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Relapsing polychondritis - A single Centre study in the United Kingdom

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ABSTRACT

Introduction and objectives: Relapsing Polychondritis (RP) is a rare immune mediated inflammatory disorder that may result in damage and destruction of cartilaginous tissues.

Patients and methods: We retrospectively analysed patients with a clinical diagnosis of RP. Patients were investigated using pulmonary function tests, dynamic high-resolution CT scans, bronchoscopy, laryngoscopy and/or PET-CT scans along with autoimmune serology. Patients had other specialist reviews when indicated.

Results: We identified 68 patients with a diagnosis of RP, 55 (81%) were Caucasian, 8 (12%) Afro Caribbean, 4 (6%) Asian and 1 patient had Mixed Ethnicity. Twenty-nine (43%) had pulmonary involvement and in 16, pulmonary involvement was the initial presentation. The mean age at onset was 44 years (range 17-74). There was a mean diagnostic delay of 55 weeks.

Sixty-six (97%) patients received a combination of oral Prednisolone and disease modifying anti-rheumatic drugs. Twelve of 19 (63%) received biologics, with an initial good response, and 10 remain on treatment. Eleven patients with respiratory collapse required CPAP to maintain airway patency. Twelve (18%) patients died due to RP and 9 had respiratory complications. Two patients developed myelodysplasia and one had lung carcinoma. In a multivariate regression analysis, the prognostic variables were ethnicity, nasal chondritis, laryngotracheal stricture and elevated serum creatinine.

Conclusion: RP is a rare autoimmune condition often associated with significant delays in diagnosis and initiation of treatment. Pulmonary involvement in RP may cause significant morbidity and mortality due to organ damage. Disease modifying anti rheumatic drugs and biologics should be considered early in the disease course to minimise adverse effects of long-term corticosteroid therapy and organ damage.

1. Introduction

Relapsing Polychondritis (RP) is a rare immune mediated inflammatory condition that has a predilection for causing cartilaginous damage and destruction [1].All cartilaginous structures are at risk, as are regions with high proteoglycan content [2]. There are 0.71 patients per million population per year in the UK with a standardised mortality ratio of 2.16 and a Caucasian predominance [3,4]. Onset is often insidious and formal diagnosis is usually made in the 5th and 6th decades, though a wide age range at disease onset can be seen [4].

2. Objectives

This was a retrospective clinical evaluation using anonymised data to assess clinical features, outcomes and prognostic factors. The study was approved by the Research & Development Office at Guys and St Thomas' Hospitals (R&D approval no 6636) and Ethics committee approval was not needed.

3. Methods

We describe 68 patients with a diagnosis of RP. Patients were investigated with pulmonary function tests, laboratory tests including inflammatory markers, full blood count, renal and liver function and autoimmune serology including ANCA antibodies, dynamic chest CT, sinus imaging and PET-CT scans where indicated.

A bronchoscopy with bronchial biopsies was arranged when deemed necessary to confirm the diagnosis. Patients were reviewed by an

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ophthalmologist, ENT and respiratory specialist wherever necessary.

We used the Michet et al. criteria for the diagnosis of RP [5]. The RP damage index (RPDAM) was used to assess damage [6].

Multivariate regression was used for the statistical analysis of prognostic factors.

4. Results

Sixty-eight patients who attended our Unit from 2003 were included in the dataset. There were 46 (68%) female and 22 (32%) male patients with a median age at symptom onset of 44 (range 15–74) years. There was a median diagnostic delay of 55 weeks (range 6–18 months). The median age at diagnosis was 48 (range 17–76) years. There were 55 (81%) Caucasian, 8 Afro-Caribbean, 4 Asian and 1 Mixed Ethnicity patients. The median ESR was 20 (range 5–70) mm per hour and CRP was 22 (range 1–110) mg/L at presentation.

Fifty-six (82%) patients fulfilled Michet et al. criteria [5] and had 2 or more affected organs. Twelve were diagnosed with RP and respiratory involvement. (Table 1).

Thirty-three patients had a sinus CT, 15 of which were abnormal with varying severity of mucosal thickening. Fifty-eight patients had a dynamic pulmonary HRCT, of which 27 were abnormal. (Table 2).

Thirty-eight of 68 patients had pulmonary function tests of which 20 were abnormal and 13 with trachea-bronchial involvement could not perform the tests. Twelve patients had PET/CT scanning and 9 showed avid cartilage FDG uptake suggesting active disease.

4.1. RP with pulmonary involvement

Of those with respiratory manifestations, presentations included dyspnoea, tracheitis, stridor, sore throat, costochondritis, hoarse voice, chest pain, laryngeal cartilage tenderness and lower respiratory tract infective symptoms. One patient also had pulmonary emboli.

The studies were performed on 16 slice helical scanners with collimation of 0.625 and 1.5 mm, pitch of 0.98 and 1.074 mm and reconstruction interval of 1 mm respectively. All patients had inspiratory with volume acquisitions and had additional expiratory images. All images were available in both soft tissue and lung window settings.

Table 1
Pattern of organ disease: 56/68 patients fulfilled Michet's criteria and multivariate analysis.

Independent Variable	Alive	Dead	OR	95% CI	*P* value
Ethnicity: African	7	1	1.19	1.02119 to 1.3954	*P* =
ancestry	4	0			0.0271
Asian	55	11			
Caucasian	1	0			
Mixed					
Gender: Men	15	7	0.85	0.68174 to	ns
Women	39	5		0.94965	
Auricular Chondritis	35	5	1.01	0.8178–1.2473648	ns
Hearing Loss	10	4	1.19	0.9316 to 1.5264	ns
Vertigo	5	0	0.78	0.51778 to 1.18	ns
Nasal Chondritis	34	10	1.34	1.09 to 1.64	*P* =
					0.0063
Saddle nose	7	1	0.89	0.637 to 1.233	Ns
Laryngotracheal	29	11	1.07	0.823 to 1.3829	Ns
symptoms					
Laryngotracheal	17	9	1.29	1.0127 to 1.65	*P* =
Stricture					0.0397
Ocular Symptoms	30	9	1.14	0.94 to 1.378	ns
Arthritis	37	4	0.97	0.783 to 1.2	ns
Fever	1	0	1.26	0.527 to 3.01	ns
Skin Manifestations	11	1	0.87	0.653 to 1.16	ns
Aortic Regurgitation	3	0	0.94	0.589 to 1.486	ns
Mitral regurgitation	1	1	1.58	0.878 to 2.84	ns
Aneurysm	1	0	1.4	0.57 to 3.46	ns
Increased ESR	20	7	0.95	0.749 to 1.2	ns
Anaemia	19	7	1.22	0.959 to 1.54	ns
Increased Creatinine	9	0	0.73	0.54 to 0.979	*P* =
					0.0361
Microhaematuria	16	2	0.89	0.687 to 1.146	ns
Proteinuria ≥2	5	1	0.82	0.56 to 1.395	ns

Table 2
Pulmonary involvement in relapsing polychondritis.

	Number of patients	Tracheostomy	Stenting
Subglottic stenosis	4	2	
Tracheal Calcification	3		
Tracheal Stenosis	9	1	
Tracheal Thickening	13		
Tracheal Collapse	10		
Bronchial Calcification	4		
Bronchial Stenosis	14		
Bronchial Collapse	8		8
Bronchiectasis	4		
Gas trapping	14		
CT chest	27		
Abnormal Lung Function Tests	20		
Bronchoscopy	18		
PET Scan	6of 8 were positive		
CPAP	11		

Twenty-nine patients had pulmonary involvement. The pathologies observed included subglottic stenosis, tracheal thickening and calcification, tracheal collapse, bronchial calcification, stenosis, airway collapse and bronchiectasis. (Table 2).

Fifty-eight patients had a dynamic HRCT scans of which 27 were abnormal indicating pulmonary involvement. Of these, nineteen had dynamic airway collapse. Eighteen had one or more bronchoscopies. (Fig. 1) (Table 2).

Eight patients with pulmonary involvement had PET/CT imaging and 6 had FDG uptake in the cartilaginous structures indicating active disease. One patient had a negative PET-CT scan on follow-up but this patient was receiving corticosteroids which may have affected the interpretation.

Respiratory complications included: tracheomalacia (10/29), bronchial collapse (8/29), tracheal stenosis (9/29), tracheal thickening (13/29), tracheal and bronchial collapse which required stenting (8/29), and bronchiectasis was seen in four patients. Three patients with stridor required an emergency tracheostomy (3/29). (Table 2).

Twenty of 29 patients had abnormal pulmonary function tests. Gas trapping was seen in 14 patients with pulmonary involvement and an obstructive picture was seen in 12 patients. (Fig. 2) (Table 2).

Sixty-one patients (90%) had multi-organ involvement. Other organs affected were eyes, ears, nasal cartilages, airways, hearing loss, and musculoskeletal involvement of the joints/chest wall. (Table 1).

Fifty-seven patients (84%) had two or more organs involved, twenty-six (38%) had three, twelve (18%) had four and one (1.5%) patient had five organ involvement.

4.1.1. Organ damage

Ten of 68 (15%) had no residual damage, 22 (32%) had one organ, 21 (31%) had two organs, 10 (15%) had three organs, 3 (4.4%) had four organs and 2 (3%) had 6 organs with damage. (Table 3) Respiratory involvement was seen in 29/68 (43%) patients. Nine of 12 patients who died had respiratory complications including tracheobronchomalacia, expiratory collapse and airway narrowing.

4.1.2. Treatment

Most patients (67/68) were treated with a combination of oral prednisolone (median dose of 12 (1–40) mg daily and disease modifying anti-rheumatic drugs (DMARDs). (Table 4) Those patients who failed to respond or continued to exhibit disease progression were considered for treatment with biologics. (Table 4).

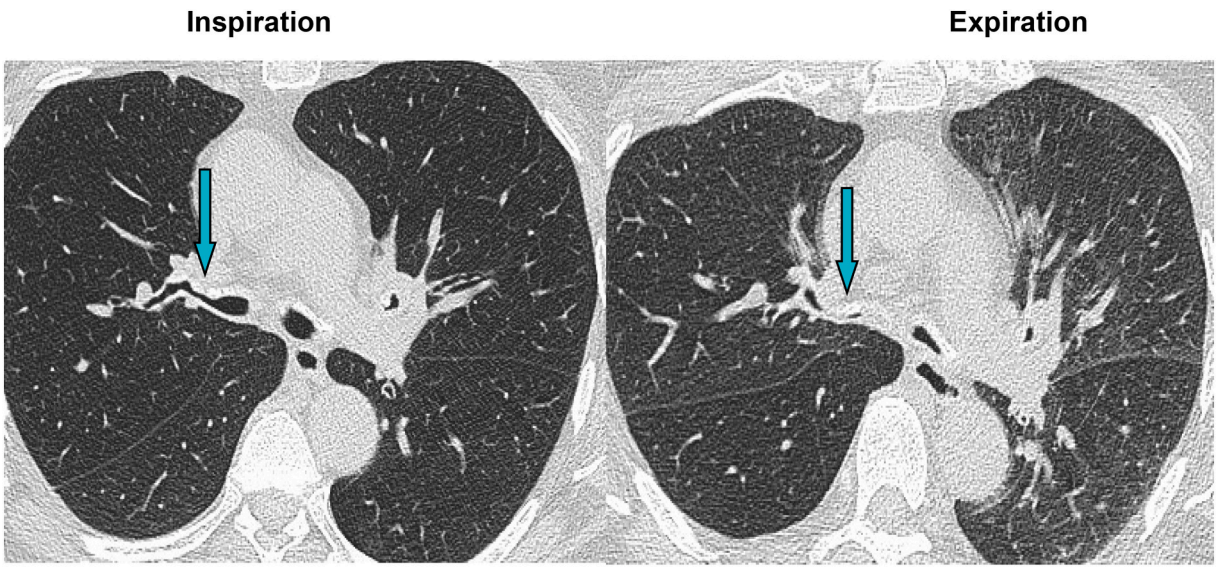

Fig. 1. A dynamic airway collapse seen on high resolution chest CT scan.

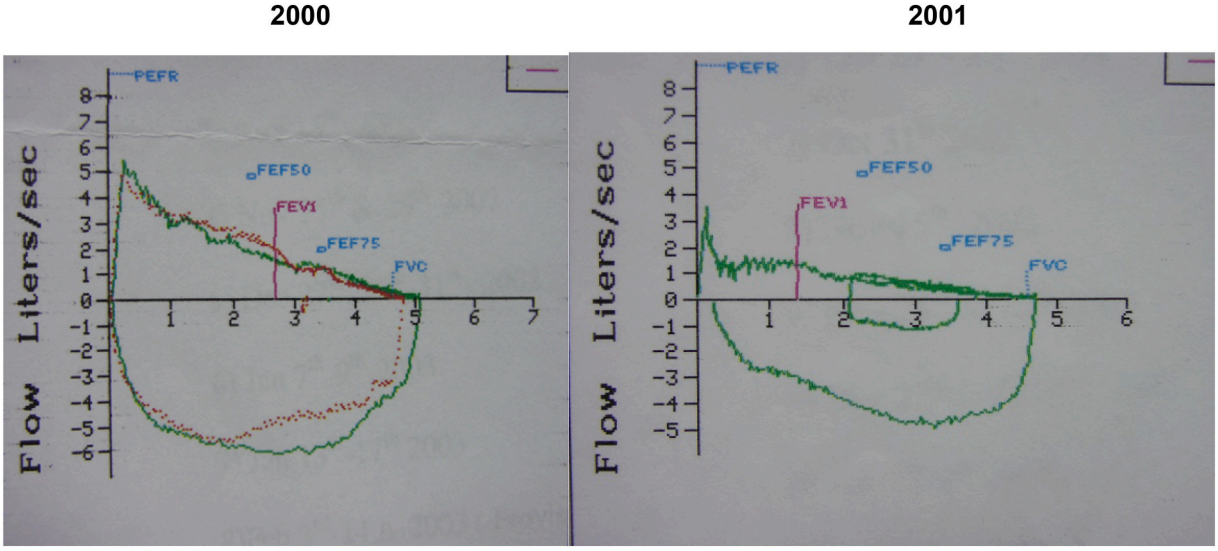

Fig. 2. Lung function test in a patient with relapsing polychondritis with airway involvement: progressive airway obstruction

Table 3
Relapsing Polychondritis Damage (RPDAM).

Ear	Permanent auricular deformities	14 (21%)
	Sensori-neural hearing loss	12 (18%)
	Conductive hearing loss	3 (4%)
	Permanent vestibular syndrome	5 (7%)
Nose	Nasal bridge collapse	10 (15%)
Eye	Scleromalacia	21 31%)
	Blindness	4 (6%)
	Orbital wall destruction	0
Respiratory	Permanent chest wall deformity	1 (1.5%)
	Dysphonia	7 (10%)
	Obstructive syndrome	26 (38%)
Cardiovascular	Aortic root dilatation	0
	Left ventricular dysfunction	1 (1.5%)
	Major tissue loss	0
Haematological	Transfusion dependency MDS*	2 (3%)
Treatment related	Osteoporosis	17 (25%)
	Avascular necrosis	0

* MDS – Myelodysplastic syndrome.

Table 4
Therapy.

Drug	Number of patients	% of patients
Prednisolone	67	99
Methotrexate	46	68
Azathioprine	18	27
Mycophenolate Mofetil	14	21
Hydroxychloroquine	10	15
Sulfasalazine	3	4.5
Ciclosporin	3	4.5
Dapsone	3	4.5
Colchicine	3	4.5
Cyclophosphamide	13	19
Infliximab	8	12
Adalimumab	7	10
Etanercept	2	3
Rituximab	4	6
Tocilizumab	2	3
Abatacept	1	1.5
Anakinra	1	1.5

4.2. Biologics

Nineteen patients received biologics. Five of these patients required several different biologics. Four patients received Rituximab: of these, two remain in remission on treatment. Eight patients received Infliximab: two of these eventually developed secondary treatment failure, three did not have a beneficial response and the remaining patients had a good response and were maintained on treatment. Seven patients received Adalimumab, five of whom achieved remission. (Table 4).

Eleven (16%) patients required CPAP to maintain airway patency due to respiratory collapse.

13/68 (19%) of patients developed Type 2 Diabetes, 20/68 (29%) had cardiovascular involvement including hypertension, hypercholesterolaemia, myocardial infarction, valvular damage and coronary artery bypass grafting. Four patients had aortic involvement, three had aortic dilatation and one had an aortic aneurysm.

Twelve of 68 (18%) patients died due to RP, of these 9 had respiratory complications. Two patients developed myelodysplasia, one had lung carcinoma. We have not identified any patients so far with VEXAS in this cohort of patients.

4.3. Statistical analysis of outcome

We used death as the dependent variable. Multivariate regression analysis was used to examine the relationship between death and the independent variables available in the dataset. Odds ratios (ORs) and 95% confidence intervals were reported. The prognostic variables were ethnicity, nasal chondritis, laryngotracheal stricture and elevated serum creatinine. Due to the small sample size, there were insufficient numbers for many of the variables to draw any definitive conclusions. (Table 1).

5. Discussion

RP is a rare autoimmune disorder often associated with diagnostic and treatment delay.

McAdam et al. defined criteria based on 3 of 6 organ involvement and a cartilage biopsy if needed [2]. Michet et al. described diagnostic criteria where cartilage biopsies are not necessary [5]. We used Michet's criteria for classification and organ involvement. (Table 1).

Mutations in the UBA1 (X linked) gene are associated with the autoinflammatory disease VEXAS. In previous studies of RP, at least 60% patients were positive for the UBA1 gene mutation and had a later disease onset in their fifties or later [7–9]. It is exclusively seen in males. Surprisingly no patients with VEXAS had airway chondritis. This syndrome is often associated with haematological abnormalities such as lymphopenia, macrocytic anaemia, thrombocytopenia, multiple myeloma and myelodysplastic syndrome. The mortality rate is higher in this group [7–9]. None of our patients have been tested for UBA1 gene mutations.

5.1. Clinical features

A French group has described 3 different phenotypes. In this large cohort of male patients, cardiac and haematological involvement were associated with increased death rates [10]. Ferrada et al. described 3 subgroups of RP. Type 1 and 2 groups had bronchomalacia with highest morbidity and aggressive disease [11].

The most common clinical manifestations are auricular and nasal chondritis. Ocular disease occurs frequently and can include episcleritis, scleritis, anterior uveitis, conjunctivitis and proptosis [12–17]. Joint involvement is mainly asymmetrical, non-deforming arthritis involving small and large joints [18].

Respiratory involvement occurs in 30–50% of patients and may be the presenting complaint in up to half of these patients. In about 20% it is the only feature [2,19–21]. Progressive respiratory involvement leads to airway stenosis, strictures and destruction of the cartilaginous tracheal rings, causing dynamic airway collapse [22,23]. Lower respiratory tract infection is a significant cause of death in these patients [24].

In our group 29/68 (43%) patients had airway involvement. Organ damage included subglottic stenoses, inflammation, stenoses and collapse of the airways. Four patients had bronchiectasis. (Table 2).

Cardiovascular involvement has been reported in 7–46% patients [25–27]. Manifestations include aortic valve disease, large vessel vasculitis, aneurysms and thromboses and mortality is high in this group [28]. In our group 20/68 (29%) patients had cardiac involvement. Three patients had aortic dilatation and 1 had an aortic aneurysm. (Table 1).

5.2. Investigations

An obstructive pattern is often seen in RP patients even in the early stages when they may not have obvious respiratory involvement [18,28]. In the later stages, irreversible airway damage due to scarring occurs [29,30] (Fig. 2).

In clinic, serial bedside peak flow measurements may help to identify early airway disease. If there is a suspicion of RP, pulmonary function testing including flow volume loops, gas transfer tests and dynamic expiratory CT scans of the chest are helpful to detect inflammation, airway collapse and air trapping [31].

Alternatively, MRI can be useful to differentiate chronic features of fibrosis from oedema and inflammation [4]. PET-CT has proven useful in the diagnosis of RP and it could be used to detect active disease [32], and our data confirms this.

In our group 26/29 patients had an abnormal chest CT, 9 of 12 had abnormal PET-CT scans, of which 6 had respiratory involvement and 20 had abnormal pulmonary function testing.

Bronchoscopy carries risks including airway collapse, pneumothorax and hypoxia [33]. Histology usually shows lymphocytic infiltration and tissue degeneration with fibrosis and necrosis [4,34]. In our cohort 29/68 (42%) patients had respiratory involvement and 18 had one or more bronchoscopies. (Table 2).

5.3. Treatment

To date there is no approved treatment for RP, and due to the rarity of the disease no randomised controlled trials are available.

The mainstay of treatment for RP is corticosteroids, often supplemented by DMARDS such as Methotrexate, Leflunomide and Azathioprine, or in severe cases low dose cyclophosphamide. Those who develop life threatening organ involvement are escalated to biologics. It has been identified that cytokines such as TNFα, interleukins are involved in pathogenesis of RP [35].

Due to biologic prescribing restrictions for RP in the UK, only 19 of our cohort were escalated to biologic therapy. Their response was suboptimal with only 50% achieving long-term remission. (Table 4) Our results are comparable to those of Kempta et al. and Moulis et al. [36–38]

Non-pharmacological therapy such as airway stenting, tracheostomy insertion and reconstructive surgery improve quality of life. Eight of 29 patients had stenting in our group.

Dubey et al. found ambulatory CPAP ventilation was beneficial in RP patients [39]. In our cohort 11 (16%) patients received CPAP.

Mortality occurred in 12 of 68 (18%) in our cohort. The majority (9/12) died from respiratory complications, 2 developed myelodysplasia and 1 lung carcinoma. Our data showed that the prognostic variables were ethnicity, especially African ancestry, presence of nasal chondritis, laryngotracheal stricture and elevated serum creatinine.

5.4. Limitations

The UK is a predominantly Caucasian country which is reflected in our cohort. It was not possible to do sequential RP disease activity index

(RPDAI) scores [40] in a period of 28 days. We do not have post treatment RP damage index scores [6]. Our centre is a tertiary referral unit so referral bias towards more severe presentations is a possibility. Left censorship bias was minimised by using a patient database. The small sample size, did not allow definitive conclusions to be drawn regarding the prognostic factors.

6. Summary

RP is a rare condition with multi-organ involvement and may lead to chronic damage if not treated early. Respiratory or cardiovascular involvement can be life-threatening. There are no clear treatment guidelines, however empirical research has suggested that infliximab may have a role to a certain extent. Early aggressive intervention may prevent the organ damage, reducing morbidity and mortality. The recent concept of VEXAS syndrome in RP has opened a new window and this may suggest a different approach may be necessary.

Declaration of Competing Interest

There are no conflicts of interest to declare; Sangle, Barry, Qureshi, Cheah, and Poh contributed in collecting data. Sangle and Hughes helped in writing the manuscript. D'Cruz helped in collecting data, supervising the project and finalising the manuscript.

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

[1] Trentham DE, Le CH. Relapsing polychondritis. Ann Intern Med 1998;129:114–22.
[2] McAdam LP, O'Hanlan MA, Bluestone R, Pearson CM. Relapsing polychondritis: prospective study of 23 patients and a review of the literature. Medicine (Baltimore) 1976;55:193–215.
[3] Hazra N, Dregan A, Charlton J, Gulliford MC, D'Cruz DP. Incidence and mortality of relapsing polychondritis in the UK: a population-based cohort study. Rheumatology (Oxford) 2015;54:2181–7.
[4] Kingdon J, Roscamp J, Sangle S, D'Cruz D. Relapsing polychondritis: a clinical review for rheumatologists. Rheumatology (Oxford) 2018;57:1525–32.
[5] Michet Jr CJ, McKenna CH, Luthra HS, O'Fallon WM. Relapsing Polychondritis: survival and predictive role of early disease manifestations. Ann Intern Med 1986; 104. 74–08.
[6] Mertz P, Belot A, Cervera R, Chuah TY, Dagna L, Damian L, et al. The relapsing polychondritis damage index (RPDAM): development of a disease-specific damage score for relapsing polychondritis. Joint Bone Spine 2019;86:363–8.
[7] Beck DB, Ferrada MA, Sikora KA, Ombrello AK, Collins JC, Pei W, et al. Somatic mutation in UBA1 and severe adult onset autoinflammatory disease. N Engl J Med 2020;383:2628–38.
[8] Ferrada MA, Sikora KA, Luo Y, Wells KV, Patel B, Groake EM, et al. Somatic mutation in UBA1 define a distinct subset of relapsing polychondritis patients with VEXAS. Arthtis Rheumatol 2021;73:1886–95.
[9] Grayson PC, Beck DB, Ferrada MA, Nigrovic PA, Kastner DL. VEXAS syndrome and disease Toxonomy in rheumatology. Arthritis Rheumatol 2022;74:1733–6.
[10] Dion J, Costedoat-Chalumeau N, Sène D, Cohen-Bittan J, Leroux G, Dion C, et al. Relapsing polychondritis. Three different clinical phenotypes: analysis of a recent series of 142 patients. Arthritis Rheumatol 2016;68:2992–3001.
[11] Ferrada M, Rimland CA, Quinn K, Sikora K, Kim J, Allen C, et al. Defining clinical subgroups in relapsing polychondritis: a prospective observational cohort study. Arthritis Rheumatol 2020;72:1396–402.
[12] Borgia F, Giuffrida R, Guarneri F, Cannavo SP. Relapsing Polychondritis: An Updated Review Biomedicines 2018;6:1–14.
[13] Lekpa FK, Chevalier X. Refractory relapsing polychondritis: challenges and solutions. Open Access Rheumatol 2018;10:1–11.
[14] Bachor E, Blevins NH, Karmody C, Kuhnel T. Otologic manifestations of relapsing polychondritis. Review of literature and report of nine cases. Auris Nasus Larynx 2006;33:135–41.
[15] Lahmer T, Treiber M, von Werder A, Foerger F, Knopf A, Heemann U, et al. Relapsing polychondritis: an autoimmune disease with many faces. Autoimmun Rev 2010;9:540–6.
[16] Tanaka R, Kaburaki T, Nakahara H, Komae K. Ocular inflammation associated with relapsing polychondritis in Japanese patients: a review of 11 patients. Int Ophthalmol 2019;39:2649–59.
[17] Yang P, Yuan W, Du L, Zhou Q, Wang C, Ye Z, et al. Clinical features of Chinese patients with relapsing polychondritis. Br J Ophthalmol 2019;103:1129–32.
[18] Letko E, Zafirakis P, Baltatzis S, Voudouri A, Livir-Rallatos C, Foster CS. Relapsing polychondritis: a clinical review. Semin Arthritis Rheum 2002;31:384–95.
[19] Ernst A, Rafeq S, Boiselle P, Sung A, Reddy C, Michaud G, et al. Relapsing polychondritis and airway involvement. Chest. 2009;135:1024–30.
[20] Shimizu J, Yamano Y, Kawahata K, Suzuki N. Relapsing polychondritis patients were divided into three subgroups: patients with respiratory involvement (R subgroup), patients with auricular involvement (a subgroup), and overlapping patients with both involvements (O subgroup), and each group had distinctive clinical characteristics. Medicine (Baltimore) 2018;97:e12837.
[21] Rafeq S, Trentham D, Ernst A. Pulmonary manifestations of relapsing polychondritis. Clin Chest Med 2010;31:513–8.
[22] Riha RL, Douglas NJ. Obstructive sleep apnoea/hypopnoea as the initial presentation of relapsing polychondritis. Int J Clin Pract 2004;58:97–9.
[23] Gorard C, Kadri S. Critical airway involvement in relapsing polychondritis. BMJ Case Rep 2014;2014.
[24] Danve A. Thoracic manifestations of ankylosing spondylitis, inflammatory bowel disease, and relapsing Polychondritis. Clin Chest Med 2019;40:599–608.
[25] Shimizu J, Oka H, Yamano Y, Yudoh K, Suzuki N. Cardiac involvement in relapsing polychondritis in Japan. Rheumatology (Oxford) 2016;55:583–4.
[26] Lin DF, Yang WQ, Zhang PP, Lv Q, Jin O, Gu JR. Clinical and prognostic characteristics of 158 cases of relapsing polychondritis in China and review of the literature. Rheumatol Int 2016;36:1003–9.
[27] Erdogan M, Esatoglu SN, Hatemi G, Hamuryudan V. Aortic involvement in relapsing polychondritis: case-based review. Rheumatol Int 2019;41:827–37.
[28] Tomelleri A, Campochiaro C, Sartorelli S, Papa M, De Luca G, Cavalli G, et al. Large vessel Vasculitis affecting the aorta and its branches in relapsing Polychondritis: case series and systematic review of the literature. J Rheumatol 2019;47:1780–4.
[29] Sarodia BD, Dasgupta A, Mehta AC. Management of airway manifestations of relapsing polychondritis: case reports and review of literature. Chest. 1999;116: 1669–75.
[30] Sato R, Ohshima N, Masuda K, Matsui H, Higaki N, Inoue E, et al. A patient with relapsing polychondritis who had been diagnosed as intractable bronchial asthma. Intern Med 2012;51:1773–8.
[31] Lee KS, Ernst A, Trentham DE, Lunn W, Feller-Kopman DJ, Boiselle PM. Relapsing polychondritis: prevalence of expiratory CT airway abnormalities. Radiology. 2006;240:565–73.
[32] Wang J, Liu X, Pu C, Chen Y. 18F-FDG PET/CT is an ideal imaging modality for the early diagnosis of relapsing polychondritis: a case report. Medicine (Baltimore) 2017;96(30):e7503.
[33] Kawano T, Matsuse H, Kinoshita N, Tsuchida T, Nishino T, Fukushima C, et al. Bronchoscopic observation of unusual deformities of bronchial cartilage and subsequent airway narrowing in respiratory relapsing polychondritis. Am J Case Rep 2012;13. 114–7.34.
[34] Stahl DL, Richard KM, Papadimos TJ. Complications of bronchoscopy: a concise synopsis. Int J Crit Illn Inj Sci 2015;5(3):189–95.
[35] Arnaud L, Mathian A, Haroche, et al. Pathogenesis of Relapsing polychondritis: a 2013 update. Autoimmun Rev 2014:1390–5.
[36] Kemta Lekpa F, Kraus VB, Chevalier X. Biologics in relapsing polychondritis: a literature review. Semin Arthritis Rheum 2012;41:712–9.
[37] Moulis G, Sailler L, Pugnet G, Astudillo L, Arlet P. Biologics in relapsing polychondritis: a case series. Clin Exp Rheumatol 2013;31:937–9.
[38] Moulis G, Pugnet G, Costedoat-Chalumeau N, Mathian A, Leroux G, Boutemy J, et al. Efficacy and safety of biologics in relapsing polychondritis: a French national multicentre study. Ann Rheum Dis 2018;77:1172–8.
[39] Dubey S, Gelder C, Pink G, Ali A, Taylor C, Shakespear J, et al. Respiratory subtype of relapsing polychondritis frequently presents as difficult asthma: a descriptive study of respiratory involvement in relapsing polychondritis with 13 patients from a single UK centre. ERJ Open Res 2021;7:00170–202039.
[40] Arnaud L, Devilliers H, Peng SL, Mathian A, Costedoat-chalumeau N, Buckner J, et al. The relapsing Polychondritis disease activity index: development of a disease activity score for relapsing polychondritis. Autoimmun Rev 2012;12:204–9.