Clinical Radiology 67 (2012) 1011–1022

Contents lists available at SciVerse ScienceDirect

Clinical Radiology

journal homepage: www.clinicalradiologyonline.net

Pictorial Review

Abnormalities of the globe

A.A. Roy [a,*], I. Davagnanam [a,b], J. Evanson [c]

[a] Lysholm Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, London, UK
[b] Moorfields Eye Hospital NHS Foundation Trust, London, UK
[c] Department of Neuroradiology, The Royal London Hospital, Barts Health NHS Trust, London, UK

ARTICLE INFORMATION

Article history:
Received 3 January 2012
Received in revised form
3 March 2012
Accepted 6 March 2012

Although much has been published in the radiology literature on the multitudinous conditions affecting the bony orbit, there has been relatively little on diseases confined to the globe itself. As current cross-sectional imaging techniques evolve, the globes can be visualized in ever greater detail, facilitating the recognition of even fairly subtle disease entities in this region. Indeed, the fact that high-resolution detailed images of this area are achievable without significant time or radiation penalty when evaluating surrounding structures means that incidental disease is not infrequently encountered. As such, common disease entities in this region are of interest to the general radiologist and the diagnosis of globe disease need not be the remit of experienced observers in specialist centres. At our institutions we have recently encountered a number of cases covering a broad spectrum of diagnoses including traumatic, neoplastic, iatrogenic, inflammatory, and infective aetiologies. The purpose of this review is to briefly revise the pertinent anatomical and physiological properties of the globe and to familiarize the reader with the computed tomography (CT) and magnetic resonance imaging (MRI) appearances of a number of these disease states. The collection of abnormalities included is not intended to be exhaustive, merely representative, with the emphasis towards those more commonly encountered.

Introduction

Radiologically discernable globe abnormalities are often overlooked on account of unfamiliarity with the anatomy and physiology in this region and the appearances of common ocular disease. Recent advances in imaging technology allow the globe to be visualized in ever greater detail and extend an increasing role to the radiologist in diagnosis. Whilst the orbits and globes have traditionally been regarded as "review areas" for the exclusion of gross abnormalities, the extent to which subtle abnormalities can now be demonstrated suggests a more structured approach may be necessary. Although patients with ocular abnormalities are often managed at specialist centres, certain conditions may also be identified incidentally on cranial imaging performed for a variety of indications. With this review, we aim to familiarize the reader with the imaging appearances of common ocular diseases.

When reviewing ocular imaging it is beneficial to consider the globe as an entity comprising fluid-filled cavities, a surrounding layer, and potential spaces between the layers.[1] Abnormalities in the anterior and posterior chambers are more accurately assessed by direct ophthalmological techniques, given their dimensions and superficial locations. Of the conventional radiological techniques, ultrasound is generally the technique of choice,

* Guarantor and correspondent: A.A. Roy, Lysholm Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, Queen Square, London WC1N 3BG, UK. Tel.: +44 207 676 2119.
E-mail address: a_a_roy@yahoo.co.uk (A.A. Roy).

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doi:10.1016/j.crad.2012.03.006

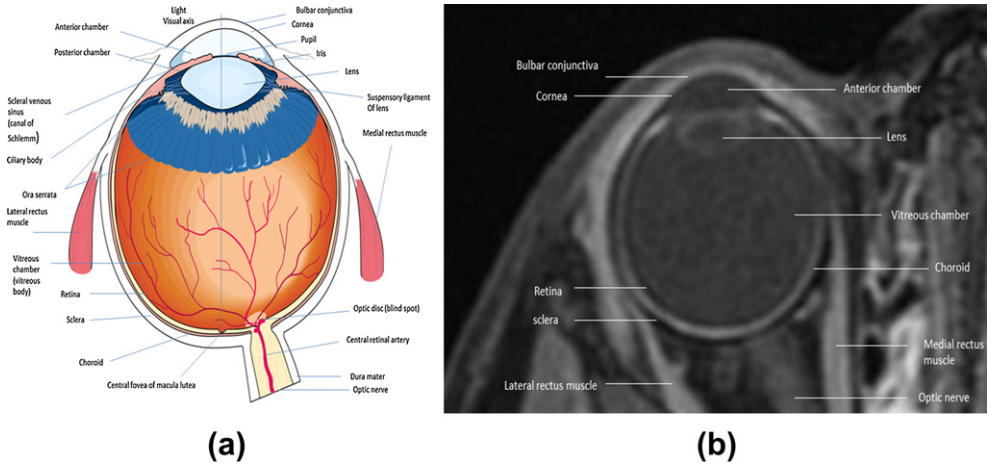

Figure 1 (a) Transverse section through the left globe (superior view). (b) Contrast-enhanced, axial, T1-weighted, fat-saturated MRI image demonstrating normal right globe appearances.

partly due to the high resolutions achievable. Conventional sonography using a 10–20 Mhz transducer can facilitate resolution of 100 μm, far in excess of that attainable by computed tomography (CT) or magnetic resonance imaging (MRI), with tissue penetration of 25 mm.[2] A more recent advance, ultrasound biomicroscopy, utilizes higher frequencies with a consequent threefold improvement in resolution.[3] It can also facilitate interrogation of structures otherwise obscured by optically opaque anatomical or pathological entities.[3,4] Neither ophthalmoscopy nor ultrasound, however, will be discussed further, the latter being generally the remit of ophthalmologists or radiologists with specific expertise.

Basic globe anatomy and physiology

The globe is a 2.5 cm ovoid structure with a volume of 6.5 ml,[5] occupying one-third of the osseous orbit. It comprises three concentric layers: the fibrous coat, uvea, and retina. These layers enclose the lens and transparent media.[5]

The fibrous cornea is highly specialized, acting as a transparent window for light as well as a physical barrier to trauma and infection. Its posterior continuation, the sclera, provides attachment for the extra-ocular musculature, protects the contents, and maintains its shape when the intra-ocular pressure fluctuates.[1] The transition zone between cornea and sclera, the limbus, has multiple putative functions including nourishment, immunosurveillance, and control of intra-ocular pressure.[5] Posteriorly, the sclera is continuous with the optic nerve's dural sheath.[1,6]

The uvea, namely the choroid, ciliary body, and iris, are continuous with one another but interrupted anteriorly by the pupil and posteriorly by the optic nerve. The choroid is analogous to the pia–arachnoid of the brain. It nourishes the retina and absorbs unwanted reflected light.[1] The ciliary body, extending from the posterior insertion of the iris to blend with the choroid at the ora serrata, facilitates accommodation and aqueous humour production. Aqueous humour circulates through the pupil, exiting via the canal of Schlemm at the irido-corneal angle. The iris is a pigmented contractile disc comparable to the diaphragm of a camera.[5]

The retina is the innermost layer of the globe, converting incident light into neural signals, relayed to the brain for

Table 1
A summary of the indications, advantages and disadvantages of computed tomography (CT) and magnetic resonance imaging (MRI) in globe imaging.

Imaging Modality	Indications	Advantages	Disadvantages
CT	• Traumatic injury • Foreign body localisation and characterisation • Assessment of calcification eg. retinoblastoma	• Superior spatial resolution • Favourable scanning time	• Radiation dose-lens is particularly radiosensitive • Inferior soft tissue contrast compared with MRI • Degradation of image quality by streak artefact from metallic implants[11]
MRI	• Leucocoria • Retinal or choroidal detachment • Neoplasia	• No radiation burden • Optimal soft tissue contrast • Fat-saturation techniques greatly improve conspicuity of pathology	• Lengthy scanning time • Requirements for general anaesthetic or sedation in certain non-compliant patient groups • Eye movement artefact such as that caused by blinking-particularly problematic at 3T[1] • Metallic foreign bodies contraindicated