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Tomographic findings of acute infections of the orbit: literature review

Aspectos tomográficos da órbita aguda infecciosa: revisão de literatura

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ABSTRACT

The acute and nontraumatic diseases that involve the orbit are often little known by most physicians. These conditions are due to several factors, such as immune disorders, congenital, infections, vascular, among others disorders. The infectious causes correspond to more than 50% of all cases and require rapid diagnosis and management in order to minimize sequels. Computed tomography (CT) is the first line imaging method on these cases, generally being available in emergency centers and capable to provide an accurate, quick and effective diagnostic information. This review article aims to describe the main tomographic findings in acute orbit infections, correlating them with the literature data.

Keywords*: X-ray, computed tomography; Acute infection; Orbit/pathology*

RESUMO

As doenças que acometem a órbita de forma aguda e não traumática por vezes não são conhecidas por médicos em centros de emergência. Essas condições são decorrentes de diversos fatores, como desordens imunológicas, congênitas, infecciosas, vasculares, entre outras. As causas infecciosas correspondem a mais de 50% de todos os casos e requer rápido diagnóstico e conduta para minimização de sequelas. A tomografia computadorizada (TC) é o exame de imagem de primeira linha nesses casos, sendo geralmente disponível nos centros de emergência e capaz de fornecer auxílio diagnóstico de forma rápida, precisa e eficaz. Esse artigo de revisão visa descrever os principais aspectos tomográficos da órbita aguda infecciosa, correlacionando-os com os dados da literatura.

Descritores: Tomografia computadorizada por raios-X; Infecção aguda; Órbita/patologia

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Introduction

Orbital diseases have been the subject of several radiological research studies conducted in Brazil[1-7]. Even though acute orbital conditions are not infrequent medical emergencies, they are little known by most professionals[8]. In this study, acute orbital conditions are defined as signs and/or symptoms starting up to seven days earlier, with no history of trauma, in patients of any age. This includes primary and secondary involvement of the orbit and involvement due to extraorbital diseases, with or without injury to the eyeball.

Infections are the most common primary orbital lesions. They are classified as pre- or post-septal depending on their location relative to the orbital septum, which is not only an anatomical reference, but also acts a barrier to prevent the infection from spreading. Post-septal lesions require more immediate and aggressive treatment than pre-septal lesions[8,9].

Sinusitis is usually the initial event triggering orbital infections. The infection spreads either by contiguity or by infecting pre-existing lesions susceptible to bacterial growth, such as dermoid cysts and mucoceles[8-10].

The aim of diagnosis and early treatment is to prevent vision loss as well as other severe complications. In addition to medical history and physical examination, imaging studies are essential to guide the management of the condition and to assess the degree of orbital involvement[8-10].

Computed tomography (CT) is the study of choice in the diagnosis and evaluation of acute orbital conditions, while magnetic resonance imaging (MRI) is usually reserved for further investigation[8,9,11].

CT provides a reliable assessment of extraocular muscles, the optic nerve, and vascular structures, with high-quality images and excellent spatial resolution[11,12]. The axial and coronal planes are the most used, and blood vessels can be assessed by intravenous administration of a contrast medium[13,14].

We performed a retrospective study based on the CT findings of patients admitted to the emergency department of a public hospital between January 1999 and November 2009.

The aim of this work is to describe the CT findings of acute infections of the orbit, correlating them with the literature. The CT scans were assessed by a radiologist with 20 years of experience in CT of the orbit.

Orbital Cellulitis

Orbital cellulitis is by definition a severe post-septal infection which usually does not cause bone destruction. In certain cases, cellulitis may develop into an abscess[8,15].

Patients present with oedema, eyelid erythema, chemosis, limitation of ocular movements, and proptosis. Its main complications are thrombosis of the superior ophthalmic vein and cavernous sinus, intracranial abscess, meningitis, and even blindness[8].

CT usually shows opacification of the paranasal sinuses and increased density in the retrobulbar orbital fat (Figure 1)[8].

Treatment consists of intravenous antibiotic therapy[15].

Subperiosteal abscess

Subperiosteal abscess is usually seen in teenagers and young adults, most commonly in cases of orbital cellulitis associated with ethmoid sinusitis[15].

CT shows a collection of extraconal fluid adjacent to the orbital wall, producing a mass effect on extraocular muscles. The condition causes displacement of the eye with collection of fluid along the medial orbital wall adjacent to the opacified ethmoid air cells (Figure 2). Phlegmons do not necessarily exhibit peripheral enhancement[16].

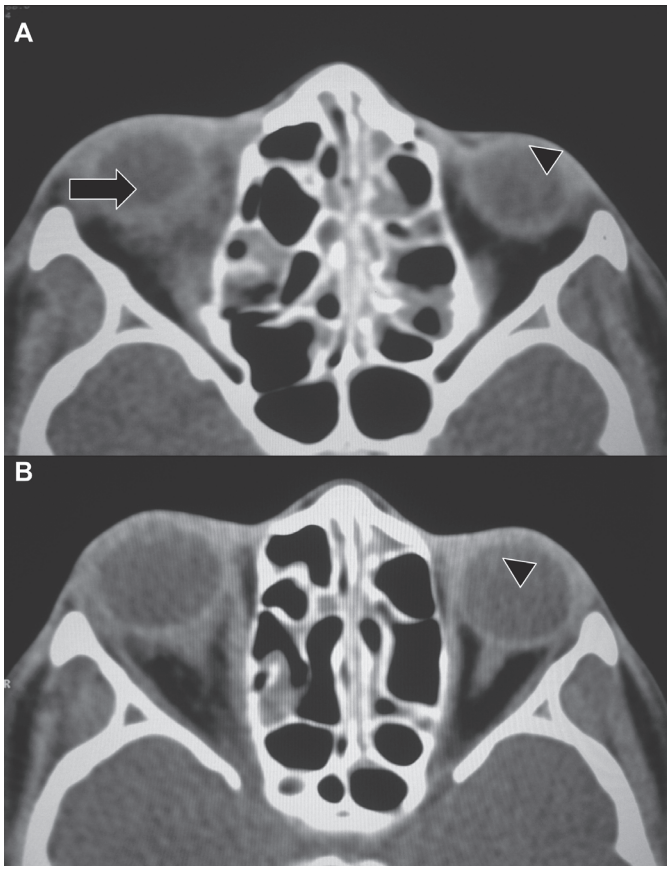

Figure 1: Post-septal cellulitis: Patient with acute sinusitis and right proptosis starting 3 days earlier. Axial CT without contrast. Bilateral opacification of the ethmoid sinuses. Increased density in the intra- and extraconal fat of the right orbit, especially in the medial quadrant (A) (arrow), with mild proptosis (B). Note that the left orbital fat has normal density (A and B) (arrowheads).

The treatment of subperiosteal abscess consists of antibiotic therapy and possible surgical drainage to prevent acute elevation of the intraorbital pressure and visual loss[15].

In patients with sickle cell anaemia, certain conditions may predispose to acute orbital conditions. Although uncommon, ischemia of the orbital wall can occur, producing acute and progressive pain, proptosis, optic nerve dysfunction, and limitation of eye movements. This is more common in children and adolescents as they have a larger medullary space in orbital bones, which increases the likelihood of subperiosteal haematomas. The accumulation of fluid predisposes to infections, which accounts for the higher incidence of orbital cellulitis and abscesses in these patients (Figure 3)[8,17].

Acute dacryocystitis

Dacryocystitis is an inflammation and dilation of the lacrimal sac usually secondary to obstruction or stenosis of the nasolacrimal duct, resulting in fluid accumulation and infection. It is more common in female and Caucasian individuals and is the main cause of persistent tearing and ocular discharge in children[15].

Although the diagnosis is typically clinical (acute local pain, fever, a mass in the medial edge of the eye, redness, and even

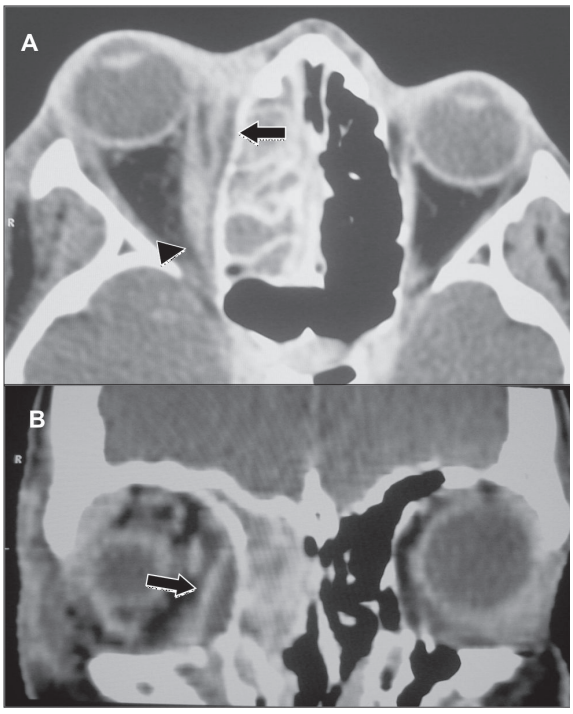

Figure 2: Subperiosteal abscess: adult patient with a history of untreated acute sinusitis with progressive proptosis of the right eye starting four days earlier. Axial CT (A) reformatted in the coronal plane (B) after contrast injection. Right maxillo-ethmoidal opacification and subperiosteal collection in the medial quadrant of the adjacent orbit (arrows) associated with a thickened medial rectus muscle (arrowhead).

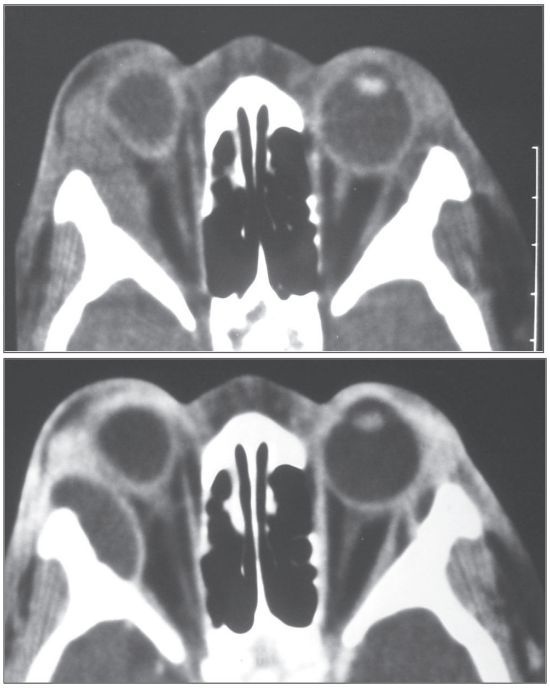

Figure 3: Bilateral subperiosteal abscess: 12-year-old male patient with sickle cell anaemia reporting fever and right proptosis starting 2 days earlier, with leukocytosis. Axial CT before (A) and after (B) contrast injection. Subperiosteal collection in the lateral quadrant of the right orbit with peripheral enhancement by the contrast medium (large arrow), causing proptosis and medial displacement of the eyeball. Note a symmetrical, smaller collection on the left side (small arrow).

pre-septal cellulitis), imaging methods such as CT are important to rule out orbital cellulitis or malignancy[15, 16].

The typical finding on CT after contrast injection is a well-defined hypoattenuating oval lesion in the lacrimal fossa with peripheral enhancement and inflammation, often associated with a thickening of adjacent soft tissues (Figure 4)[15,16].

Antibiotic therapy should be started early to avoid complications and the need for nasolacrimal duct drainage or probing[15,16].

Infected dermoid cyst

Dermoid and epidermoid cysts are frequent orbital lesions in childhood and are usually found in the upper quadrants of the orbital bones. They are congenital in origin, probably due to failed separation between the ectoderm surface and the head mesenchyme[18].

In case of rupture, usually due to infection, an intense inflammatory reaction affects the surrounding tissues, which can mimic a neoplastic process[18].

Imaging methods can show a cystic lesion with an internal content of fatty density (Figure 5) and calcification. When infected, peripheral enhancement is typically seen after contrast injection. Bone lesions occur in a great majority of cases, but they tend to be indolent, emerging near the zygomatic-facial suture[18].

Treatment is based on surgical excision and antibiotic therapy[18].

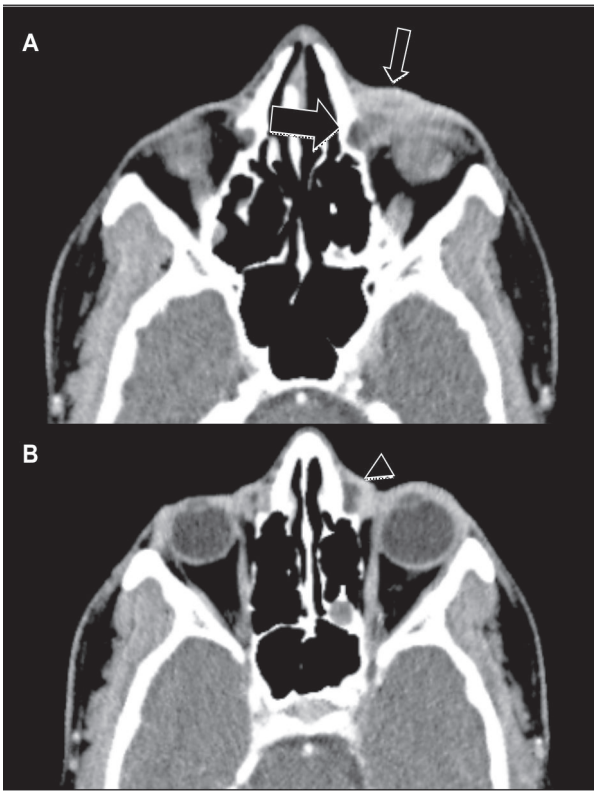

Figure 4: Acute dacryocystitis: 6-year-old patient with a history of congenital stenosis of the left nasolacrimal duct complaining of pain, bulging and redness in the inner corner of the left orbit, starting 2 days earlier. Axial CT after contrast injection (A and B). Collection in the topography of the left lacrimal sac (large arrow) and thickened pre-septal soft tissues (small arrow). Note the significant peripheral enhancement of the collection by the contrast medium (arrowhead).

Ophthalmomyiasis

There are over 85,000 species of flies (Diptera), but only a few can cause ophthalmomyiasis. In this rare disease, the eyelids, conjunctiva, cornea, eyeball, or orbit can be invaded by larvae, a condition that corresponds to only 5% of all cases in humans[19,20].

The diagnosis is most often made by fiberoptic imaging with direct visualization of the larvae; clinically, patients present with oedema, proptosis, visual loss, and restriction of eye movements. However, additional tests such as CT have proved extremely important in the assessment of tissue invasion[19,20].

CT can show intra- and/or extraconal orbital invasion (Figure 6), variable thickening of soft tissues and invasion of the eyeball, potentially leading to its complete destruction. The pattern of eyeball displacement depends on which region of the orbit was invaded[19,20].

Treatment varies according to the location and severity of the disease. It may consist of expectant management, oral antiparasitic agents, mechanical removal of the larvae, and even posterior vitrectomy with surgical removal of the larvae[19,20].

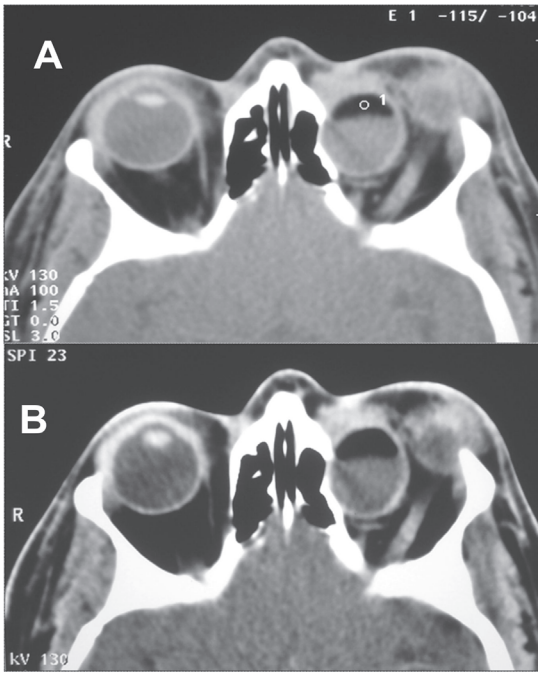

Figure 5: Infected dermoid cyst: 26-year-old male patient with long-term proptosis and lateral-inferior displacement of the left eyeball, complaining of bulging and intense pain in the inner corner of the ipsilateral orbit starting one day earlier. Axial CT before (A) and after (B) contrast injection. Heterogeneous cystic oval lesion with a partially fatty content (-115 HU), forming a liquid level in the upper medial quadrant of the left orbit. Note the peripheral enhancement by the contrast medium (small arrow), bone remodeling of the adjacent lamina papyracea (large arrow), and significantly increased density in the pre-lesional fat (arrowhead). Also note the lateral-inferior displacement of the left eyeball with proptosis.

Gradenigo's Syndrome

Gradenigo's syndrome is a very rare complication of acute mastoiditis associated with inflammatory and infectious processes of the ear, mastoid and/or paranasal sinuses. Its incidence has been dramatically reduced due to the development of antibiotic therapy. Its clinical triad consists of otitis media with purulent discharge, pain in the regions innervated by the first or second branches of the trigeminal nerve, and abducens nerve palsy[16].

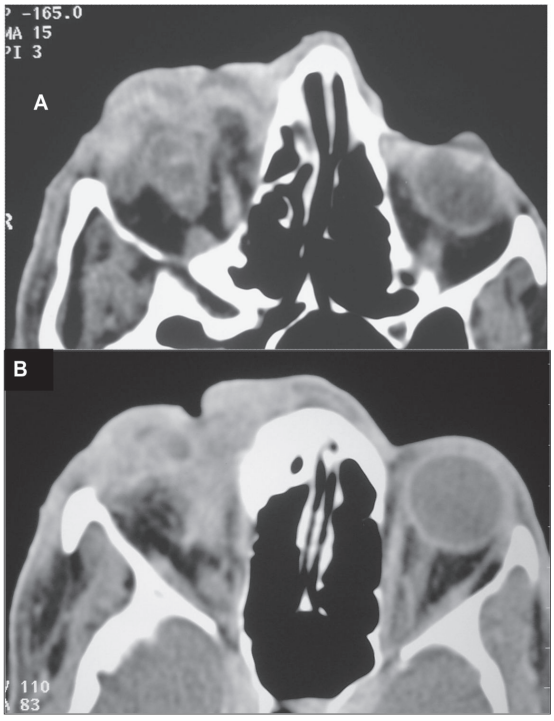

Figure 6: Ophthalmomyiasis: homeless elderly patient with a history of enucleation of the right eye of unknown cause, presenting with facial myiasis and pain in the right orbital region starting six days earlier. Axial CT after contrast injection. Irregular and amorphous thickening of pre- and intra-orbital soft tissues due to larval invasion.

Figure 7: Gradenigo's syndrome: 7-year-old female patient with a history of recurrent otomastoiditis presents with right retro-ocular pain, ipsilateral impairment of visual acuity, and diplopia starting one day earlier. Axial (A) and coronal (B) CT in bone window. Complete opacification of the right tympanic cavity and mastoid air cells (arrowheads). The right petrous apex is also opacified, with coalescence and associated erosion (large arrows). Note the pneumatisation of the petrous apex and normal mastoid aeration on the left side (small arrows).

The infection spreads to adjacent tissues reaching the petrous apex of temporal bone through the air cells located near the paths of the abducens and trigeminal nerves[16,21].

CT findings include opacification of the tympanic cavity and the petrous apex with bone erosion (Figure 7)[16].

There is still no consensus in the literature on the treatment of this condition, with authors disagreeing over early surgery versus conservative treatment to revert the syndrome and reduce the risk of sequelae[21].

Infected mucocele

Mucocele is a benign cystic dilation of the sinuses. It probably results from occlusion of the drainage orifice of the paranasal sinuses or mucoserous glands for various reasons, including trauma and inflammation. It can also occur when the orifice is patent[13,16].

If the accumulated secretion does not drain spontaneously, increased intrasinusal pressure causes a thinning of the cavity's bone wall with expansion in the direction of least resistance, such as the floor of the frontal sinus or lamina papyracea. In cases of superimposed infection the condition is called pyomucoocele (Figure 8)[13,22].

The frontal sinus is most commonly affected, followed by the ethmoid sinus. Mucocele corresponds to about 3.4% of orbital mass lesions and primarily affects individuals aged 35-58 years[22].

Proptosis and of signs mass effect are typically observed, with slow progression of exophthalmos being the most common finding; visual impairment can also occur. Local pain is suggestive of infection[21].

CT shows a generic uniform lesion with a liquid content. Expansion of the sinus cavity leads to adjacent bone remodeling and even bone sclerosis, causing ischemia secondary to chronic compression of the periosteum and orbital invasion[22].

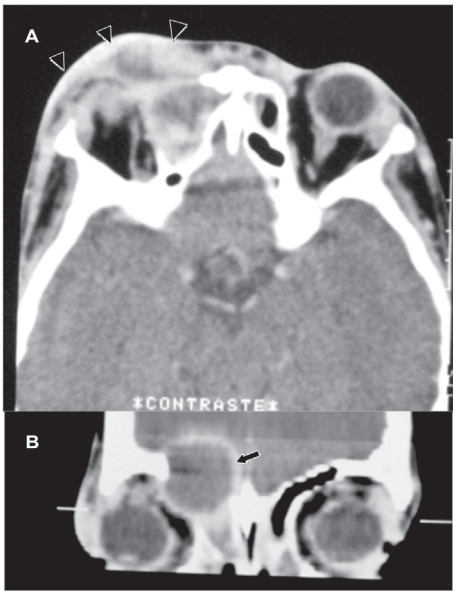

Figure 8: Infected mucocele: 17-year-old female patient with right eye pain, ptosis, and frontal bulging starting 4 days earlier. CT after contrast injection in the axial plane (A) reformatted in the coronal plane (B). **A.** Collection originating from the right frontal sinus (arrow) with significant thickening of pre-orbital soft tissues (arrowheads). The eyeball is not identified at this level due to its inferior displacement. **B.** Collection in the topography of the right frontal sinus (arrow) with wall enhancement after contrast injection, associated with erosion of the upper and lower bony walls of the sinus cavity. Part of the lesion projects into the upper medial quadrant of the ipsilateral orbit and the anterior cranial fossa. Note the infero-lateral displacement of the eyeball on this side.

Final considerations

In summary, CT is the method of choice for imaging evaluation of acute infections of the orbit. The technique, especially with modern multi-detector devices, provides for rapid and accurate identification and characterisation of orbital lesions, adjacent bone abnormalities, and associated intra- and extrasinusal conditions. Emergency medical services should be familiar with the various infectious lesions that can affect the orbit in order to provide early treatment and minimise the risk of sequelae.

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