Figure 3 CT scan image of the orbit demonstrating extra-scleral loculated spaces (marked with an open white arrow) with the same radio-density as the intra-ocular gas.

noted; however, there was no hypopyon or pupil block and the anterior chamber was deep (Figure 1). Despite treatment with maximal topical antihypertensives and intravenous acetazolamide, IOP remained 44 mm Hg. The patient was admitted for management of the pain and the raised IOP. In the next 24 h she developed a 2 mm right-sided proptosis, a subtle relative afferent pupillary defect, mild limitation of right eye ocular movements, increasing pain, and a spike in temperature (38 °C). Based on the clinical findings of chemosis, congestion, a developing proptosis, limited ocular motility, a spike in temperature, and a subtle relevant afferent pupillary defect, an orbital cellulitis was suspected. An urgent CT scan of the orbits showed no signs of orbital haemorrhage, infection, or inflammation, but there were extra-scleral and subconjunctival loculated spaces with an appearance similar to that of the gas in the vitreous cavity (Figures 2 and 3). The CT scan raised suspicion of extra-ocular gas. Owing to the progressive proptosis and uncontrolled IOP despite maximum medical therapy, we decided to release and exchange the gas tamponade. The patient underwent 23-gauge vitrectomy with gas to fluid and then fluid to 1000 centistoke silicone oil exchange. Postoperatively the chemosis, congestion, and proptosis resolved completely and the patient was asymptomatic with a flat retina and a normal IOP. One month postoperatively, the retina is flat under oil; however, visual acuity is limited to hand movements owing to optic atrophy presumed to be secondary to the raised IOP and compression of the nerve from the intra-orbital gas.

Comment

Pure C2F₆ is expansible to 3.3 times its original volume and is isovolumetric at 16%. We believe this clinical picture was caused due to an error in dilution of C2F₆

resulting in an expansile intra-ocular concentration being used. The resultant increase in IOP exceeded the limit of the self-sealing sclerostomies, with gas escaping into the subconjunctival and orbital space. This gas that had escaped into the orbit continued to expand, resulting in proptosis, limitation of movements, and compression of the optic nerve. Removal of the gas resulted in resolution of the proptosis, chemosis, and IOP.

To the best of our awareness there are no reports of gas escaping from small-gauge self-sealing sclerostomies causing a clinical picture that resembles orbital cellulitis.^{1–5}

Conflict of interest

The authors declare no conflict of interest.

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N Kumar¹, P Tsangaris² and RJ Haynes²

¹Moorfields Eye Hospital, London, UK

²Bristol Eye Hospital, Bristol, UK

E-mail: richardjhaynes@me.com

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Sir, IgG4-related orbital inflammation presenting as bilateral proptosis in a child

IgG4-related orbital disease is an immune-mediated fibro-inflammatory disease with systemic associations^{1,2} and predominantly affects middle-aged and elderly patients,² presentation of IgG4-related orbital disease in children is very rare.^{3,4}

Case report

A 14-year-old boy presented with an 8-year history of gradually progressive painful protrusion of both eyeballs. Examination showed bilateral massive proptosis with severe fullness of superior sulcus and absent eyelid crease (Figure 1a). All recti were palpably firm and enlarged. Clinical history and examination did not reveal enlargement of salivary glands and there was no evidence of lymphadenopathy or organomegaly. Clinical differential diagnoses included thyroid eye disease/myeloid sarcoma/metastatic neuroblastoma. Systemic examination, complete blood picture, peripheral blood smear, and thyroid function tests were normal. CT scan of orbit in axial and coronal sections showed massive enlargement of the recti in both eyes with involvement of the muscle belly and tendons (Figure 1b).

Microscopic examination of an incisional biopsy from left medial rectus showed fibro-inflammatory tissue (Figure 2a). Fibrous component showed storiform pattern (Figure 2b) adjacent to pattern-less zones. Collagenous tissue was loose to dense with sclerosis and hyalinization. Inflammation was patchy, polymorphic, and ranged from moderate to severe (Figure 2c). They were composed of mature lymphocytes, numerous plasma cells, occasionally with more than one nucleus (Figure 3a) and occasional eosinophils. Granulomatous

inflammation or vasculitis was absent. Immunohistochemical stains with IgG4 showed an average of 35–40 IgG4-positive plasma cells per high-power field (h.p.f.) (Figure 3b) counted in three h.p.f.s with maximum plasma cells. Ratio of IgG4-bearing plasma cells and IgG-bearing plasma cells was >40%.

Serum IgG4 was elevated at 4.3 g/l (reference range: 0.049–1.985 g/l). A diagnosis of IgG4-related orbital disease was made after excluding systemic involvement on clinico-radiological workup and the patient was started on oral steroids at 0.6 mg/kg body weight. He showed an initial improvement but was subsequently lost to follow-up.

Comment

IgG4-related orbital disease is a previously unreported cause of bilateral proptosis in children.⁴ Characteristic storiform fibrosis and dense lymphoplasmacytic infiltrate¹ call for further immunohistochemical, serological, and systemic evaluation. Commoner inflammatory/infectious causes of bilateral orbital inflammation with systemic associations, such as thyroid ophthalmopathy, granulomatosis with poly-angiitis, sarcoidosis, and tuberculosis, need exclusion. Paucity of literature on IgG4-related orbital disease in children limits protocol-based management; however, glucocorticoids stay as the first-line management strategy with azathioprine, mycophenolate mofetil, methotrexate,

Figure 1 Colour photograph of the patient with bilateral massive proptosis (a). Contrast-enhanced CT scan of the orbits and paranasal sinus in axial section shows grossly proptosed globes with massive enlargement of the belly and tendons of the horizontal recti in both orbits (b). The full colour version of this figure is available at *Eye* online.

Figure 2 Photomicrograph shows fibro-inflammatory tissue (a, haematoxylin-eosin $\times 100$), with characteristic storiform pattern of sclerosis (b, haematoxylin-eosin $\times 400$), and dense polymorphic lymphoplasmacytic infiltrate (c, haematoxylin-eosin $\times 100$).

Figure 3 Photomicrograph shows plasma cell predominance, binucleated plasma cells are arrow marked (a, haematoxylin–eosin $\times 400$), immunoperoxidase staining shows positivity of plasma cells with IgG4, lymphocytes are negative for IgG4 (b, IgG4 $\times 400$).

or rituximab as the second- or third-line drugs. Long-term close follow-up is warranted to treat relapses and early identification of systemic involvement.

Conflict of interest

The authors declare no conflict of interest.

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R Mittal¹, A Ganguly², S Rath², B Das³ and A Mishra⁴

¹Dalmia Ophthalmic Pathology Service, L V Prasad Eye Institute, Bhubaneswar, India

²Department of Ophthalmic Plastic Surgery, Orbit and Ocular Oncology, L V Prasad Eye Institute, Bhubaneswar, India

³Department of Medicine, SCB Medical College and Hospital, Cuttack, India

⁴Clinical Services, Radharaman Hospital, Cuttack, India

E-mail: dr.rmittal@gmail.com

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Sir, Patterns of ocular injury from paintball trauma

Paintballs pose a significant risk for devastating ocular trauma.¹ ASTM International² regularly publishes eye protection standards for paintball, and guidelines from the National Professional Paintball League³ in the United States require that players exposed to shooting areas wear eye protection that meets these standards. ASTM International has updated their standards four times since 1999, most recently in 2012. To assess the impact of these guidelines, this study investigated the patterns of ocular paintball trauma that presented to US emergency departments (EDs) from 2001 to 2010.

The study received Institutional Review Board exemption from Rhode Island Hospital. Data were extracted from the National Electronic Injury Surveillance System (NEISS-CPSC) and reviewed for demographics, diagnosis, locale, and eye protection status.⁴ Patients were included if they visited an ED from 2001 to 2010 with an injury that (1) involved paintball equipment and (2) affected the eye. Weighted estimates were calculated using SAS version 9.1.2 (SAS Institute, Inc., Cary, NC, USA).

All statistical estimates represent weighted frequencies based on data from 100 representative US EDs. Of 11 827 paintball-related eye injuries from 2001 to 2010 (Table 1), most occurred in patients who were male (10 906; 92.2%) and aged 10–19 years (8055; 68.1%). The highest proportion of injuries occurred from 2001 to 2004 (13.7–15.2%). Of 1586 patients with eye protection data, 724 (45.6%) removed protection immediately before injury and 863 (54.4%) were not wearing protection.

This study found that ocular paintball injuries are decreasing over time but – despite clearly defined eye protection guidelines – remain a persistent challenge, especially in males and young patients. Several injuries were related to removing or not using eye protection. Moreover, similar proportions of injuries occurred at home and in commercial settings. This suggests the need