Orbital IgG4 Related Disease (IgG4RD): Incidence and Accompanying Histological Features Using the Latest Consensus Criteria

Anita SY Chan1,2, Sunny Shen1,2, Audrey Looi Lee Geok1,2, Seah Lay Leng1,2, Leonard Tan Hwan Cheong1 and Issam Al Jajeh1*

1Histopathology, Pathology Department, Singapore General Hospital, 20 College Road, Academia, Level 10, Diagnostics Tower, Singapore
2Singapore National Eye Centre, 11 Third Hospital Avenue, Singapore

Abstract

Purpose: Orbital Immunoglobulin G 4 (IgG4) related disease (IgG4RD) is a fibro-inflammatory condition that mimics sclerosing orbital inflammatory disease (OID). The recently published IgG4RD consensus criteria included its defining histological features. Using the published criteria, this study aims to describe the frequency of orbital IgG4RD and its histological features in OID biopsies over a 1 year period.

Method: Thirty-seven consecutive orbital biopsies for OID over 1 year were prospectively examined for the features of fibrosis, inflammation, and vasculitis. Immunohistochemistry (IHC) evaluation was performed when significant fibrosis and/or lymphoplasmacytic inflammation (>25% of the biopsy section) was present.

Results: Ten of 37 (27%) orbital biopsies showed significant fibrosis and/or lymphoplasmacytic inflammation with the remaining cases showing only non-specific chronic inflammation or reactive lymphoid hyperplasia. Only 3 cases (30%) fulfilled the IgG4RD consensus criteria. The histological patterns included sclerosing dacrooadenitis, sclerosing xanthogranulomatous orbital inflammation, and eosinophilic angiocentric fibrosis. Storiform fibrosis was the most common histological feature present (70%), followed by dense lymphoplasmacytic inflammation (60%). When both were present, an almost 2-fold elevation of tissue IgG4 plasma cells and ratio above the diagnostic cut-off was detected. Xanthogranulomatous inflammation and eosinophilia were occasionally present.

Conclusions: Using the consensus criteria, IgG4RD was diagnosed in 30% of our orbital biopsies with significant fibrosis and/or inflammation and 11% of all OID biopsied in 1 year. Although the storiform fibrosis and lymphoplasmacytic inflammation was most commonly seen, associated eosinophilia and xanthogranulomatous inflammation may also be seen in IgG4RD.

Keywords: IgG4 related disease; Orbital inflammatory disease; Histopathology; Sclerosing orbital inflammation

Introduction

Immunoglobulin (Ig) G 4 related disease (IgG4RD) is a multi-organ fibro-inflammatory condition that encompasses retroperitoneal fibrosis, autoimmune pancreatitis and orbital inflammatory disease (OID) [1-3,4]. It is characterized by a fibrosing mass-like lesion with dense lymphoplasmacytic infiltrate rich in IgG4 plasma cells on histology [1-3,5]. In the orbit, florid reactive lymphoid hyperplasia and sclerosing OID are common differential diagnoses which may mimic IgG4RD. The recently published IgG4RD consensus criteria included its defining histological features. Using the consensus criteria, this study aims to describe the frequency of orbital IgG4RD and the accompanying histological features in OID biopsies over a 1 year period.

Methods

Thirty-seven consecutive cases of orbital and lacrimal gland biopsies for OID at the Pathology department, Singapore General Hospital (SGH) and Singapore National Eye Center (SNEC) from January 2012-January 2013 were prospectively reviewed using our orbital inflammatory protocol where all biopsies were subjected to Hemotoxylin and Eosin (H&E) and Masson Trichrome (MT) stains.

Quantification of fibrosis and inflammation

Percentage of fibrosis was calculated by the comparison of area of fibrosis highlighted by the MT stain with total area of tissue. The degree of inflammatory infiltrate was graded in similarly. Those with significant fibrosis and/or inflammatory infiltrate (significant fibrosis or inflammation was defined as >25% of the biopsy section) were subjected to immunohistochemical (IHC) analysis for CD138 positive plasma cells, tissue IgG and IgG4 in addition to routine diagnostic stains to exclude infections and lymphoma when warranted. The pattern of fibrosis and inflammation and the presence of vasculitis were recorded.

*Corresponding author: Issam Al Jajeh, Histopathology, Pathology Department, Singapore General Hospital, 20 College Road, Academia, Level 10, Diagnostics Tower, Singapore 169856, Tel: 65-6321-4875; Fax: 65-6227-6562; E-mail: issam.al.jajeh@sgh.com.sg

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Quantification of tissue IgG4 and calculation of IgG4: IgG ratio

Using consecutive sections, the numbers of absolute counts of CD138 positive IgG4 and IgG cells were counted in 3 separate high power fields (x40) where inflammation was maximal. The mean number of IgG4 and IgG was then calculated, and the ratio of IgG4:IgG was determined based on the mean number of IgG4 and IgG. Exclusion criteria included the diagnoses of Granulomatosis with polyangiitis (GPA, previously known as Wegener’s granulomatosis), Sjogren’s syndrome, adnexal lymphomas such as extranodal marginal lymphoma and cases with neutrophilic infiltration, necrosis or granulomatous inflammation. The histological diagnosis of IgG4RD was highly suggestive when the at least 1 of the major histological feature of the consensus criteria (storiform fibrosis, dense lymphoplasmacytic inflammation and obliterator phlebitis) was present with elevated tissue IgG4 plasma cells as defined by the consensus criteria [6]. The diagnostic criteria for elevated tissue IgG4 included both the presence of: 1) CD138 positive IgG4 positive plasma cells >50 per high power field (hpf), and 2) Ratio of IgG4: IgG >40% as stated in the consensus criteria [6]. These confirmed cases were also reviewed clinically and radiologically for evidence of systemic IgG4RD.

Statistical analysis

All data were expressed as mean ± SD.

Results

Ten of 37 (27%) of our orbital biopsies showed features suggestive of sclerosing orbital inflammation or IgG4RD characterized by significant fibrosis and/or lymphoplasmacytic inflammation. The remaining cases showed only non-specific chronic inflammation or reactive lymphoid hyperplasia. Using the histological consensus criteria, only 3 of these (3/10, 30%) cases fulfilled the morphological features and IgG4 IHC definition described above. The histological patterns included: 1) Sclerosing orbital inflammation or dacroadenitis (Figures 1A-1C and 2) Sclerosing orbital inflammation with xanthogranulomatous inflammation (Figures 2A-2C and 3) Eosinophilic angiocentric fibrosis (EAF) (Figures 3A-3C).

Fibrosis/ Sclerosis

Seven cases (7/10, 70%) showed obvious storiform (whorl-like type) fibrosis with hyalinization/sclerosis (Figure 1B, 2C and 3C), occupying ≥50% area of the tissue section. The remaining 3 cases showed some degree of fibrosis varying from 25% to less than 50% of the biopsy area. (Table 1)

Inflammation

The predominant inflammatory infiltrate comprised of lymphocytes and plasma cells (Figures 1C, 2C and 3B) and was present in about 6/10 (60%) cases. Thirty percent showed only lymphoplasmacytic infiltrate without significant fibrosis (<25% biopsy area), another 30% showed BOTH dense lymphoplasmacytic infiltrate with significant storiform fibrosis (>50%) and the remaining 40% did not have significant inflammation but only storiform fibrosis as the main feature. The predominance of plasma cells was often only highlighted on CD138 IHC (Figures 1D, 2D and 3D) and was not always apparent on routine HE stain. Scattered eosinophils were noted in the background but was only significantly elevated in 1 case (Figure 3B). Xanthogranulomatous inflammation in the absence of other infectious or underlying etiology was also noted in another case (Figure 2B and Table 1).

Tissue IgG4 plasma cell counts and IgG4: IgG ratio

In the 3 cases with BOTH storiform fibrosis and dense

Figure 1: (A-F) Sclerosing dacryoadenitis form of IgG4RD. (A): Lacrimal gland biopsy, 2x Hematoxylin & Eosin (HE) stain showing areas of fibrosis (arrow) and dense lymphoplasmacytic infiltrate (asterisk). (B): HE stain, 20x. Storiform fibrosis (arrow) characterized by thick eosinophilic collagen bands with a whorl-like appearance. (C): HE stain 20x. Dense lymphoplasmacytic infiltrate. (D & E): CD138 and IgG4 immunohistochemistry (Peroxidase, 20x) showing increased tissue IgG4 CD138 positive plasma cells ~134 cell/ hpf. (E & F): IgG4 and IgG immunohistochemistry (Peroxidase, 20x) showing increased IgG4: IgG ratio (90%).
lymphoplasmacytic inflammation, a marked increased of tissue IgG4 plasma cells that fulfilled both criteria with the average of 119 (range: 102 to 134 cells) IgG4 positive plasma cells (identified using CD138, plasma cell marker)/hpf and an IgG4: IgG ratio of 75-90% (Table 1).

In the remaining cases where only either storiform fibrosis (4 of 7) OR dense inflammation (3 of 7) was present, the IgG4 plasma cell count and IgG4: IgG ratio failed to meet the criteria with the average of 12 (range: 4 to 25 cells) IgG4 positive plasma cells/hpf and an IgG4: IgG ratio of 10-20% (Table 1).

**Systemic review**

Our 3 cases of histologically diagnosed as IgG4RD had no prior history of IgG4RD, but were subsequently all found to have elevated serum IgG4 and other IgG4RD features: involvement of the parotid gland (Case 1, sclerosing dacroadenitis), autoimmune pancreatitis (Case 2, sclerosing xanthogranulomatous orbital inflammation) and retroperitoneal fibrosis (Case 3, EAF).

<table>
<thead>
<tr>
<th>Cases</th>
<th>Field 1 (40x)</th>
<th>Field 2 (40x)</th>
<th>Field 3 (40x)</th>
<th>Mean ± standard deviation (SD)/ 3rep</th>
<th>Histological criteria</th>
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<tr>
<td></td>
<td>No. of IgG4</td>
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<tr>
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<td>Case 3: Eosinophilic angiocentric fibrosis</td>
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Table 1: Overall description of different histological criteria with different cases.

Conclusions

Rootman et al. first described an idiopathic sclerosing orbital inflammation which is clinically aggressive [7]. Orbital IgG4RD has renewed interest in sclerosing orbital inflammation and reports have suggested their shared histological features may represent a spectrum of IgG4RD [4,8,9].

Using the IgG4RD consensus criteria, we found that almost 27% of our OID orbital biopsies shared overlapping features of sclerosing and IgG4RD making this criteria useful for differentiation of these entities since sclerosing OID is a more aggressive orbital inflammation requiring early immunosuppression therapy [7] in comparison to IgG4RD which is highly steroid sensitive, in addition to having systemic implications [1,4,5,8]. In our study, IgG4RD accounted for 11% of all our OID and up to 30% of our orbital inflammation with significant fibrosis and/or inflammation. As IgG4RD overlaps with many other systemic AI disorders, it is a diagnosis of exclusion. Elevated tissue IgG4 plasma cells are present in the biopsies to prevent over reporting. Although borderline values of IgG4 plasma cells may represent the "early stage" of IgG4RD, long term follow up to determine the true IgG4 nature in repeat or other organ biopsies would be necessary to confirm this observation.

In our study, the most common major histological feature seen for IgG4RD was storiform fibrosis 70%, followed by dense lymphoplasmacytic infiltrate (60%). The lack of storiform fibrosis in the lacrimal gland as described by the consensus group [6] was not reflected in our series as 70% of our cases presented with significant fibrosis. This discrepancy may represent the different stages of orbital inflammation at the time of biopsy, however, a larger series would be necessary to confirm this.

When both storiform fibrosis and lymphoplasmacytic infiltration were present, we noted a marked elevation of IgG4 plasma cells and the IgG4: IgG ratio which was consistently almost 2-fold above the diagnostic criteria with over 100 IgG4 positive plasma cells present and the IgG4: IgG ratio of 75-90% (Table 1). This correlates with the consensus group findings and others who report the number of IgG4 plasma cells in the lacrimal gland as typically in the 100s range (Table 1) [6,10]. This should be kept in mind when only a borderline number of IgG4 plasma cells are present in the biopsies to prevent over reporting.

In such situation, it is necessary to exclude other autoimmune (AI) conditions since IgG4 plasma cells are not specific to IgG4RD and to correlate with the presence of other systemic IgG4RD features. Although borderline values of IgG4 plasma cells may represent the "early stage" of IgG4RD, long term follow up to determine the true IgG4 nature in repeat or other organ biopsies would be necessary to confirm such a suspicion in the absence of other clinical features.
Of the cases that did not meet the diagnostic criteria of IgG4RD, four cases had only significant fibrosis whilst 3 cases had predominantly inflammation without significant fibrosis and all lacked tissue IgG4 plasma cells (an average of 12 IgG4 plasma cells/hpf and an IgG4: IgG ratio <25%, (Table 1). The issue of whether the 4 cases with only significant “sclerosing” inflammation could represent a “burnt-out” fibrotic stage of IgG4RD rather than “idiopathic sclerosing inflammation” has yet to be resolved. However, without serum IgG4 elevation and other clinical evidence of IgG4 RD, it may be best to classify these cases as “sclerosing orbital inflammation with insufficient evidence for IgG4RD”.

In conclusion, orbital IgG4RD represents 11% of all our OID and 30% of those with significant sclerosis and dense lymphoplasmacytic infiltrate seen over 1 year. Tissue IgG4 levels is paramount to the diagnosis and both the number of IgG4 plasma cells and IgG4: IgG ratio must be assessed. Systemic review is a useful adjunct to exclude IgG4RD. Although storiform fibrosis and lymphoplasmacytic inflammation is predominantly seen, the presence of eosinophils and xanthogranulomatous inflammation may also be present in orbital IgGRD.

References