes of single-organism Enterococcus peritonitis in peritoneal dialysis patients. Perit Dial Int. 2011 Sep-Oct;31(5):522-8. doi: 10.3747/pdi.2009.00260. Epub 2011 Apr 30

20 - Yip T, Tse KC, Lam MF, Cheng SW, Lui SL, Tang S, Ng M, Chan TM, Lai KN, Lo WK. Colonic diverticulosis as a risk factor for peritonitis in Chinese peritoneal dialysis patients. Perit Dial Int. 2010 Mar-Apr;30(2):187-91. doi: 10.3747/pdi.2007.00244. Epub 2010 Feb 1.

21 - Buttigieg J, Borg Cauchi A, Rogers M, Farrugia E, Fava S. Seasonal Variation in the Peritoneal Dialysis-Related Infections: A Single Center Experience in the Mediterranean. Ther Apher Dial. 2016 Oct;20(5):501-506. doi: 10.1111/1744-9987.12416. Epub 2016 Sep 15. PMID: 27629524.

22 - Figueiredo AE, Moraes TP, Bernardini J, Poli-de-Figueiredo CE, Barretti P, Olandoski M, Pecoits-Filho R; BRAZPD Investigators. Impact of patient training patterns on peritonitis rates in a large national cohort study. Nephrol Dial Transplant. 2015 Jan;30(1):137-42. doi: 10.1093/ndt/gfu286. Epub 2014 Sep 8. PMID: 25204318.

journal officiel du Registre de Dialyse Péritonéale de Langue Française RDPLF www.rdplf.org

https://doi.org/10.25796/bdd.v4i4.73553
ISSN 2607-9917

23 - Bronikowski AM, Bennett AF, Lenski RE. Evolutionary adaptation to temperature. VIII. Effects of temperature on growth rate in natural isolates of Escherichia coli and Salmonella enterica from different thermal environments. Evolution. 2001 Jan;55(1):33-40. doi: 10.1554/0014-

24 -Chen HL, Tarng DC, Huang LH. Risk factors associated with outcomes of peritoneal dialysis in Taiwan: An analysis using a competing risk model. Medicine (Baltimore). 2019 Feb;98(6):e14385. doi: 10.1097/MD.0000000000014385. PMID: 30732176; PMCID: PMC6380716.

25 - Ozener C, Arikan H, Karayaylali I, Utas C, Bozfakioglu S, Akpolat T, Ataman R, Ersoy F, Camsari T, Yavuz M, Akcicek F, Yilmaz ME. The impact of diabetes mellitus on peritoneal dialysis: the Turkey Multicenter Clinic Study. Ren Fail. 2014 Mar;36(2):149-53. doi: 10.3109/0886022X.2013.843275. Epub 2013 Oct 17. PMID: 24131086.

26 - Meng LF, Yang LM, Zhu XY, Zhang XX, Li XY, Zhao J, Liu SC, Zhuang XH, Luo P, Cui WP. Comparison of clinical features and outcomes in peritoneal dialysis-associated peritonitis patients with and without diabetes: A multicenter retrospective cohort study. World J Diabetes. 2020 Oct 15;11(10):435-446. doi: 10.4239/wjd.v11.i10.435. PMID: 33133391; PMCID: PMC7582114.