

RESEARCH

Open Access



The fast-track outpatient clinic significantly decreases hospitalisation rates among polymyalgia rheumatica patients

Stavros Chrysidis^{1,2*}, Philip Rask Lage-Hansen¹, Nikoletta Svendsen¹ and Andreas P. Diamantopoulos³

Abstract

Objectives: This study aimed to investigate the hospitalisation rates and the reasons for hospitalisation in patients with polymyalgia rheumatica (PMR). Furthermore, it aimed to clarify the impact of a newly established Fast Track Clinic (FTC) approach on hospitalisation rates in connection with PMR diagnosis.

Methods: Patients diagnosed with PMR at South-West Jutland Hospital, Denmark, between 2013 and 2018 were included retrospectively. Only patients fulfilling the 2012 EULAR/ACR classification criteria were included in our cohort. An FTC for patients suspected of having PMR was established in the rheumatologic department of South-West Jutland Hospital in January 2018.

Results: Over 6 years (2013 to 2017), 254 patients were diagnosed with PMR, 56 of them while hospitalised. Hospitalised patients were more likely to have a higher initial CRP mean \pm standard deviation (SD) 99.53 ± 59.36 vs 45.82 ± 36.96 mg/Lt ($p < 0.0001$) and a shorter duration of symptoms ($p = 0.0018$). After implementing the FTC, a significant decrease in hospitalisation rates (from 20.4% to 3.5%) and inpatient days of care (mean \pm SD 4.15 ± 3.1 vs 1 ± 0) were observed. No differences between the two groups were observed regarding clinical symptoms, laboratory values and initial prednisolone dose.

Conclusion: A substantial number of patients are hospitalised in connection with the PMR diagnosis. The FTC approach can decrease the hospitalisation rates significantly among these patients.

Trial registration: Retrospectively registered.

Keywords: Polymyalgia rheumatica, Health economics, Disease management, General practice

Background

Polymyalgia rheumatica (PMR) is characterised by shoulder and hip girdle pain accompanied by systemic inflammation [1]. The incidence increases with age, and PMR is rarely seen before the age of 50 years. Populations of Scandinavian ancestry are at higher risk of developing PMR [2].

The vast majority of PMR patients are diagnosed and managed in general practice [3–5]. Diagnosing PMR can be challenging as many conditions can mimic the disease [6]. The variety of symptoms may lead to hospitalisation to rule out other serious diseases [7]. In a study from the United Kingdom [8], a majority of general practitioners (GPs) reported that they considered several other conditions (i.e., GCA, infection, malignancy) as the cause of symptoms in their differential diagnosis. Treatment cannot be used in a diagnostic approach as the patient's immediate response to low dose (15–20 mg) prednisolone

* Correspondence: Stavros.chrysidis@rsyd.dk

¹Department of Rheumatology, South-west Jutland Hospital, Finsensgade 35, 6700 Esbjerg, Denmark

²OPEN, Odense Patient data Explorative Network, Odense University Hospital, Odense, Denmark

Full list of author information is available at the end of the article



© The Author(s). 2021 **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

daily is not always achieved within a few days/weeks after treatment initiation [9, 10].

Very limited data on hospitalisation rates regarding PMR diagnostics exist [7, 11, 12] and, to our knowledge, the hospitalisation rates in patients diagnosed with PMR have only been mentioned in one short communication [12]. Furthermore, in a symposium review [13], a researcher group described the implementation of a rapid-access PMR clinic, where patients with PMR suspicion were accessed within 2–3 weeks (normal referral time 8–10 weeks) [13]. Fast Track Clinics (FTC) focusing on GCA patients have shown an improvement in patient outcomes and a reduction in medical expenses [14, 15].

Thus, the aims of this study were to investigate the hospitalisation rates and the initial reasons for hospitalisation in patients with PMR. Furthermore, to evaluate the impact of a newly established FTC approach on the hospitalisation rates related to PMR diagnosis.

Methods

This retrospective observational cohort study was conducted at the Department of Internal Medicine and Rheumatology at South-West Jutland Hospital in Esbjerg (catchment area of 270,000 inhabitants). The South Denmark Region Committees on Health Research Ethics reviewed the study and concluded that the study does not fall under the scope of the Medical Research Involving Human Subjects Act and that written informed consent was not mandatory.

In Denmark, all GPs can refer a patient for further investigation to the secondary health care, as a part of The Danish healthcare system is based on the principles of free and equal access to healthcare for all citizens. PMR patients can be treated in the primary sector, and no specific criteria for which PMR suspected patients should directly be referred to a rheumatologist exist in Denmark. The decision is up to the single GP.

In South-West Jutland Hospital, as in the rest of the country, the GPs can refer a patient to the medical emergency department, where the physicians decide whether the patients will be immediately discharged or be hospitalised for further examinations and treatment. In the South-West Jutland Hospital medical emergency department, the admitted patients can either have a short stay of up to 6–8 h and then immediately discharged or hospitalised. The patients can stay up to 3 days in the medical emergency department or be forwarded to one of the seven internal medicine specialities. The rheumatologists serve primarily the outpatient clinic and the inpatient ward with approximately five beds. During the study period, this arrangement remained unchanged.

Patient identification: All patients registered with a diagnosis of PMR in the Department of Rheumatology

in South-West Jutland Hospital from April 2013 to December 2018 were identified using the electronic medical record system (Cambio COSMIC) introduced in our hospital in April 2013. Each patient's medical record was carefully evaluated. The following baseline data were registered: Age, gender, duration of symptoms, presence of bilateral shoulder pain, inflammatory markers (cut-off for elevated inflammatory markers C-reactive protein-CRP > 10 mg/Lt and/or Erythrocyte sedimentation rate-ESR > 30 mm/hr), morning stiffness more than 45 min, presence of rheumatoid factor (RF) and/or Anti-cyclic citrullinated peptide (Anti-CCP), hip pain/decreased range of motion, other joint involvement, fulfilment the 2012 EULAR/ACR classification criteria [16] for PMR, initial prednisone dose, imaging examinations. For hospitalised patients, the initial reason for hospitalisation, the number of inpatient days of care, the initial treatment, and the use of imaging modalities were also recorded.

At baseline, patients with a concomitant rheumatic disease or coexisting GCA symptoms/findings (headache, jaw claudication, tender/thickened temporal arteries, and vision disturbances) were excluded. Due to the absence of accessibility of all patients diagnosed before 2013, it was not possible to estimate the annual incidences of newly diagnosed patients for the years before Cosmic establishment; therefore, patients diagnosed before 2013 were excluded from this cohort. Only patients fulfilling the 2012 EULAR/ACR classification criteria were included in our cohort.

In summer 2017, all GPs in our catchment area were informed about the FTC's establishment, including a three-hour educational meeting about the PMR/GCA challenges and the FTC approach. For better service of the local GPs' or other medical departments' needs, direct telephone access to a rheumatologist was introduced. A rheumatologist evaluated all referrals to our outpatient clinic, and in case of PMR suspicion, the patient was examined within 3 days. Furthermore, patients admitted to the emergency medical department with PMR symptoms/suspicion could be discharged and given an appointment in the FTC within 24 h if the referring GP finds it appropriate. Detailed patient history and clinical examination were performed at the FTC, including musculoskeletal (MSK) and vascular ultrasound (US).

REDCap (Research Electronic Data Capture) [17] tools hosted at OPEN Odense University were used for data collection and management. The study was approved by the Danish Health Authority and the Data Agency of the South-West Hospital in Esbjerg.

The statistical analysis was performed by using STATA Ver. 12 SE. The patient cohort included all patients registered with a diagnosis of PMR in the Department of Rheumatology in South-West Jutland Hospital

from April 2013 to December 2018. Patients admitted to the medical emergency department with an inpatient care duration of > 8 h were defined as hospitalised. For comparisons between groups, the independent samples t-test was used for continuous variables. For the categorical variables, the Chi-square test or Fisher’s exact test was used when appropriate. *P* values < 0.05 were considered statistically significant.

Results

Four hundred seventy-six patients were registered with the diagnosis of PMR during the study period. Seventy-two patients were excluded from the study: 30 due to incorrect diagnosis, 16 suffered from other rheumatic diseases before the PMR diagnosis, 12 patient records were incomplete, and 14 had concomitant GCA symptoms at baseline. Furthermore, 82 of the identified patients were excluded due to the time of diagnosis before 2013. To summarise, in a period of 6 years (2013–2018), 324 patients were diagnosed with PMR, where 310 of them fulfilled the 2012 EULAR/ACR classification criteria and were included in the study (Fig. 1).

During the study period, 54 patients were admitted to the South-West Jutland Hospital with a mean duration of 4.02 inpatient days of care. In 2013, data were

collected only from April to December, and the annual number of newly diagnosed PMR patients was 31, of whom seven were hospitalised. In 4 years (2014–2017), the annual number of newly diagnosed PMR patients was relatively stable, with a mean value of 59 patients (range 52–68). The hospitalisations rates were equal for 2014 (*n* = 12), 2015 (*n* = 13), 2016 (*n* = 12), and slightly decreased at 2017 (*n* = 8).

The baseline characteristics of all the patients are presented in Table 1. There were no differences among hospitalised patients compared to non-hospitalised patients regarding gender and PMR-related symptoms. Hospitalised patients were more likely to have higher initial CRP (*p* < 0.0001), shorter duration of symptoms (*p* = 0.0018); they were slightly older (mean 74.11 vs 71.12 years) and with a slightly higher initial prednisolone dose (mean 20.75 vs 18.01 mg) compared to non-hospitalised patients (Table 1).

In 48% of the hospitalised patients, the reason for the initial referral to the emergency medical department was musculoskeletal pain and abnormal inflammatory markers, followed by tentative PMR diagnosis (25%). Other initial tentative diagnoses included infection (*n* = 6), fever or inflammation of unknown origin (*n* = 3), and malignancy suspicion (*n* = 2) (Fig. 2). The majority of the

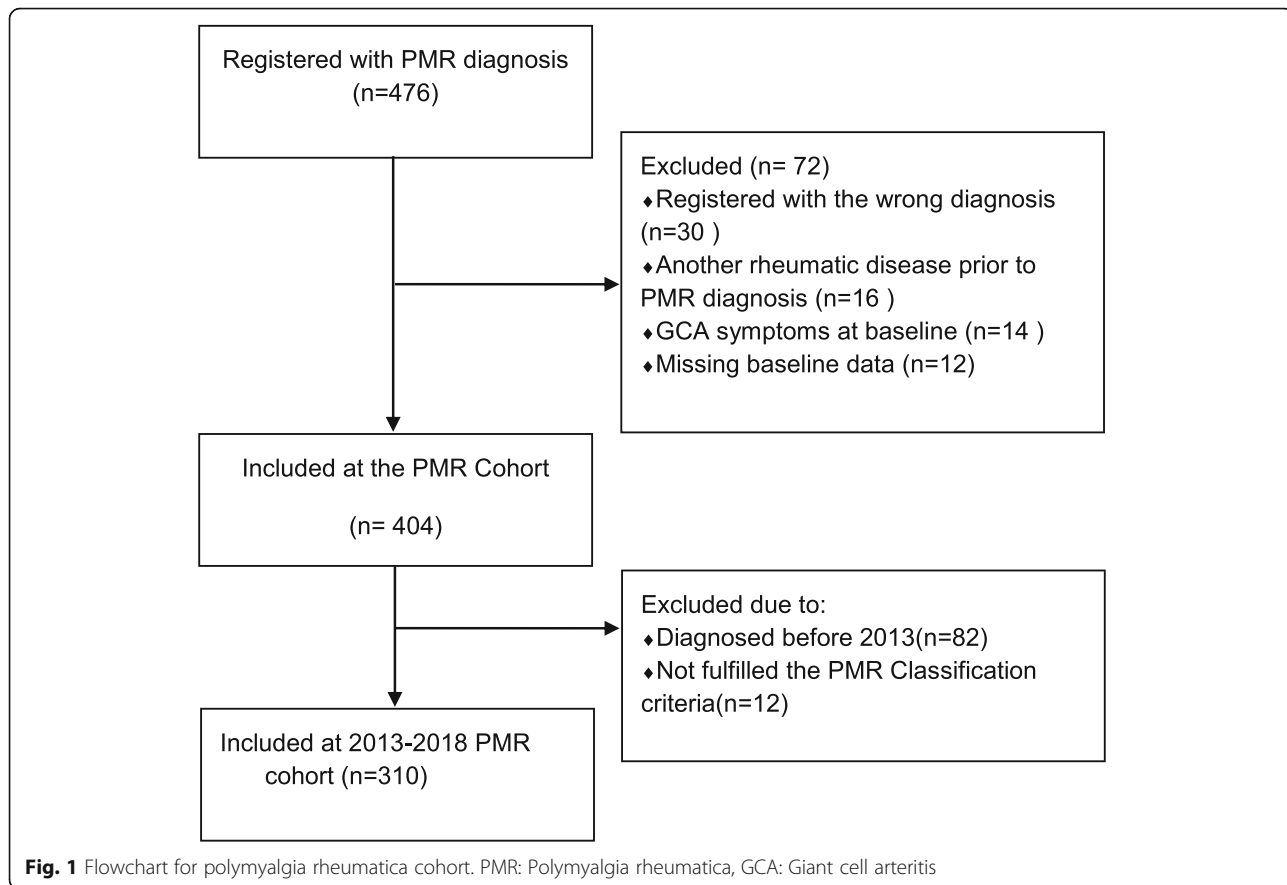


Fig. 1 Flowchart for polymyalgia rheumatica cohort. PMR: Polymyalgia rheumatica, GCA: Giant cell arteritis

Table 1 Baseline characteristics of all patients and comparison between hospitalised vs non-hospitalised patient groups

	All Patients N 310	Group A Hospitalised N 54	Group B Non-Hospitalised N 256	Group A vs B P values
Age (years) mean ± SD	71.63 ± 7.79	74.11 ± 8.24	71.12 ± 7.61	0.010
Gender-female(%)	56.1%	56.6%	56.0%	1
Duration of symptoms before the admission (weeks) mean ± SD	11.36 ± 11.54	6.94 ± 5.60	12.37 ± 12.30	0.001
CRP (mg/l) mean ± SD	55.37 ± 46.50	99.53 ± 59.36	45.82 ± 36.96	< 0.00001
Morning stiffness duration > 45 min	94.8%	98.1%	94.1%	0.220
Hip pain or limited range of motion	71.3%	78.8%	69.8%	0.182
RF and ACPA negative	96.1%	98.1%	95.7%	0.675
Absence of other joint involvement	71.9%	71.7%	72.0%	1
Initial prednisolone dose(mg) mean ± SD	18.49 ± 8.50	20.75 ± 10.02	18.01 ± 8.08	0.030

SD Standard deviation, CRP C-reactive protein, RF Rheumatoid factor, Anti-CCP Anti-cyclic citrullinated peptide

hospitalised patients (70%) were treated initially with moderate doses (15-25 mg) of glucocorticosteroids (GS) followed by antibiotics (18%) (Supplementary Fig. S1).

During hospitalisation, various diagnostic imaging procedures were performed to exclude underlying conditions other than PMR. The use of imaging modalities (computer tomography scanning of chest and abdomen, chest X-ray, abdominal ultrasound, magnetic resonance of the spine) was significantly higher compared to the non-hospitalised group (81,5% vs 15,9%, $p < 0,00001$) (Table 2). No pathological findings other than these attributed to PMR on PET-CT and bone scintigraphy were observed on the above examinations. The most common imaging modality performed in PMR patients was the musculoskeletal US, which was carried out in 64 and 63.3% of hospitalised and non-hospitalised patients, respectively. The most common findings were inflammatory

changes of the shoulders/hips (82% in hospitalised patients versus 78% in non-hospitalised patients).

After implementing the FTC in January 2018, the hospitalisation rates decreased significantly from 20.4 to 3.5% ($p = 0.001$) and the inpatient days of care from a mean of 4.15 days to 1 day ($P < 0.00001$). In two cases, the referral to the emergency department was converted to an FTC appointment the day after; both patients' final diagnosis was PMR. No differences regarding clinical and laboratory characteristics between the two groups were observed (Table 3). The symptoms' duration before diagnosis was as expected, significantly ($p = 0.001$) decreased in the FTC group (Table 3). No cases with admission to the medical emergency department and a short duration of stay (≤ 8 h) before discharging were observed, both in the 2013–2017 and 2018 cohort.

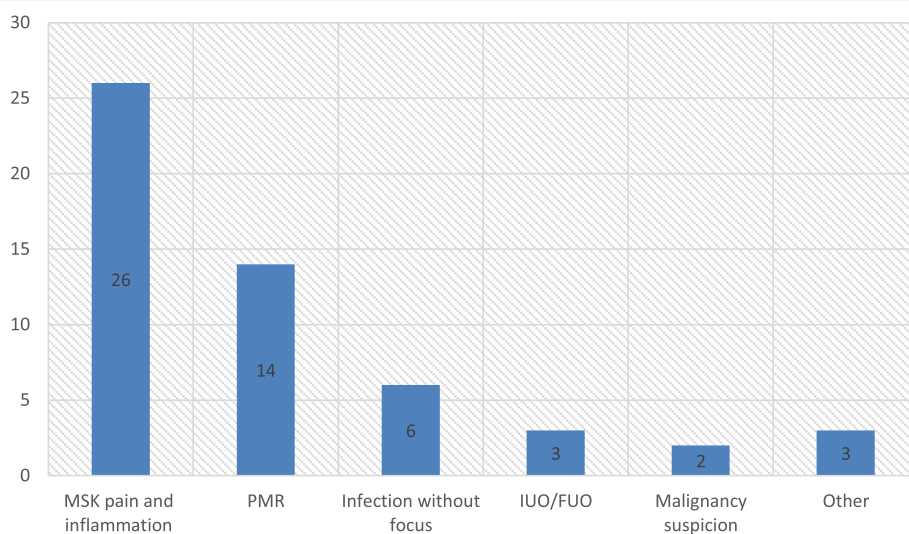


Fig. 2 Initial reasons for hospitalisation. MSK: musculoskeletal; PMR: Polymyalgia rheumatica; IUO/FUO: Inflammation/Fever of Unknown Origin

Table 2 Imaging modalities used other than musculoskeletal ultrasound between the group of hospitalised and non-hospitalised patients

	Group A Hospitalised N 54	Group B Non-Hospitalised N 256	P values
Imaging examination was performed n (%)	44(81.4%)	37(14.3%)	< 0.00001
PET-CT n(%)	3(5.5%)	9(3.5%)	0.444
CT-Chest/Abdomen n(%)	18(33.3%)	10(3.8%)	< 0.00001
Chest X-ray n(%)	18(33.3%)	5(1.9%)	< 0.00001
Bone Scintigraphy n(%)	3(5.5%)	4(1.5%)	0.156
Abdominal US n(%)	6(11.1%)	2(0.7%)	0.0005
Axial MR n(%)	5(9.2%)	6(2.3%)	0.027

PET-CT Positron emission tomography-computed tomography, CT Computer tomography, US Ultrasound, MR Magnetic resonance

According to the Danish Ministry of Finance, the healthcare costs (inpatient and outpatient) in the Danish hospitals are calculated using the DRG system [18]. The annual cost for 56 new diagnosed patients was reduced by 65% after introducing the FTC in 2018 compared to the 2013 to 2017 period.

Discussion

To our knowledge, this is the first study investigating the hospitalisation rates among newly diagnosed patients with PMR and the reasons for hospitalisation. In our study cohort, one in five newly diagnosed PMR patients was referred for hospitalisation at disease presentation before establishing the FTC. Our results demonstrated a significant difference (< 0.0001) on the initial CRP level between hospitalised and non-hospitalised patients (mean \pm standard deviation-SD) 99.53 \pm 59.36 vs 45.82 \pm 36.96 mg/Lt, without differences in the PMR-related symptoms. The high initial CRP levels and the consequent

fear of a potentially severe underlying disease may be the main reason for admission to the hospital (Fig. 2).

In a Swedish study from 1995, which investigated the mortality among 220, temporal biopsy negative PMR patients [11] 72% of all PMR patients were hospitalised. However, in this study, the patients with initial GCA-related symptoms were not excluded, leading to a potential selection bias. Furthermore, inpatient days were not presented, and it is generally unclear if the hospitalisation included patients referred from the rheumatology outpatient clinic. A Norwegian study from 1997 analysed the incidence of GCA/PMR in the county of Aust Agder (catchment area of 98,000 inhabitants) over 8 years [7]. They encouraged GPs to refer patients with GCA/PMR suspicion to the local Department of Rheumatology. During the study period, only three patients were referred to the department of internal medicine with a tentative PMR diagnosis, while in the previous 8 years, 31 cases of PMR & GCA were diagnosed by other than

Table 3 Baseline characteristics between the patient cohorts before and after implementation of the FTC

	Diagnosed during the period 2013–2017	Diagnosed after the implementation of FTC	P values
Number of patients	254	56	
Age (years) mean \pm SD	71.60 \pm 8.04	71.79 \pm 6.6	0.861
Gender (female)	57.9%	48.2%	0.233
Duration of symptoms (weeks) mean \pm SD	12.30 \pm 12.30	6.79 \pm .72	0.001
CRP (mg/Lt) mean \pm SD	55.10 \pm 48.41	56.5 \pm 37.2	0.830
Morning stiffness	94.9%	92.7%	0.527
Hip pain or limited range of motion	73.4%	61.8%	0.149
RF and anti-CCP negative	95.3%	100%	0.133
Absence of other joint involvement	71.3%	75%	0.627
Initial prednisolone dose (mg) mean \pm SD	18.37 \pm 8.33	19.2 \pm 9.25	0.550
Hospitalised n(%)	52 (20.4%)	2 (3.5%)	0.001
Inpatient days of care mean \pm SD	4.15 \pm 3.1	1 \pm 0	< 0.00001

FTC Fast track clinic, SD Standard deviation, CRP C-reactive protein, RF Rheumatoid factor, Anti-CCP Anti-cyclic citrullinated peptide

Rheumatology departments. However, it is unclear if these patients were hospitalised or diagnosed in the outpatient clinic.

In a short communication a research group from Turkey reported, that about 30% of the PMR patients were hospitalised for a mean period of 7 ± 3 days before referral to rheumatology unit [12]. Somehow, in this study, initial GCA related symptoms as headache and sight loss were reported in 43 and 7.5% of the patients. Furthermore, no information is available about hospitalisations reasons and when during the disease patients were hospitalised. Another significant difference was the very high duration (13.2 ± 12.4 months) between the first symptom onset and admission or referral to a rheumatology clinic, compared to our 2013–2017 cohort (mean 12.30 ± 12.30 weeks). An explanation can be that the physician might not be so aware and experienced on PMR diagnosis in countries with low PMR incidences [2].

In our study, the main reason for hospitalisation was musculoskeletal symptoms in association with significantly elevated levels of inflammatory markers. Non-rheumatologists initially evaluated hospitalised patients in the emergency medical department, which could be the reason for the frequent initiation of treatment with antibiotics (Supplementary S1), a high number of inpatient days of care (Table 3), higher initial prednisolone dose (Table 1), and finally increased use of imaging modalities (Table 2) to exclude other conditions, compared to the non-hospitalised group. In the study by Schönau V et al. [19], patients with fever or inflammation of unknown origin (FUO and IUO) were referred to the Immunology and Infectious Disease Clinic for further examinations. With the help of a PET-CT scanning and later on confirmed by a rheumatologist, the diagnosis of PMR was made in 6% of patients with FUO and 18% with IUO. These results are in line with our observations that patients with PMR symptoms can be referred to a non-rheumatological department or hospitalised, leading to a diagnostic delay and excessive, expensive examinations.

Hospitalised patients had a significantly ($p = 0.0018$) shorter duration of symptoms before diagnosis compared to the non-hospitalised group. In 2018, using the FTC approach, the duration of symptoms before diagnosis decreased significantly and was similar to hospitalised patients. The difference in symptoms' duration can be explained by the time from referral to evaluation in the rheumatological outpatient clinic (approximately 4–6 weeks) before establishing the FTC.

Twelve patients with a PMR diagnosis made by a rheumatologist did not fulfil the classification criteria for PMR. In 10 of the cases, the reason was initially normal inflammatory markers. ESR and CRP usually support PMR diagnosis, and increased inflammatory markers are mandatory for satisfying the PMR classification criteria

algorithm [16]. Studies, however, show that 1.5–22.2% of patients with PMR present with normal acute-phase reactants [20, 21]. In our study, none of the 12 excluded patients was hospitalised.

The fact that PMR is the second most common rheumatic disease in the elderly [22, 23] and the number of people aged over 60 years expected to increase dramatically in all countries with a high prevalence of PMR [24] emphasises the importance of our findings. The rapid evaluation of patients with PMR by using the FTC approach led to a significant decrease in hospitalisation rates and the inpatients days of care, highlighting another advantage of the FTC as a potentially more cost-effective approach for diagnosing PMR.

One of this study's strengths is that it performed in one endemic region for PMR [2, 3], where GPs are used to managing patients with these conditions [3]. The electronic journal system (Cambio COSMIC) ensured all medical records' availability, hence collecting all necessary clinical and paraclinical data. Besides, the emergency department in SVS is the only available department for admissions in our catchment area, securing the registration of hospitalised PMR patients.

Our study has limitations. The study's design is retrospective and included only patients referred to the hospital, thereby excluding patients diagnosed and treated in primary care. Nevertheless, it is a common international practice, GPs treating PMR patients and referring challenging cases to specialist healthcare for advanced diagnostics and treatment. Consequently, our study reflects the real population of PMR patients referred to specialist healthcare. The groups of hospitalised vs non-hospitalised patients were comparable in PMR related symptoms, but we could not compare the severity of symptoms, disability, or comorbidities, which may be one of the reasons for hospitalisation. Somehow, diagnostic imaging modalities were performed in the majority of hospital patient (Table 2) and other causes for PMR symptoms as malignancy or infections were excluded. Furthermore, none of the patients in the 2018 cohort developed malignancy during the first year of follow-up. The association between PMR and cancer is unclear, with previous studies yielding mixed results [11, 25–28].

Another limitation is that we did not routinely examine the 2013–2017 PMR cohort for subclinical GCA. It is reported in 16–21% of PMR patients, and the possibility of coexistent GCA arises in PMR patients with constitutional symptoms and markedly elevated acute phase reactants ([29]). In our cohort, the hospitalised patients underwent a CT scan of chest/abdomen with contrast or PET-CT in almost 40% of cases (Table 2) without evidence of large-vessel vasculitis. Furthermore, none of the hospitalised patients has been diagnosed with GCA

during the first-year follow-up after the treatment initiation. Another limitation of our study is that we included patients with an established PMR diagnosis but not patients with PMR suspicion ending with other final diagnoses. We identified our patient population using an electronic database, where patients are registered according to their final diagnosis and not the tentative/referred diagnosis. More studies evaluating the impact of FTC on patients with PMR suspicion are warranted in the future.

Conclusion

This is the first study to investigate the hospitalisation rates and the reason for hospital admissions of newly diagnosed PMR patients. Furthermore, the implementation of an FTC approach decreases the hospitalisation rates and inpatients' days of care. Future research should focus on PMR diagnosing challenges and how the primary sector and hospital departments can optimise their collaboration.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s41927-021-00210-6>.

Additional file 1: Figure S1. Initial treatment during hospitalization.

Acknowledgements

Not applicable.

Authors' contributions

SC and APD designed the study, SC build the database. SC, NS, PLH were responsible for data entry and data precession. NS and PLH performed the statistical analysis. SC, APD, and PLH wrote the manuscript. All authors contributed to the acquisition of data and have read and revised the manuscript. All author(s) read and approved the final manuscript.

Funding

The authors declare that they have not received a specific grant for this research from any funding agency in public, commercial, or not-for-profit sectors.

Availability of data and materials

The data that support the findings of this study are not publicly available, and restrictions apply to the availability of these data according to the Danish Data Protection Regulation. Data are, however, available from the authors upon reasonable request and with permission of the South-West Hospital in Esbjerg, legal services of the Research & Innovation Organisation, and approval from the Danish Data Protection Agency.

Declarations

Ethics approval and consent to participate

1. Permission to access the data was obtained from the Danish Health Authority with number: 3–3013-2338/1.
2. Permission by the South-West Hospital's Data Agency in Esbjerg: "Region Syddanmark 1779" was obtained.
- 3 The ethics committee of the South Denmark Region Committees on Health Research Ethics reviewed the study and concluded that the study does not fall under the scope of the Medical Research Involving Human Subjects Act and that written informed consent was not mandatory. Further information and documentation to support this are available to the editor on request.

Consent for publication

Not required.

Competing interests

The authors declare that they have no competing interests.

Author details

¹Department of Rheumatology, South-west Jutland Hospital, Finsensgade 35, 6700 Esbjerg, Denmark. ²OPEN, Odense Patient data Explorative Network, Odense University Hospital, Odense, Denmark. ³Department of Rheumatology, Martina Hansens Hospital, Baerum, Norway.

Received: 10 January 2021 Accepted: 17 June 2021

Published online: 05 October 2021

References

1. Buttgerit F, Dejaco C, Matteson EL, Dasgupta B. Polymyalgia Rheumatica and Giant cell arteritis: a systematic review. *JAMA*. 2016;315(22):2442–58. <https://doi.org/10.1001/jama.2016.5444>.
2. Gonzalez-Gay MA, Vazquez-Rodriguez TR, Lopez-Diaz MJ, Miranda-Fillooy JA, Gonzalez-Juanatey C, Martin J, et al. Epidemiology of giant cell arteritis and polymyalgia rheumatica. *Arthritis Rheum*. 2009;61(10):1454–61. <https://doi.org/10.1002/art.24459>.
3. Boesen P, Sorensen SF, Giant cell arteritis, temporal arteritis, and polymyalgia rheumatica in a Danish county. A prospective investigation, 1982-1985. *Arthritis Rheum*. 1987;30(3):294–9.
4. Helliwell T, Hider SL, Mallen CD. Polymyalgia rheumatica: diagnosis, prescribing, and monitoring in general practice. *Br J Gen Pract*. 2013;63(610):e361–6. <https://doi.org/10.3399/bjgp13X667231>.
5. Kremers HM, Reinalda MS, Crowson CS, Zinsmeister AR, Hunder GG, Gabriel SE. Use of physician services in a population-based cohort of patients with polymyalgia rheumatica over the course of their disease. *Arthritis Rheum*. 2005;53(3):395–403. <https://doi.org/10.1002/art.21160>.
6. Nielsen BD, Dasgupta B. Perspectives and unmet needs in polymyalgia rheumatica. Providing the fundamental framework for the development of new treatment regimes in polymyalgia rheumatica. *Reumatismo*. 2018;70(1):1–9. <https://doi.org/10.4081/reumatismo.2018.1070>.
7. Gran JT, Myklebust G. The incidence of polymyalgia rheumatica and temporal arteritis in the county of Aust Agder, South Norway: a prospective study 1987-94. *J Rheumatol*. 1997;24(9):1739–43.
8. Helliwell T, Muller S, Hider SL, Zwierska I, Lawton S, Richardson J, et al. Challenges of diagnosing and managing polymyalgia rheumatica: a multi-methods study in UK general practice. *Br J Gen Pract*. 2018;68(676):e783–93. <https://doi.org/10.3399/bjgp18X699557>.
9. Matteson EL, et al. Patient-reported outcomes in polymyalgia rheumatica. *J Rheumatol*. 2012;39(4):795–803. <https://doi.org/10.3899/jrheum.110977>.
10. Hutchings A, Hollywood J, Lamping DL, Pease CT, Chakravarty K, Silverman B, et al. Clinical outcomes, quality of life, and diagnostic uncertainty in the first year of polymyalgia rheumatica. *Arthritis Rheum*. 2007;57(5):803–9. <https://doi.org/10.1002/art.22777>.
11. Ji J, Liu X, Sundquist K, Sundquist J, Hemminki K. Cancer risk in patients hospitalized with polymyalgia rheumatica and giant cell arteritis: a follow-up study in Sweden. *Rheumatology (Oxford)*. 2010;49(6):1158–63. <https://doi.org/10.1093/rheumatology/keq040>.
12. Dalkilic E, et al. The process from symptom onset to rheumatology clinic in polymyalgia rheumatica. *Rheumatol Int*. 2014;34(11):1589–92. <https://doi.org/10.1007/s00296-014-3034-y>.
13. Quick V, Kirwan JR. Our approach to the diagnosis and treatment of polymyalgia rheumatica and giant cell (temporal) arteritis. *J R Coll Physicians Edinb*. 2012;42(4):341–9. <https://doi.org/10.4997/JRCPE.2012.413>.
14. Patil P, et al. Fast track pathway reduces sight loss in giant cell arteritis: results of a longitudinal observational cohort study. *Clin Exp Rheumatol*. 2015;33(2 Suppl 89):S103–6.
15. Diamantopoulos AP, Haugeberg G, Lindland A, Myklebust G. The fast-track ultrasound clinic for early diagnosis of giant cell arteritis significantly reduces permanent visual impairment: towards a more effective strategy to improve clinical outcome in giant cell arteritis? *Rheumatology (Oxford)*. 2016;55(1):66–70. <https://doi.org/10.1093/rheumatology/kev289>.
16. Dasgupta B, Cimmino MA, Maradit-Kremers H, Schmidt WA, Schirmer M, Salvarani C, et al. 2012 provisional classification criteria for polymyalgia rheumatica: a European league against rheumatism/American College of

- Rheumatology collaborative initiative. *Ann Rheum Dis.* 2012;71(4):484–92. <https://doi.org/10.1136/annrheumdis-2011-200329>.
17. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009;42(2):377–81. <https://doi.org/10.1016/j.jbi.2008.08.010>.
 18. Available from: <https://sundhedsdatastyrelsen.dk/da/afregning-og-finansiering/takster-drg/takster-2019>.
 19. Schonau V, et al. The value of (18) F-FDG-PET/CT in identifying the cause of fever of unknown origin (FUO) and inflammation of unknown origin (IUO): data from a prospective study. *Ann Rheum Dis.* 2018;77(1):70–7. <https://doi.org/10.1136/annrheumdis-2017-211687>.
 20. Cantini F, Salvarani C, Olivieri I, Macchioni L, Ranzi A, Niccoli L, et al. Erythrocyte sedimentation rate and C-reactive protein in the evaluation of disease activity and severity in polymyalgia rheumatica: a prospective follow-up study. *Semin Arthritis Rheum.* 2000;30(1):17–24. <https://doi.org/10.1053/sarh.2000.8366>.
 21. Helfgott SM, Kieval RI. Polymyalgia rheumatica in patients with a normal erythrocyte sedimentation rate. *Arthritis Rheum.* 1996;39(2):304–7. <https://doi.org/10.1002/art.1780390220>.
 22. Lawrence RC, Felson DT, Helmick CG, Arnold LM, Choi H, Deyo RA, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II *Arthritis Rheum.* 2008;58(1):26–35. <https://doi.org/10.1002/art.23176>.
 23. Smeeth L, Cook C, Hall AJ. Incidence of diagnosed polymyalgia rheumatica and temporal arteritis in the United Kingdom, 1990–2001. *Ann Rheum Dis.* 2006;65(8):1093–8. <https://doi.org/10.1136/ard.2005.046912>.
 24. Kontis V, Bennett JE, Mathers CD, Li G, Foreman K, Ezzati M. Future life expectancy in 35 industrialised countries: projections with a Bayesian model ensemble. *Lancet.* 2017;389(10076):1323–35. [https://doi.org/10.1016/S0140-6736\(16\)32381-9](https://doi.org/10.1016/S0140-6736(16)32381-9).
 25. Haga HJ, Eide GE, Brun J, Johansen A, Langmark F. Cancer in association with polymyalgia rheumatica and temporal arteritis. *J Rheumatol.* 1993;20(8):1335–9.
 26. Myklebust G, Wilsgaard T, Jacobsen BK, Gran JT. No increased frequency of malignant neoplasms in polymyalgia rheumatica and temporal arteritis. A prospective longitudinal study of 398 cases and matched population controls. *J Rheumatol.* 2002;29(10):2143–7.
 27. Muller S, Hider SL, Belcher J, Helliwell T, Mallen CD. Is cancer associated with polymyalgia rheumatica? A cohort study in the general practice research database. *Ann Rheum Dis.* 2014;73(10):1769–73. <https://doi.org/10.1136/annrheumdis-2013-203465>.
 28. Pfeifer EC, Crowson CS, Major BT, Matteson EL. Polymyalgia Rheumatica and its Association with Cancer. *Rheumatology (Sunnyvale).* 2015;Suppl 6:003. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4681516>.
 29. Dejaco C, Duftner C, Buttgerit F, Matteson EL, Dasgupta B. The spectrum of giant cell arteritis and polymyalgia rheumatica: revisiting the concept of the disease. *Rheumatology (Oxford).* 2017;56(4):506–15. <https://doi.org/10.1093/rheumatology/kew273>.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

