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Research article

Characteristics of patients with incidental eosinophilia admitted to a tertiary hospital in southern China

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ABSTRACT

Background: The characteristics of patients with eosinophilia are heterogeneous and the outcomes can vary from asymptomatic to severe.
Objective: To describe the feature of patients with eosinophilia in a single center.
Design: Based on the electronic medical records from Yangjiang People's Hospital in China, the inpatients admitted between June 2018 and February 2021 with measured blood eosinophil counts were evaluated.
Methods: Eosinophilia was defined as a peripheral blood eosinophil count of $\geq 0.5 \times 10^9$/L. Differences were compared by eosinophilia severity. The medical records of patients with moderate to severe eosinophilia were reviewed and summarized in terms of examination, diagnoses and management. And these patients were matched with patients without incidental eosinophilia by propensity score and the differences were compared.
Results: A total of 7,835 patients with eosinophilia were identified out of 131,566 total inpatients. All types of eosinophilia were most common in males (8.2%; 5,351/65,615), and in patients aged 0–6 years (11.6%; 1,760/15,204), and in the pediatric (10.8%; 1,764/16,336) department, followed by dermatology (10.6%; 123/1,162), Oncology (7.5%; 394/5,239) and Intensive care unit (ICU) (7.4%; 119/1,608). Patients with moderate to severe eosinophilia were more likely to admit

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to ICU (moderate: 1.3%; severe: 0.50%). In patients with moderate to severe eosinophilia, only 205/621 (33%) had eosinophilia mentioned in their records, and only 63/621 (10.1%) underwent investigations for eosinophilia. The majority of patients with moderate to severe eosinophilia (372/621, 59.9%) had an infectious disease, and little examination (7.4%; 46/621) was taken to identify the cause of eosinophilia, and only 39/621 (6.3%) of patients had a discrete cause of eosinophilia identified. Patients with moderate to severe eosinophilia (24.3%; 151/621) exhibited certain chance to have organ dysfunction.

Conclusion: Incidental eosinophilia in inpatients was frequently neglected and less investigated. Multidisciplinary consultation may improve outcomes of inpatients with moderate to severe eosinophilia.

1. Introduction

Eosinophil counts are routinely obtained by sampling peripheral blood in inpatients. The upper limit of normal for the range of eosinophils in the peripheral blood is 3–5% of the white cell count with a corresponding absolute eosinophil count (AEC) of 350–500/mm^3 [1]. The cut-off value to define eosinophilia may be varied in different centers [2]. According to the definition from World Health Organization (WHO), the severity of eosinophilia has been arbitrarily divided into mild (AEC from the upper limit of normal to 1,500/mm^3), moderate (AEC 1,500–5,000/mm^3), and severe (AEC >5,000/mm^3) [3].

However, eosinophilia encountered incidentally was frequently neglected by clinicians. Martin Pejuet*et al.* [4] reported that a total of 46.6% of the 298 eosinophilia cases observed in their study were likely ignored and not mentioned in medical records, despite the fact that the level of eosinophils was high. And it was reported that most physicians did not pay attention to patients with transitory mild eosinophilia unless they were associated with disease disorders [5].

A variety of causes of eosinophilia have been widely recognized including asthma, dermatosis diseases, hematological malignancy, drug-effect, parasitic infections, gastrointestinal disorders and vasculitides [6,7]. Recently, an increasing number of studies demonstrated that lymphocyte variant of HES subtype (L-HES), Immunoglobulin G4-related disease (IgG4-RD) and Eosinophilic granulomatosis with polyangiitis (EGPA) could be the common causes of secondary eosinophilia [8,9], but with inadequate evaluation. Patients with eosinophilia could exhibit with different symptoms involving multiple organs, which could be neglected by clinicians easily [10]. As the close relationship between parasitic infection and eosinophilia, doctors in department of infectious diseases should pay attention to the patient's epidemiological history and exclude the possibility of parasitic infection in conjunction with clinical symptoms. However, a high incidence of parasitic infections is uncommon in Yangjiang city. Most patients are local residents without a history of travel to a tropical region before admission to hospitals, which is worth evaluating the characteristics of patients with all types of eosinophilia.

More works are required for other clinicians, for example, pulmonologists should pay attention to lung conditions and exclude the possible diagnosis of eosinophilia-related lung disease. Gastroenterologist should pay attention to gastrointestinal symptoms and exclude the possible diagnosis of eosinophilic esophagitis and other eosinophilia-related gastrointestinal diseases. The radiologist should provide imaging findings to determine the primary lesion and the barrier of the lesion. Pathologists should provide the conclusion of pathological tissue biopsy and determine the situation of eosinophil infiltration. Hematologist should conduct further examination based on the symptoms and the pathological biopsy results. However, because of the diversity of eosinophilic-related diseases and the lack of eosinophilia work-up, as well as insufficient knowledges in the field of clinical characteristics of all types of eosinophilia in China, conducting research in this area based on real-world data is of great significance.

Our study aimed to describe the clinical characteristics of inpatients with incidental eosinophilia in a tertiary hospital in China. We calculated the proportion of eosinophilia among the hospital populations. The approach to evaluate patients with moderate to severe eosinophilia from the clinicians was explored. And the differences between patients with moderate to severe eosinophilia and patients without eosinophilia were compared.

2. Materials and methods

Data was derived from June 2018 to February 2021 in electronic health system of Yangjiang People's Hospital [11], which is the only tertiary hospital in Yangjiang City, Guangdong, China (Appendix Fig. 1). Types of hospital departments or centers and settings are shown in Appendix Table 1.

A retrospective chart review was completed by searching the electronic medical records to identify all records of individuals of all ages hospitalized at Yangjiang People's Hospital. Patients with blood eosinophil counts were identified. And those meeting diagnostic criteria for eosinophilia were included for analysis. Eosinophilia was defined as a peripheral blood eosinophil count of $\geq 0.5 \times 10^9$/L [3].

Results of parameters measured during the admission (e.g., routine blood tests, liver or renal function tests, tumor markers, or blood gas analysis) were included in the analysis.

To calculate the proportion of patients with eosinophilia based on the hospital populations, the number of patients who met the definition of eosinophilia was divided by the total number of patients in the inpatient setting (June 2018–February 2021).

Basic information such as age, sex, discharge department, and outcome status of 621 patients with moderate to severe eosinophilia were reported. Additionally, we reviewed the medical records of these patients and summarized their examination, diagnoses and

management especially related to eosinophilia.

Patients with moderate to severe eosinophilia were matched by propensity score to patients without incidental eosinophilia, in order to balance the differences in characteristics and to compare the differences in having organ failure. The propensity score was estimated with the use of a multivariable logistic-regression model, with patients with moderate to severe eosinophilia and patients without incidental eosinophilia as the dependent variable and the basic information as covariates. Matching was performed with the use of a 1:1 matching protocol without replacement. A p value of greater than 0.05 for a given covariate indicates a relatively small imbalance. In order to compare the organ function impairment between these two groups, creatinine (CR) and Urea were used to indicate the renal function. And firbrin or fibrinogen degradation products (FDP), D-Dimer, activated partial thromboplastin time (APTT) and prothrombin time (PT) were used to indicate coagulation function. And the partial pressure of arterial oxygen (PaO_2) less than 60 mmHg was used to indicate respiratory failure, due to the lack of medical records of patients without eosinophilia.

2.1. Statistical analysis

The clinical characteristics comparisons were performed using Mann–Whitney test or Kruskal–Wallis test for continuous variables and chi-squared test for categorical variables. Propensity score matching was used to compared the differences between patients with moderate to severe eosinophilia and patients without incidental eosinophilia. A p-value of less than 0.05 was considered significant for all tests. Statistical analyses were performed with R version 4.0.5 (http://CRAN.R-project.org, R Foundation, Vienna, Austria).

3. Results

3.1. Clinical characteristics

A total of 131,566 patients were recorded in the inpatient setting during June 2018 to February 2021. Therefore, the hospital-based proportion for eosinophilia was 6.0% (7,835/131,566) [mild: 5.5%, moderate: 0.4%, severe: 0.1%]. Among them, 5,351 patients (8.2%; 5,351/65,615) were male. The median (min, max) age was 56 (0, 101). Eosinophilia was more common in patients aged 0–6 years (11.6%; 1,760/15,204), patients ≥86 years (9.1%; 395/4,360), and in the pediatric (10.8%; 1,764/16,336) department, followed by dermatology (10.6%; 123/1,162), Oncology (7.5%; 394/5,239) and ICU (7.4%; 119/1,608) (Table 1). Patients from Yangjiang City and nearby areas accounted for 89.6% (117,996/131,566) of admissions.

In addition, the results showed that the proportion of eosinophilia was higher in males than in females, and there were statistically significant differences in mild and severe eosinophilia groups and among four age groups ($p < 0.05$) (Appendix Figs. 2 and 3). When further analyzing the severity of eosinophilia in internal and surgical departments, the level of blood eosinophil counts [median (min, max), unit: $\times 10^9$/L] and the percentage of severe eosinophilia seemed higher in hematology [0.9 (0.5, 32.7) and 13.7%] and hepatological surgery [0.8 (0.5, 23.6) and 3.3%] departments (Appendix Tables 2 and 3).

Table 1
Characteristics of inpatients (n = 131,566).

Characteristics	Number of total patients	Number of patients with eosinophilia (%)	Number of patients with moderate eosinophilia (%)	Number of patients with severe eosinophilia (%)
Gender				
Female	65,951	2,484 (3.8)	190 (0.3)	33 (0.1)
Male	65,615	5,351 (8.2)	354 (0.5)	44 (0.1)
Age at admission (y)#		56 (0, 101)	60 (0, 96)	57 (1, 91)
0–6	15,204	1,760 (11.6)	101 (0.7)	7 (0.1)
7–18	5,831	388 (6.7)	21 (0.4)	1 (0.02)
19–40	24,638	546 (2.2)	31 (0.1)	11 (0.04)
41–65	50,089	2,262 (4.5)	175 (0.4)	30 (0.1)
66–85	31,444	2,484 (7.9)	190 (0.6)	25 (0.1)
86–101	4,360	395 (9.1)	26 (0.6)	3 (0.1)
Hospital department				
Pediatrics	16,336	1,764 (10.8)	96 (0.6)	6 (0.04)
Dermatology	1,162	123 (10.6)	20 (1.7)	1 (0.1)
Oncology	5,239	394 (7.5)	32 (0.6)	2 (0.04)
ICU	1,608	119 (7.4)	21 (1.3)	8 (0.5)
Internal medicine	36,404	2,310 (6.3)	174 (0.5)	43 (0.1)
Surgery	49,143	2,524 (5.1)	169 (0.3)	14 (0.03)
ENT	7,833	315 (4.0)	16 (0.2)	2 (0.03)
Gynecology	5,365	97 (1.8)	4 (0.1)	–
Obstetrics	6,299	38 (0.6)	2 (0.03)	–
Other	2,177	151 (6.9)	10 (0.5)	1 (0.1)

#: Data are presented as median (min, max).
Abbreviations: Intensive Care Unit (ICU); Ear, Nose, and Throat (as a department in a hospital) (ENT).

3.2. Clinical parameters

Out of 7,835 eosinophilia cases, a total of 7,214 (92.1%) cases [0.7 (0.5, 1.5)] were mild eosinophilia, 544 (6.9%) cases [1.9 (1.5, 4.9)] were moderate, and 77 (1.0%) cases [8.6 (5.1, 44.4)] were severe. The distribution of absolute eosinophil counts converted by the log-transformation could be seen in Appendix Fig. 4. And multiple clinical parameters related to first-line coagulations tests, cardiac, liver, renal function or inflammation deteriorated as the severity of eosinophilia. Compared with mild eosinophilia, patients with moderate and severe eosinophilia had a higher level in LDH, CRP, hs-CRP, PT, APTT, INR, FDP, D-Dimer, CKMB, Urea, ALB, ALT, AST, Hb (All $p < 0.05$) (Appendix Table 4).

3.3. Diagnosis and treatment of patients with moderate to severe eosinophilia

The majority of patients with moderate to severe eosinophilia (59.9%, 372/621) had an infectious diseases (59.9%, 372/621), followed by tumor (15.5%, 96/621), skin diseases (10.0%, 62/621), respiratory diseases (6.0%, 37/621), leukemia (4.2%, 26/621), rheumatic diseases (2.6%, 16/621), vasculitis (0.5%, 3/621), lymphoma (0.5%, 3/621), and parasitic diseases (0.3%, 2/621). Only 205 patients had eosinophilia mentioned in their medical records. Patients had closed blood eosinophil counts and the proportion of eosinophils in white blood cells between groups mentioned eosinophilia in the medical records and those did not ($p = 1.0$, 0.3 and 0.8). Except the comparison of eosinophil counts in patients with moderate eosinophilia ($p < 0.05$) (Appendix Table 5). The cause of eosinophilia was taken into account in the medical records of the 63 patients. Only 54 patients were scheduled for targeted examinations to explore the etiology, primarily through stool testing for parasites (100%; 54/54), bone marrow puncture-biopsy (61.1%; 33/54), bacteria-related examination (55.6%; 30/54), ANA serology testing (29.6%; 16/54), fungi-related examination (20.4%; 11/54), IgE levels (14.8%; 8/54), Gastroscopic observation and biopsy (14.8%; 8/54), lesion skin biopsy (9.3%; 5/54), and serum parasites antibody tests (7.4%; 4/54). However, none of them were arranged for ANCA serology testing, serum protein electrophoresis (SPEP), IgG subclasses, serum tryptase and vitamin B12. Finally, only 39 patients had the etiology of eosinophilia recorded. Among them, 26/39 (66.7%) of patients were diagnosed with myeloid/lymphoid neoplasms, and four patients had eosinophilic gastroenteritis, and two patients each had bullous pemphigoid and parasitic disease, one of whom also had eosinophilic gastritis. Additionally, one patient each had eczema, atopic dermatitis, hypereosinophilic syndrome (HES), and AGPA (Allergic Granulomatosis with Polyangiitis) (Fig. 1 and Appendix Table 6).

A total of 361 consultations (361/621, 58.1%) were made, with only 43 consultations (43/361, 11.9%) were undertaken for eosinophilia, all of which were conducted by hematologists. No allergist/immunologist or multidisciplinary was consulted for eosinophilia.

Organ dysfunction was common in patients with moderate [23.4% (127/544)] to severe eosinophilia [31.2% (24/77)]. However, physicians rarely analyzed whether it was caused by eosinophilia.

A total of 161 patients [25.9% (161/621)] had poor prognosis and transferred to general hospitals in Guangzhou, the capital of Guangdong Province, for further treatment or gave up treatment because their condition did not improve (Fig. 2). Moreover, eight patients died because of renal failure, heart failure, multiple organ failure, leukemia, advanced cancer, brain injury or myocardial infarction.

3.4. Patients with incidental eosinophilia compared with patients without incidental eosinophilia

Before propensity score matching, there were differences in baseline characteristics between patients with incidental eosinophilia and patients without incidental eosinophilia (Table 2). After matching, a cohort of 621 patients without incidental eosinophilia was identified. As the p values were greater than 0.05 for all baseline variables, we concluded that small differences were found. With a mean age of 51.3 years, patients with incidental eosinophilia, as compared with patients without incidental eosinophilia, had a higher level of APTT [mean (sd): 38.4 (25.2) vs 33.7 (17.4), $p < 0.05$], CKMB [mean (sd): 73.6 (236.8) vs 36.6 (52.6), $p < 0.05$], CR [mean (sd): 137.2 (198.9) vs 90.4 (99.2), $p < 0.05$], D-Dimer [mean (sd): 4.1 (6.2) vs 2.4 (4.1), $p < 0.05$], PLT [mean (sd): 340.3 (222.4) vs

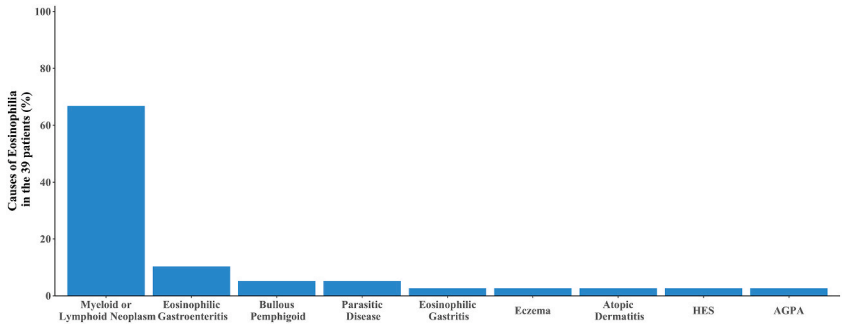

Fig. 1. The causes of eosinophilia in patients with definite diagnosis. Sample size, n = 39; AGPA: Allergic Granulomatosis with Polyangiitis; HES: Hypereosinophilic syndromes.

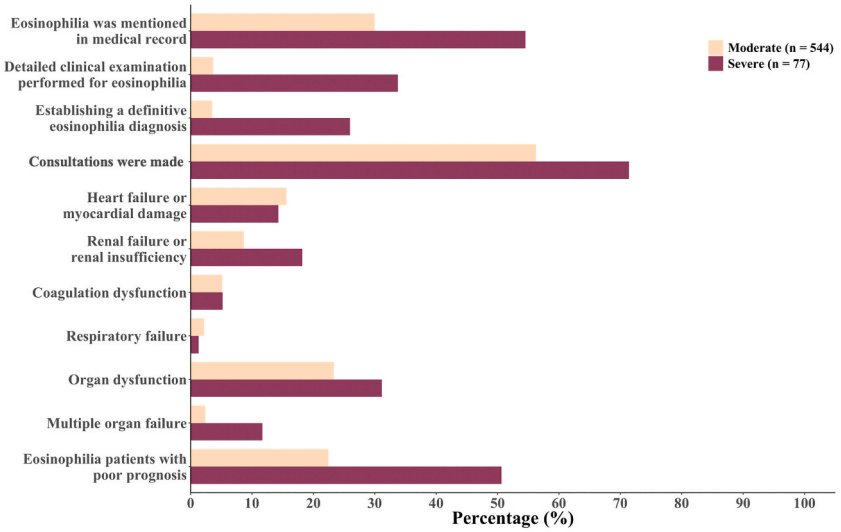

Fig. 2. Diagnosis and treatment of patients with moderate and severe eosinophilia.

Table 2
Baseline characteristics before and after propensity score matching.

Characteristics	Before Matching			After Matching		
	non-eosinophilia (n = 123,731)	Eosinophilia (7,835)	P value	non-eosinophilia (n = 621)	Eosinophilia (621)	P value
Gender			<0.05			1.0
Female	63,467 (51.3)	2,484 (31.7)		223 (35.9)	223 (35.9)	
Male	60,264 (48.7)	5,351 (68.3)		398 (64.1)	398 (64.1)	
Age at admission (y)#	47.6 (24.6)	47.3 (30.5)	<0.05	51.4 (28.0)	51.3 (28.7)	0.9
0–6	13,444 (10.9)	1,760 (22.5)		108 (17.4)	108 (17.4)	
7–18	5,443 (4.4)	388 (5.0)		22 (3.5)	22 (3.5)	
19–40	24,092 (19.5)	546 (7.0)		42 (6.8)	42 (6.8)	
41–65	47,827 (38.7)	2,262 (28.9)		205 (33.0)	205 (33.0)	
66–85	28,960 (23.4)	2,484 (31.7)		215 (34.6)	215 (34.6)	
86–101	3,965 (3.2)	395 (5.0)		29 (4.7)	29 (4.7)	
Hospital departments			<0.05			1.0
Pediatrics	14,572 (11.8)	1,764 (22.5)		102 (16.4)	102 (16.4)	
Dermatology	1,039 (0.8)	123 (1.6)		21 (3.4)	21 (3.4)	
Oncology	4,845 (3.9)	394 (5.0)		34 (5.5)	34 (5.5)	
ICU	1,489 (1.2)	119 (1.5)		29 (4.7)	29 (4.7)	
Internal medicine	34,094 (27.6)	2,310 (29.5)		217 (34.9)	217 (34.9)	
Surgery	46,619 (37.7)	2,524 (32.2)		183 (29.5)	183 (29.5)	
ENT	7,518 (6.1)	315 (4.0)		18 (2.9)	18 (2.9)	
Gynecology	5,268 (4.3)	97 (1.2)		4 (0.6)	4 (0.6)	
Obstetrics	6,261 (5.1)	38 (0.5)		2 (0.3)	2 (0.3)	
Other	2,026 (1.6)	151 (1.9)		11 (1.8)	11 (1.8)	

Abbreviations: Intensive Care Unit (ICU); Ear, Nose, and Throat (as a department in a hospital) (ENT).

270.3 (107.1), $p < 0.05$], and WBC [mean (sd): 27.6 (61.8) vs 9.4 (8.3), $p < 0.05$] (Appendix Table 7). And it was found that the proportion of patients with organ function impairment was higher in patients with eosinophilia (Fig. 3).

4. Discussion

Our study showed that eosinophilia was not uncommon and occurred in inpatients across most departments of a general hospital, but was frequently neglected. Investigation and multidisciplinary consultation were insufficient and might improve outcomes for patients with moderate to severe eosinophilia. To our knowledge, this is the first study with large sample sizes to report the characteristics of inpatients with incidental eosinophilia in China. Findings in this study could provide information in the distribution of increased blood eosinophil counts and the distribution of organ failure in patients with moderate to severe eosinophilia.

In our study, eosinophilia was most common in males and in patients aged 0–6 years. After conducting a stratified analysis according to hospital departments, we found that the proportion of eosinophilia was higher in males than in females in most age groups. Results of our study were quite consistent to other studies. According to the results of a cross-sectional study in a large general

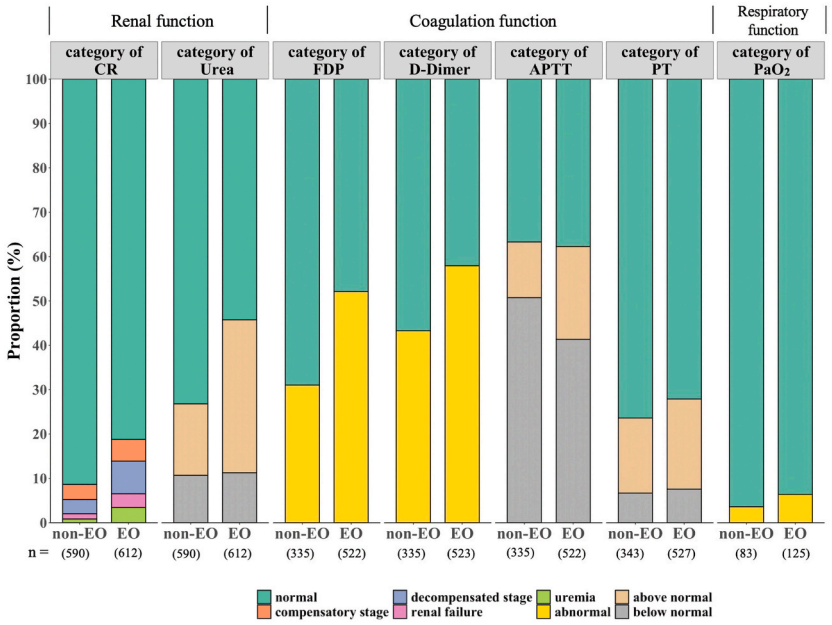

Fig. 3. Differences in organ function impairment between patients with or without eosinophilia.

population cohort in Austria [12], blood eosinophil counts were highest in infancy and adolescence, and were higher in males than in females in all age groups. Similar conclusions were obtained retrospectively from health checkups of individuals aged 3–99 years performed at 16 health promotion centers in 13 cities across Korea [13]. And Kibum Jeon et al. also considered that blood eosinophil counts were higher in males than in females according to a large cohort of healthy Korean adults [14]. However, the eosinophil counts and the severity of eosinophilia were higher in females in ICU. More focus on the diagnosis or combined diseases, infection exposure and the drug use in patients admitted to ICU are needed to get an explanation [15,16].

To the best of our knowledge, our study is the first to report the differences in the distribution of increased eosinophil counts across departments in a hospital. The results indicate that the proportion of patients with eosinophilia is highest in departments of pediatrics and dermatology, followed by oncology, which was consistent with dermatologic or pulmonary clinical presentation of hypereosinophilic syndrome to some extent [17]. Previous studies found that pediatric hypereosinophilia had an incidence of 54.4 per 100,000 persons per year [18]. Eosinophils in patients with tumors were also studied, and findings suggested that eosinophils could be an early clinical sign of malignant disease or an antitumor effect of the host [19,20]. When further analyzing the distribution of blood eosinophil counts in the internal and surgical departments, we observed that it was higher in the departments of hematology, rheumatology, and hepatological surgery, which could be closely related to some diseases in these departments. Some previous studies believed that the use of blood eosinophilic counts combined with other auxiliary diagnosis evidence can be of great help in the diagnosis of some complex diseases, which should receive greater attention in the future [21–24].

In terms of clinical characteristics, findings in our study were consistent with the experience in clinical practice. In our results, the level of blood parameters such as CKMB increased with the severity of eosinophilia. It was likely that the increased level of blood eosinophils in our population was related to cardiovascular disease [25,26]. Systemic involvement, malignancy and multi-organ dysfunction could be seen with mild anemia, severe leukocytosis, and high ALT (Alanine aminotransferase), AST (Aspartate aminotransferase), and serum creatinine. The association between eosinophilia and multi-organ failure has been noted in literatures [27–29].

Compared with the study from T. Voltsinger et al. [30], our study had a lower proportion of hospital-based eosinophilia based on approximately 131,566 patients in two and half years, which might because city of Yangjiang isn't an industrialized city (50% urbanization) with an intermediate economic development level (real GDP per capita: 52,758 Chinese yuan [8,267 US dollars]; real GDP per capita: 72,447 Chinese yuan [11,352 US dollars] in China) [31]. It was also considered that the characteristics of patients with eosinophilia could be different by regions [32].

Furthermore, 67% of treating clinicians of patients with moderate to severe eosinophilia did not pay attention to the significance of eosinophilic count, with only 7.4% of clinicians performing corresponding investigations for eosinophilia. Additionally, most of the 621 patients had infectious diseases, solid tumors, skin diseases, respiratory diseases, or rheumatic diseases. However, clinicians did not analyze whether eosinophilia was happened secondarily to these diseases, which may have led to misdiagnosis and missed diagnosis.

The main findings from our study was that clinicians initiated valuations and arranged targeted examination when patients were likely with moderate to severe eosinophilia. Even in the tertiary hospitals, no feasible diagnostic procedures for eosinophilia were established in clinical practice. As shown in our study, a combined assessment of serum chemistry, serology or stool testing, bacteria-related examination, fungi-related examination and allergy testing were often performed as an initial differential diagnosis work-up

[33,34]. Due to the most common cause of elevated eosinophils is infections, particularly parasitic infestation, empiric treatment of parasites may be considered in patients with a travel history and the unhygienic use of food. However, work-up for additional secondary causes of eosinophilia, such as L-HES, IgG4-RD and EGPA, received little attention from clinicians. A combination of bone marrow biopsy, cytogenetics, flow cytometry immunophenotypic analysis and T-cell clonality studies are necessary to determine the diagnosis of L-HES [9]. When IgG4-related disease is suspected, serum protein electrophoresis (SPEP) and IgG subclasses are helpful as initial tests [35]. When clinical manifestations include eosinophilia, asthma, vasculitis, pulmonary infiltrates and sinus disease, consideration of EGPA is required [36]. Comorbidity diagnostic evaluation and ANCA serology testing (especially Anti-MPO ANCA) should be evaluated for patients with suspected EGPA [37]. A tissue biopsy is most definitely for a diagnosis if the clinical index of suspicion is high. Regrettably, these tests were poorly accessible and rarely performed on eosinophils, resulting in missed diagnoses.

If these investigations are not diagnostic, a definitive diagnosis of clonal eosinophilia requires a specialist examination in the hematology department. Elevated serum tryptase and vitamin B12 levels may suggest myeloid neoplasms and can be recommended as a screening tool. Examination of blood smear and bone marrow morphology in conjunction with cytogenetic, immunophenotyping, and molecular analysis help to determine the diagnosis of myeloid neoplasm as defined by WHO [3]. When myeloid neoplasia is highly suspected, clinicians usually schedule a bone marrow aspiration or biopsy to confirm the diagnosis, rather than perform further tests to examine the type of gene fusion. For example, screening PDGFRA, PDGFRB, FGFR1, or PCM1-JAK2 gene fusion, by reverse transcription-polymerase chain reaction (RT-PCR) or interphase/metaphase fluorescence in situ hybridization (FISH).

Eosinophilia can cause extensive terminal organ dysfunction [27–29,38]. In our study, 24.3% of 621 patients with moderate to severe eosinophilia exhibited organ function impairment. Unfortunately, doctors rarely analyzed whether the fatal organ dysfunction was caused by eosinophil infiltration. Also, compared to patients without eosinophilia, our study showed that it was more likely to exhibit abnormalities in indicators in patients with incidental eosinophilia. Thus, early detection of multiple organs, systemic symptoms, or abnormalities in indicators may help to reduce or delay terminal organ damage and improve prognosis by considering the presence of eosinophilia and intervening to address the cause. It would be reasonable to arrange close follow- up and perform serum troponin, BNP (B-type natriuretic peptide), renal function tests, lung function tests, chest X-rays, ultrasound endoscopy, computed tomography, and echocardiography to assess end-organ damage in those with hypereosinophilia.

Therefore, clinicians should pay greater attention to the clinical phenomenon related to eosinophilia. However, due to its complex etiology, the diagnosis and treatment of eosinophilia is difficult and requires multidisciplinary collaboration, with our study indicating that there was no record of patients with eosinophilia requiring multidisciplinary consultation. The clinical characteristics of patients with eosinophilia are heterogeneous and the outcome may vary from asymptomatic to severe, with multiple organ failures. It is important to share information on the patients' diagnosis and treatment in each department. A careful clinical examination and routine blood testing are crucial steps toward the identification of organ or system damage and dysfunction. If these indicators are abnormal, they may require repeat targeted diagnostic evaluation [39]. In summary, eosinophilia is challenging to treat and requires a multidisciplinary approach to improve the diagnostic approaches and therapeutic strategies.

We considered baseline corrections using propensity score matching based on the available data [40], in order to perform the reliable conclusion, but some potential factors were still needed to be adjusted [40,41]. The hospital settings represented in this study can mirror many other hospitals' in most regions in China, and even in developing countries in the world. Thus, the results are representative to some extent.

Eosinophilia which is increasingly observed in clinical practice is associated with a broad variety of diseases. Due to the lack of data in terms of its clinical characteristics, there is uncertainty regarding its investigation, diagnosis and treatment. In order to shed light on the important characteristics of incidental eosinophilia, we conducted this analysis based on real-world data to provide real-world evidence for future studies.

While comprehensive, our study had several limitations. Firstly, a study considered that although children with eosinophilia often presented with higher peak eosinophil counts than adults, the differential diagnosis, clinical characteristics and prognosis of eosinophilia are similar in the two groups [42]. Because most of the available knowledge is obtained from case reports and small case series, little is known about the clinical presentation of eosinophilia in children or infants [43]. Further detailed information on children or infants is also warranted [18]. Secondly, the proportion of eosinophilia calculated in this study was based on hospitalizations, which could overestimate the prevalence of eosinophilia.

5. Conclusions

Eosinophilia is associated with a broad spectrum of diseases and conditions and occurs in most clinical specialties in general hospital. The significance of eosinophilia encountered as an incidental finding in routinely obtained complete blood counts is frequently neglected. Patients with moderate to severe eosinophilia may exhibit a poor prognosis due to inadequate assessment and treatment. Multidisciplinary approach and further investigation of eosinophilia during hospitalization would probably lead to a better prognosis.

Declarations

Ethics approval

This study was conducted in accordance with the ethical principles laid down in the 1964 Declaration of Helsinki and its later amendments. The ethics committee of Yangjiang People's Hospital approved the study.

Consent to participate

The oral or written informed consent to participate was obtained.

Author contribution statement

Bigui Chen and Qiuping Rong: Contributed reagents, materials, analysis tools or data; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Yu Fu and Hanwen Liang: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Xuetao Kong and Qingling Zhang: Performed the experiments; Wrote the paper.

Mei Jiang and Jiaxing Xie: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

Zhufeng Wang: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no competing interests.

Abbreviations

AEC	absolute eosinophil count
ALT	Alanine aminotransferase
APTT	Activated partial thromboplastin time
AST	Aspartate aminotransferase
APL	Acute promyelocytic leukemia
ALL	Acute lymphoblastic leukemia
AML	Acute myeloid leukemia
AGPA	Allergic Granulomatosis with Polyangiitis
BNP	B-type natriuretic peptide
CBC	Complete blood counts
CKMB	Creatine kinase MB
CR	Creatinine
CRP	C-reactive protein
CLL	Chronic lymphoblastic leukemia
CMML	Chronic myelomonocytic leukemia
CML	Chronic myeloid leukemia
CAP	Community-acquired pneumonia
DIC	Disseminated intravascular coagulopathy
EGPA	Eosinophilic granulomatosis with polyangiitis
ENT	Ear, Nose, and Throat (as a department in a hospital)
FDP	Firbrin or fibrinogen degradation products
FISH	Fluorescence in situ hybridization
Hb	Hemoglobin
HES	Hypereosinophilic syndromes
ICU	Intensive Care Unit
IQR	Interquartile range
IgG4-RD	Immunoglobulin G4-related disease
km	kilometer
L-HES	Lymphocyte variant of HES subtype
MDS-MPN	Myelodysplastic/myeloproliferativeneoplasms
PaO_2	Pressure of arterial oxygen
PLT	Platelet

PT	Prothrombin time
sd	Standard deviation
WBC	White blood cell
RT-PCR	Reverse transcription-polymerase chain reaction
SLL	Small lymphocytic lymphoma
SPEP	Serum protein electrophoresis

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e15569.

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