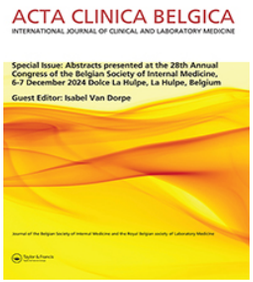
Taylor & Francis
Taylor & Francis Group



Acta Clinica Belgica

International Journal of Clinical and Laboratory Medicine

ISSN: 1784-3286 (Print) 2295-3337 (Online) Journal homepage: www.tandfonline.com/journals/yacb20

Procalcitonin levels at hospital admission are increased in cyst infection in patients with autosomal dominant polycystic kidney disease

Jihad Abdelmalki, Laurence Seidel, Frédéric Frippiat, Pierre Lovinfosse & François Jouret

To cite this article: Jihad Abdelmalki, Laurence Seidel, Frédéric Frippiat, Pierre Lovinfosse & François Jouret (12 Jun 2025): Procalcitonin levels at hospital admission are increased in cyst infection in patients with autosomal dominant polycystic kidney disease, Acta Clinica Belgica, DOI: 10.1080/17843286.2025.2518059

To link to this article: https://doi.org/10.1080/17843286.2025.2518059

Published online: 12 Jun 2025.

ACTA CLINICA BELGICA
https://doi.org/10.1080/17843286.2025.2518059

Taylor & Francis
Taylor & Francis Group

Procalcitonin levels at hospital admission are increased in cyst infection in patients with autosomal dominant polycystic kidney disease

Jihad Abdelmalki[a], Laurence Seidel[b], Frédéric Frippiat[c], Pierre Lovinfosse[d] and François Jouret[a]

[a]Division of Nephrology, ULiège Academic Hospital, Liège, Belgium; [b]Division of Biostatistics, ULiège Academic Hospital, Liège, Belgium; [c]Division of Infectious Diseases, ULiège Academic Hospital, Liège, Belgium; [d]Division of Nuclear Medicine, ULiège Academic Hospital, Liège, Belgium

ABSTRACT

Introduction: The diagnosis of cyst infection in autosomal dominant polycystic kidney disease (ADPKD) is difficult. [18F]FDG PET/CT imaging is helpful, but early diagnosis remains challenging. Procalcitonin (PCT), a serum biomarker for bacterial infections, has not been evaluated in ADPKD-related cyst infections.

Methods: A retrospective review (between 2009 and 2023) identified all ADPKD patients who were (i) hospitalized (ii) with serum PCT measurements. Cyst infection was conventionally defined. Univariate and multivariate logistic regressions assessed the association between PCT and cyst infection risk.

Results: The cohort included 104 patients (mean age of 65.5 ± 14.9 years; 49% post-kidney transplantation; 16.3% on chronic dialysis). Cyst infections occurred in 24 cases. [18F]FDG PET/CT was performed in 47 patients, detecting cyst infection in 17 cases and non-cystic inflammation in 11. In the whole cohort, CRP levels at admission reached 97.3 [42.8; 164] mg/L. Serum PCT level was measured within 72-h *post* admission in 83/104 (79%) cases, and the median value reached 0.47 [0.18–2.04] µg/L. A significant correlation was observed between serums levels of PCT and creatinine at admission ($r = 0.37$, $p < 0.05$). PCT > 0.59 µg/L significantly predicted cyst infection (OR = 6.30, $p = 0.0047$). Antibiotics were administered ≥48 h before PCT measurement in 9/24 cases of cyst infection. PCT levels did not significantly differ between patients exposed to antibiotics (0.98 [0.43–2.19] µg/L) or not (1.42 [0.94–3.81] µg/L; $p = 0.39$). Higher PCT was associated with cyst [18F]FDG uptake above the pathological threshold (OR = 2.01, $p = 0.0028$).

Conclusion: PCT >0.59 µg/L within 72-h *post* admission is a significant biomarker for cyst infection in ADPKD patients.

ARTICLE HISTORY
Received 3 January 2025
Accepted 15 March 2025

KEYWORDS
Autosomal dominant polycystic kidney disease; cyst infection; diagnosis; biomarker; procalcitonin

Introduction

The diagnosis of cyst infection in patients with autosomal dominant polycystic kidney disease (ADPKD) is challenging due to nonspecific symptoms like fever, abdominal pain, and elevated inflammatory markers, which can overlap with other cystic and non-cystic complications [1,2]. Imaging techniques, especially 2-deoxy-2-[18F]fluoro-D-glucose ([18F]FDG) positron emission tomography (PET) combined with computed tomography (CT), help identify infected cysts [3,4]. Still, early diagnosis remains complex [5,6]. Procalcitonin (PCT) has been proposed as a serum biomarker of bacterial infections [7]. Its use in diagnosing cyst infection in ADPKD patients has not been tested.

Methods

All ADPKD patients hospitalized between 2009 and 2023, with measurement of serum PCT, were retrospectively identified using computer-based databases. Medical files were systematically reviewed. Cyst infection was conventionally defined by the combination of (i) fever (≥38°C), (ii) abdominal pain, (iii) increased plasma C-reactive protein levels (≥70 mg/L), (iv) absence of any other cause of inflammation, (v) [18F]FDG accumulation around cyst(s) above the physiological hepatic background when [18F]FDG PET/CT had been performed in clinical routine [5,8]. Cyst accumulation of [18F]FDG was semi-quantitatively quantified for the purpose of this study according to a previously validated [18F]FDG scale [9]. All extracystic sites of pathological [18F]FDG accumulation were documented. Dichotomy comparisons were statistically done using the Student t-test on the logarithm of PCT. The Pearson correlation between serum levels of PCT and creatinine was calculated on the logarithm of the variables to normalize their distributions. The risk of cyst infection was studied using

CONTACT François Jouret francois.jouret@chuliege.be Divisions of Nephrology, ULiège Academic Hospital (CHU de Liège), Avenue Hippocrate, 1, Liège B-4000, Belgium

univariate and multivariate logistic regressions of clinical and biological parameters using SAS version 9.4. Ordinal logistic regression was used to study the association between the visual [18F]FDG PET/CT scale and PCT. The present monocentric retrospective study was approved by the Commission of Biomedical Ethics of ULiège Academic Hospital in Liège, Belgium.

Results

The cohort included 104 patients, with an average age of 65.5 ± 14.9 years and a mean body mass index of 25.9 ± 4.8 kg/m^2. The gender distribution was nearly balanced (Table 1). Half of the cohort had benefited from kidney transplantation, while 16.3% were under chronic dialysis. Cyst infection was diagnosed in 24 cases (Table 1). The hospitalization motives of the remaining cases were infections or inflammation in the lungs ($n = 19$), the urinary tract ($n = 9$); or the digestive tract ($n = 12$). COVID-19 was evidenced in 13 cases, while inflammation remained of unknown origin in 18 cases. Cyst hemorrhage was suspected in nine cases. [18F]FDG PET/CT was conducted in 47/104 (45.2%) patients, within 7.0 [5.0–9.0] days post admission: Cyst infection was diagnosed in 17/47 cases. [18F]FDG PET/CT detected a non-cystic inflammation in 11/47 cases, and it was not contributive in 19/47 cases (Table 2). In the whole cohort, CRP levels at admission were elevated at 97.3 [42.8; 164] mg/L, while white blood cell counts averaged 8.52 [6.3; 12.1] 10^3/mm^3. Serum PCT level was measured within 72-h post admission in 83/104 (79%) cases, and the median value reached 0.47 [0.18–-2.04] µg/L. A significant correlation was observed between serums levels of PCT and creatinine at admission ($r = 0.37$, $p < 0.05$), excluding the patients under chronic dialysis ($n = 17$). The Youden cut-off for PCT in cyst infection diagnosis was 0.59 µg/L. In a multivariate model based on variables with a univariate p-value of less than 0.10, PCT >0.59 µg/L emerged significantly, with an odds ratio (OR) of 6.30 ($p = 0.0047$). Antibiotics were administered ≥48 h before PCT measurement in 9/24 cases of cyst infection (39.1%). PCT levels did not significantly differ between patients previously exposed to antibiotics (0.98 [0.43–2.19] µg/L) or not (1.42 [0.94–-3.81] µg/L; $p = 0.39$). Ordinal logistic regression showed higher PCT values for higher cyst [18F]FDG uptake, with an OR of 2.01 ($p = 0.0028$). The median value of PCT was 0.99 [0.59; 2.44] for cyst [18F]FDG uptake score above the pathological threshold [8,9].

Discussion

In the present monocentric retrospective cohort of 104 hospitalized ADPKD patients including 24 episodes of cyst infection, serum levels of PCT >0.59 µg/L within 72-h *post* admission were significantly associated with the diagnosis of cyst infection. Furthermore, PCT significantly correlates with [18F]FDG accumulation around the suspected cyst, with no proven causality between these 2 bio- / icono-markers. PCT is a widely used diagnostic biomarker of bacterial infections [10]. To the best of our knowledge, our novel data highlight for the first time the

Table 1. Characteristics of the cohort.

Parameters	Cohort	Cyst infection (+)	Cyst infection (-)
	n = 104	n = 24	n = 80
Age (years)	65.5 ± 14.9	59.3 ± 17.9	67.3 ± 13.5
BMI (kg/m^2)	25.9 ± 4.77	26.8 ± 4.92	25. 6 ± 4.72
Female gender, N (%)	51 (49.0)	14 (58.3)	37 (46.3)
Dialysis, N (%)	17 (16.3)	3 (12.5)	14 (17.5)
Kidney Tx, N (%)	51 (49.0)	11 (45.8)	40 (50.0)
Liver Tx, N (%)	7 (6.7)	1 (4.2)	6 (7.5)
Nephrectomy, N (%)	32 (30.8)	3 (12.5)	29 (36.3)
CRP (mg/L)	97.3 [42.8–164]	137 [93.6–257]	90.2 [38.4–149]
WBC (10^3/mm^3)	8.52 [6.31–12.1]	11.4 [7.06–13.8]	8.20 [6.04–10.9]
Procalcitonine (µg/L)	0.47 [0.18–2.04]	1.42 [0.74–3.35]	0.31 [0.14–1.48]
Leucocyturia, N (%)	44 (46.3)	13 (56.5)	31 (43.1)
Hematuria, N (%)	42 (44.2)	11 (47.8)	31 (43.1)
Urine culture, N (%)	26 (27.4)	8 (34.8)	18 (25.0)
Blood culture, N (%)	24 (23.8)	12 (50.0)	12 (15.6)
Antibiotics, N (%)	85 (81.7)	24 (100.0	61 (76.3)
Duration of antibiotics (days)	14.0 [7.0–27.0]	32.0 [21.0–42.0]	10.0 [7.00–15.0]
Hospitalisation (days)	11.5 [6.0–20.0]	9.50 [6.50–18.5]	12.5 [6.00–20.0]
18F-FDG PET/CT			
N (%)	47 (45.2)	17 (70.8)	30 (37.5)
Glycemia (mg/dL)	97.0 [86.0–107]	95.0 [84.0–106]	98.5 [87.0–107]
[^{18}F]FDG Uptake (min)	64.0 [60.0–73.0]	61.0 [60.0–78.0]	67.0 [61.0–72.0]
Admission/PET (Days)	7.0 [5.00–9.00]	7.00 [6.00–9.00]	6.50 [4.00–9.00]

CRP, C-reactive protein; Tx, Transplantation; [^{18}F]FDG PET/CT, 2-deoxy-2-[^{18}F]fluoro-D-glucose ([^{18}F]FDG) positron emission tomography (PET) combined with computed tomography (CT).

Table 2. [^{18}F]FDG PET/CT findings.

Parameters	N (%)
[^{18}F]FDG PET/CT in the cohort	**47 (100%)**
Visual Scale	
1	26 (55,3%)
2	4 (8,5%)
3	6 (12,8%)
4	11 (23,4%)
Cyst infections	**17 (36,2%)**
Liver	8 (47%)
Kidney	8 (47%)
Liver AND kidney	1 (6%)
Non-cystic inflammations	**11 (23,4%)**
Lung	7
Peritoneum	1
Perineum	1
Kidney graft	1
Prostate	1
[^{18}F]FDG PET/CT (-)	**19 (40,4%)**

potential use of PCT in the early diagnosis of ADPKD-related cyst infection [1,11]. The sample size might not be sufficient to generalize the results, with a need for additional (ideally prospective and multicentric) cohorts. Still, we would like to respectfully emphasize that the vast majority of the literature in the field of ADPKD-related cyst infection is based on retrospective monocentric cohorts of limited sample size [2,5,12]. The present >0.59 µg/L diagnostic threshold has been calculated by the Youden Index, which helps determine the optimal cutoff point for a test by balancing sensitivity and specificity. This value matches the 0.5–2 µg/L range classically used in clinical routine for the diagnosis of bacterial infection [13]. Note that the diagnostic yield of PCT has well-known limitations in particular clinical settings like non-bacterial infections ('false-negative') or non-infectious systemic inflammation ('false positive') [14]. As a reminder, that fungi have been identified in (very) few cases cyst infection resistant to conventional antibiotics [2]. The effect of PCT point-of-care test remains debated since PCT measurement is usually part of the global clinical and biological assessment of patients with suspected bacterial infections [15]. In our small cohort of 24 cyst infections, PCT levels at admission did not significantly differ between patients formerly exposed to antibiotics ($n = 9$) or not. Prolonged clearance of PCT has been described in patients with renal impairment, which may lead to falsely elevated levels independent of infection [16]. However, PCT levels rapidly decrease after successful antibiotic therapy [10]. Since the duration of treatment remains largely debated, PCT follow-up may have clinically relevant implications by tailoring antibiotic exposure in cyst infection in ADPKD patients [17]. No follow-up data were available in our present cohort. The recently published 'ADAPT-Sepsis Randomized Clinical Trial' suggests that care guided by measurement of PCT reduces antibiotic duration safely compared with standard care, but CRP does not [10,18,19].

In conclusion, PCT determination at hospital admission may help to accelerate the diagnostic algorithm of ADPKD patients with suspected cyst infection [1,20]. Given that PCT can be elevated in non-infectious inflammatory states and/or impaired kidney function, PCT should not be used alone as a point-of-care test but must be interpreted in the clinical context alongside other clinical and biological findings and patient history. The role of repeated measurements of serum PCT levels in the therapeutic management of cyst infection needs to be explored in prospective – ideally multicenter – clinical trials.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

François Jouret http://orcid.org/0000-0003-2547-6593

Author contributions

Conceptualization and Study Design: PL & FJ; Data Collection: JA; Data Analysis and Interpretation: LS & FJ; Methodology: PL, LS & FJ; Writing – Original Draft: JA & FJ; Writing – Review & Editing: JA, LS, FP, PL & FJ.

Consent to participate statement

Given its retrospective design, the present study has been granted an exemption from requiring written informed consent by the Ethical Review Board of ULiège Academic Hospital (CHU de Liège, Liège, Belgium)

Data availability statement

Further enquiries can be directed to the corresponding author.

Ethical review board

The Ethical Review Board of ULiège Academic Hospital (CHU de Liège, Liège, Belgium) Reference number: #2024108

Study approval statement

This study protocol was reviewed and approved by the Ethical Review Board of ULiège Academic Hospital (CHU de Liège, Liège, Belgium), approval number #2024108.

References

[1] Jouret F, Hogan MC, Chebib FT. A practical guide for the management of acute abdominal pain with fever in patients with autosomal dominant polycystic kidney disease. Nephrol Dial Transpl Off Publ Eur Dial Transpl Assoc- Eur Ren Assoc. 2022;37(8):1426–1428. doi: 10.1093/ndt/gfab040

[2] Torres VE, Ahn C, Barten TRM, et al. KDIGO 2025 clinical practice guideline for the evaluation, management, and treatment of autosomal dominant polycystic kidney disease (ADPKD): executive summary. Kidney Int. 2025;107(2):234–254. doi: 10.1016/j.kint.2024.07.010

[3] Jouret F, Lhommel R, Beguin C, et al. Positron-emission computed tomography in cyst infection diagnosis in patients with autosomal dominant polycystic kidney disease. Clin J Am Soc Nephrol. 2011;6(7):1644–1650. doi: 10.2215/CJN.06900810

[4] Treglia G, Albano D, Rizzo A, et al. Performance of [(18)F]FDG PET/CT in diagnosing cyst infections in patients with autosomal dominant polycystic kidney disease: a systematic review and a bivariate meta-analysis. Diagnostics (Basel). 2024;14(15):1603. doi: 10.3390/diagnostics14151603

[5] Sallée M, Rafat CAA, Zahar J-R, et al. Cyst infections in patients with autosomal dominant polycystic kidney disease. Clin J Am Soc Nephrol. 2009;4(7):1183–1189. doi: 10.2215/CJN.01870309

[6] Neuville MF, Krzesinski J-M, Jouret F. Serum levels of carbohydrate antigen 19–9 do not systematically increase in case of liver cyst infection in patients with autosomal dominant polycystic kidney disease. Clin Kidney J. 2020;13(3):482–483. doi: 10.1093/ckj/sfz119

[7] Branche A, Neeser O, Mueller B, et al. Procalcitonin to guide antibiotic decision making. Curr Opin Infect Dis. 2019;32(2):130–135. doi: 10.1097/QCO.0000000000000522

[8] Neuville MF, Lovinfosse P, Jadoul A, et al. The use of a visual 4-point scoring scale improves the yield of (18)F-FDG PET-CT imaging in the diagnosis of renal and hepatic cyst infection in patients with autosomal dominant polycystic kidney disease. Eur J Nucl Med Mol Imaging. 2021;48(1):254–259. doi: 10.1007/s00259-020-04903-x

[9] Demuynck S, Lovinfosse P, Seidel L, et al. Standardized 4-point scoring scale of [(18)F]-FDG PET/CT imaging helps in the diagnosis of renal and hepatic cyst infections in patients with autosomal dominant polycystic kidney disease: a validation cohort. Clin Kidney J. 2023;16(12):2542–2548. doi: 10.1093/ckj/sfad159

[10] Dark P, Hossain A, McAuley DF, et al. Biomarker-guided antibiotic duration for hospitalized patients with suspected Sepsis: the ADAPT-Sepsis randomized clinical trial. JAMA. 2024;333(8):682–693. doi: 10.1001/jama.2024.26458

[11] Jouret F, Lhommel R, Devuyst O, et al. Diagnosis of cyst infection in patients with autosomal dominant polycystic kidney disease: attributes and limitations of the current modalities. Nephrol Dial Transpl Off Publ Eur Dial Transpl Assoc- Eur Ren Assoc. 2012;27(10):3746–3751. doi: 10.1093/ndt/gfs352

[12] Neuville M, Hustinx R, Jacques J, et al. Diagnostic algorithm in the management of acute febrile abdomen in patients with autosomal dominant polycystic kidney disease. PLOS ONE. 2016;11(8):e0161277. doi: 10.1371/journal.pone.0161277

[13] Schuetz P, Albrich W, Mueller B. Procalcitonin for diagnosis of infection and guide to antibiotic decisions: past, present and future. BMC Med. 2011;9(1):107. doi: 10.1186/1741-7015-9-107

[14] Iankova I, Thompson-Leduc P, Kirson NY, et al. Efficacy and safety of Procalcitonin guidance in patients with suspected or confirmed Sepsis: a systematic review and meta-analysis. Crit Care Med. 2018;46(5):691–698. doi: 10.1097/CCM.0000000000002928

[15] Smedemark SA, Aabenhus R, Llor C, et al. Biomarkers as point-of-care tests to guide prescription of antibiotics in people with acute respiratory infections in primary care. Cochrane Database Syst Rev. 2022;10(10). doi: 10.1002/14651858.CD010130.pub3

[16] Tao M, Zheng D, Liang X, et al. Diagnostic value of procalcitonin for bacterial infections in patients undergoing hemodialysis: a systematic review and meta-analysis. Ren Fail. 2022;44(1):81–93. doi: 10.1080/0886022X.2021.2021236

[17] Dang J, Scemla A, Loheac C, et al. Efficacy of prolonged antibiotic therapy for renal cyst infections in polycystic kidney disease. Mayo Clin Proc. 2022;97(7):1305–1317. doi: 10.1016/j.mayocp.2022.01.027

[18] Velissaris D, Zareifopoulos N, Lagadinou M, et al. Procalcitonin and sepsis in the emergency department: an update. Eur Rev Med Pharmacol Sci. 2021;25(1):466–479. doi: 10.26355/eurrev_202101_24416

[19] Spellberg B, Ghanem B, Boyles T, et al. ESR and CRP: it is time to stop the zombie tests: author's response. Clin Microbiol Infect. 2025;31(1):136–137 at 10.1016/j.cmi.2024.09.029

[20] Lantinga MA, Darding AJM, de Sévaux RGL, et al. International multi-specialty Delphi survey: identification of diagnostic criteria for hepatic and renal cyst infection. Nephron. 2016;134(4):205–214. doi: 10.1159/000446664