Orbital cellulitis

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SENIOR THESIS

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INTRODUCTION

The disease known as orbital cellulitis is a purulent inflammation of the cellular tissues of the orbit.

The subject is of interest from a diagnostic standpoint since it might be confused with intracranial conditions. It is also of interest because of the relationship it bears to diseases of the nose and accessory sinuses.

A good history of the subject has not yet been written. Anderson Critchett reported a case to the Ophthalmological Society of the United Kingdom in 1886. (1) The case had been diagnosed as a hemorrhage. Later there occurred proptosis of the right eye with frontal and orbital pain. The vision was reduced and the reaction to light sluggish. The temperature was 100°F. No pus was found on incision into the orbit. Later the left eye became affected. Several operations were carried out without much success. The left eye cleared up, but the right eye remained impaired until after the removal of some infected teeth.

In 1895, before the same society, Lawson described five cases. In four, no pus was found. Three died. One had the affected eye removed, while one recovered with impaired vision.

ETIOLOGY

The majority of cases of orbital cellulitis are secondary to nasal infections. Of 684 cases studied by Patterson (2), 408 were due to accessory sinus inflammation. In 129 cases the frontal
sinus, in 89 the maxillary antrum, in 83 the ethmoidal sinuses and in 25 the sphenoidal sinuses were involved.

Infection may result from a cold in the head, influenza, one of the specific fevers, the entrance of fluid into the nose; it may be secondary to osteomyelitis of the maxilla or the frontal bone, or suppuration in the alveoli, actinomycosis, trauma, from a missile or a stab wound or a fractured skull or an operation on the sinuses, especially the ethmoid. Chronic suppuration on the nasal sinuses may be complicated by orbital inflammation and abscess.

Ballenger, (3) states that orbital infections in children most frequently are due to sinusitis, particularly ethmoiditis.

In a period just short of five years, McMillan (4) saw only eight cases of orbital cellulitis, of these only three occured in scarlet fever.

Davis (5) states that in his own experience the commonest cause of orbital inflammation of nasal origin is suppuration of the frontal sinus in adults and ethmoidal suppuration in children. Babbit (6) states that the greater majority of cases are the result of infection from the accessory nasal sinuses, traumatic injuries and extension from general facial infections. Faulkner (7) states, "the condition formally described as orbital cellulitis is usually direct extension from the frontal or ethmoidal sinus ". White (8), Ballenger (3) and Crane (9) have demonstrated the frequency of toxaemia as well as actual sepsis.

According to Hajek (10) there are four possible in the extension of a diseased process from the bony frame work of the sinuses: 1. Extension of the inflammatory processes through apparently intact bone. 2. Extension by thrombosis of one of
of the large veins perforating bone and spreading infectious material to the other side. 3. Direct extension of the ulcerating process to the bone with periostitis, osteitis and finally necrosis with perforation. 4. Extension of inflammatory processes through dehiscences in the bony wall.

Vail (11) has reported four cases of exophtalmus from sphenoid, posterior ethmoid, anterior ethmoid and frontal sinus involvement, respectively, where an opening was found in the periossteum of the orbital wall.

Babbit (6) states that emphasis should be put upon the rarity of authentic reported cases, as orbital cellulitis offers a serious diagnostic problem, in considering the pathological background of cavernous sinus thrombosis. Dwight (12) and Germain (12) in 1902 gave the number of cases of orbital cellulitis as 182. Smith (13) in 1918, less than 300. Chisholm and Watkins (14) found only eight cases in John Hopkins records of 50,000 surgical cases from 1889 to 1919. Of the twelve cases reported by Chisholm-Watkins four were assigned to foci in the paranasal sinuses, two to facial infection and one to orbital abscess. In Loebs group of nine cavernous sinus thrombosis fatalities recorded in his later survey, five followed intranasal operations. The rich anastomosis of the facial vein with the cavernous sinus show the possibility of extension through the angular ophthalmic, nasal, supraorbital and infraorbital veins and ptergoid plexus to the cavernous sinus.

The causes of orbital cellulitis are outlined by as follows by MacCallan (1):
(1) Injuries
(2) Primary osteomyelitis
(3) Acute dacryo-adenitis
(4) Spread of inflammation from neighboring or distant parts as in (a) panophthalmitis
(b) cavernous sinus thrombosis
(c) infections of the face or eyelids or erysipelas
(d) acute pharyngitis, including scarlet fever
(e) acute periodontitis and maxillary periostitis
(f) infections of the accessory sinuses
(g) tuberculous meningitis
(h) acute dacryocystitis

(5) Septicemia
(6) Syphilis and tuberculosis
(7) Orbital myiasis, aspergillosis and actinomycosis

Injuries: "Orbital cellulitis the result of the entrance of bodies into the orbit, whether these be projectiles or sharp instruments, may result in periostitis and cellulitis."
--- MacCallan (1)

Kalt and Lemaitre (1) report a case of streptococci osteo-periostitis of the orbit which followed a bee sting on the upper lid. MacCallan also reports a case from Brusselmans in which orbital cellulitis was caused by retrobulbar injection of novocain for anesthesia. Shelbourne (15) reports a case caused by powder burn.

Primary osteomyelitis: Parsons (20) reports a case by Ammons.
(3) Acute Dacryo-adenitis: Trulaimo (1) has described orbital cellulitis as resulting from acute dacryo-adenitis. (4) Spread of inflammation from neighboring parts: (a) Panophthalmitis: Although panophthalmitis is usually the result of injury, it may occur in acute fevers. In acute fevers the condition is the result of bacterial metastasis. Mayou has described cases occurring in the course of acute arthritis, and in cystitis. Tenonitis is always accompanied by some cellulitis of the orbit, and by a varying degree of inflammation of the intra-ocular tissues.

(b) Cavernous sinus thrombosis: This fatal condition may arise by extension from the ophthalmic veins, the source of infection being wounds or septic infections of the skin, or from the ears, nose and accessory sinuses, pharynx, tonsils, etc., or from metastasis in infections or septic conditions.

Uhnoff (16), states that cerebral abscess may lead to septic sinus thrombosis and thrombophlebitis of the orbit with exophthalmos. Especially characteristic of such cases is the severity of the inflammation in the orbit.

The signs are similar to those exhibited by an orbital cellulitis. The lids and the conjunctiva swell with edema, and the eyeball is proptosed and its movements restricted. Fisher (17) has reported a case of bilateral pyemic intraocular infection. Edema of the mastoid is frequently, but not always present in thrombosis of the lateral sinus.

Among the fundus appearances which may be present in cavernous sinus thrombosis are optic neuritis, papilledema, and venous engorgement of the retina, according to Kalt and Blum (1). Fundus changes are in favor of sinus thrombosis according to Uhnoff (16), although they may occur in orbital cellulitis. Coupland (1) mentions an important sign in cavernous sinus cases, the
enlargement of the frontal veins due to the diversion of the blood stream through the orbital-facial anastomosis, There is ophthalmoplegia of first one eye then the other, there is also mydriasis, ptosis and divergent squint.

(c) Infected wounds, abscesses or erysipelas: The development of a hordeolum into a case of orbital cellulitis has been described by Green (18), as the result of an attempt at opening the cyst with infected instruments. When sores on the face become seriously infected, orbital cellulitis may result by the spread of the inflammation; or thrombosis of the cavernous sinus may, and septic meningitis, as in a case reported by Rockliffe (1). Ronne (19) has reported four cases in which erysipelas of the face caused bilateral orbital cellulitis.

(d) Acute pharyngitis, including scarlet fever: The occurrence of orbital cellulitis as a complication of scarlet fever is uncommon. Here spontaneous recovery is the rule.

(e) Acute periodontitis and maxillary periostitis: Not only may inflammation of the teeth and the surrounding tissue give rise to orbital cellulitis by direct extension on the same side, but Parsons (20) had a case in which an abscess in connection with an upper molar was followed by orbital cellulitis on the opposite side. The oral abscess was opened and the orbital cavity drained. Vision and ocular movements were perfectly restored. McCaw (21) has reported a case in which bilateral orbital cellulitis occurred subsequent to a severe dental operation. Here spontaneous cure resulted after eleven days of pyrexia. Szokolik (1) has reported three cases of orbital cellulitis following periostitis of the upper jaw in children of ten years, two years, and four months old, respectively. The periostitis in these cases started in connection
with the teeth. Other cases of the same kind have been reported by Guibe and Le Roux (22).

(f) Infections of the accessory sinuses: Patterson (2), B allenger (3), McMillan (4), Davis (5), Babbit (6), Faulkner(7) and others quoted above, have stressed the importance of accessory sinus infections as causes of orbital cellulitis.

(g) Tuberculous meningitis: Cramer(1) states that orbital inflammation may be the first symptom of meningitis. He has reported two cases of tuberculous meningitis, whose earliest indications were, in the first case, tenonitis with fever, and in the second, lid edema, proptosis and immobility of the left eye.

(h) Acute dacryocystitis: The cause of dacryocystitis is not known. MacCallan (1) reports a case of a woman aged 40 who had proptosis of the left eye with limitation of movements. The orbit was surrounded by an area of edema; the patient's temperature was 99.8°F. The pupil reacted normally and the vision was good. Incision over the lacrimal sac allowed the escape of pus and the proptosis subsided. It is supposed that the lacrimal sac became infected at the time the teeth were extracted, when much infected material was let loose.

(i) Septicemic conditions: Septicemic conditions as the cause of orbital cellulitis are not uncommon. MacCallan (1) reports a case at the Royal Eye Hospital. Pus was evacuated from both orbits, from the right eye after incision, from the left spontaneously. The pus grew pure cultures of the Morax-Axenfill bacillus. The patient recovered with shrunken globes. Opinions may differ as to whether the orbital conditions can be considered to have been septicemic in origin, or whether the lowered resistance of the patient enabled the invasion of the orbital tissues by the
Morax-Axenfeld bacilli to take place.

(6) Syphilis and Tuberculosis: Gummata of the orbital tissues is of occasional occurrence. Such a case has been reported by Williamson-Noble (23). In this case there was marked proptosis, with much conjunctival injection. The movements of the globe however, were full and normal. As antisyphilitic treatment caused no decrease in the amount of proptosis, it was thought that the condition was one of orbital neoplasm. Therefore the orbit was exenterated and the actual cause was determined by microscopical examination.

Gummatous disease of the ethmoidal cells or the frontal sinus may occur. Chronic periostitis of syphilitic origin may occur in the outer wall of the orbit, according to Hessberg (1).

Tuberculous disease may occur in three ways: First, there may be a tuberculous mass in the orbit. Second, there may be a tuberculous condition of the ethmoid cells or of the sphenoidal sinus as reported by Lebenhert (24), or thirdly, there may be the more common condition of a tuberculous affection of the outer wall of the orbit, with sinus formation, according to MacCallan (1).

(7) Inflammatory conditions of the orbit due to Myiasis and to Aspergillosis: These conditions have been met with in tropical and subtropical countries, according to MacCallan (1).

Infestation of the orbit with the larvae of Cordylobia anthropophaga (Tumba Fly) or Wohlfartia magnifica, is not uncommon in Egypt, so MacCallan states (1). The latter insect evacuates live larvae from the genital tract. Wahlen and Barsoun (1) state that appalling conditions of orbital sepsis are seen as a result of this condition, Wright (25) described Aspergillosis.
Norman Patterson (2) reports that actinomycosis of the orbit has been met with secondary to infection of the antrum.

Anatomy of the Orbit and Neighboring Structures

In considering disease of the orbit the anatomy of the nasal sinuses must be taken into consideration as well as the anatomy of the orbit. Mayou (26), Woodruff and Gray (27) and Norman Patterson (2) described very well, the anatomy and the routes by which infection may travel from the nose and neighboring structures to the orbit. Mayou states that for study of the track taken by pus in the orbit forward to the skin, it is important to study the fibro-cellular tissue planes in the orbit. These tissue planes are arranged in two directions (1) those closing in the anterior wall of the orbit, and (2) those which take an antero-posterior direction. The orbit being almost entirely enclosed by bony tissue, except on its anterior wall, an abscess which occurs with in it will manifest itself by a protuberance of its anterior wall, and pus will be directed forwards to it by the cellular tissue planes arranged in the antero-posterior direction. This anterior wall in the normal condition is closed by the fibrous attachments of the lids to the orbit, which is thickest at the outer and inner canthus, where they receive special names of the tarsal ligaments of the pulley of the superior oblique.

Another plane of cellular tissue which helps to form a barrier to the passage of pus forwards from the orbit is the attachments of the check ligaments. In these planes of cellular tissue, there are three compartments. One contains the lacrimal gland another contains the lachrymal sac, the third, is Tenon's capsule and contains the eye. These are all comparatively superficial, and if pus forms in either it will nearly always burst through the skin or conjunctiva rather than into the orbit. The connective
tissue planes which are arranged in the antero-posterior
direction are the periosteum of the orbit, and the sheath of
the optic nerve. These membranes are all of sufficient density
in the early stages to completely stop the passage of pus from
one compartment to another; that is to say, abscesses may form
subperiosteally within the fatty tissue of the orbit or in the
sheath of the optic nerve. It is important to recognize this
early, as the abscess can then be opened before other parts of
the orbit have become involved.

Necrosis of the orbital wall may give rise to the formation
of a subperiosteal abscess. The orbit on its upper, inner, and
inferior wall is surrounded by the sinuses of the nose in which
suppuration may occur giving rise to the same condition. These
abscesses as a rule point in very definite positions. Those
arising from the frontal sinus usually present opposite the center
of the upper orbital margin. Those arising from the ethmoidal
cells present at the upper and inner angle of the orbit in the
region of the superior oblique, while the ones from the antrum
which, are rare, present at the lower and outer orbital margin.

In opening abscesses which rise from necrosis of the orbital
walls, it is important to know that they are at first subperiosteal,
because they can be evacuated without opening the cellular planes
of the orbit by cutting straight down on the orbital margin and
stripping up the periosteum until the abscess is opened. In the
early stages of the condition it may be possible in the case of
the ethmoid to open the subperiosteal abscess from the nose after
removing large portions of the ethmoid. Abscesses which occur in
the fatty cellular tissues of the orbit are most frequently the
result of a penetrating wound, cellulitis of the face, or pyemic
infection and at first give rise to a diffuse infiltration with a general swelling of all the orbital tissues and later may point in any position, more commonly in the upper part of the orbit, as in that position the fibro-cellular tissue is thinner than elsewhere. When these abscesses are opened and drained, pockets of pus are liable to form in the orbital fat and drain imperfectly.

Abscesses which form in Tenon's capsule, usually burst forward beneath the conjunctiva between the insertion of the recti muscles, but sometimes perforation of the globe takes place, according to Mayou (26).

The orbit is bounded above and medially by the frontal sinus and the anterior ethmoidal cells, and below by the maxillary sinus; while the posterior group, the sphenoidal sinus and the posterior ethmoidal cells, are in relationship to the posterior half of the medial wall of the orbit. Suppuration of these cells may extend to the orbital tissues, directly through involvement of the bony wall separating them and through dehiscences, and indirectly by venous and lymphatics channels, according to Woodruff and Gray (27).

Norman Patterson (2) describes several ways by which infection may pass from the nose to the orbit. Infection, he states, may pass from the ethmoid through one of the many foramina which give passage to vessels and nerves. Possibly a septic thrombosis may arise in one of the veins of the ethmoid mucous membrane, and the inflammatory process may be carried to the orbit through the anterior or the posterior ethmoidal veins, and finally the infection may reach the cavernous sinus. In the case of the sphenoidal sinus the infection generally reaches the orbit by direct
extension. Dehiscences may occur in the lamina papyracea through which infection may take place, or it may occur through lines of the suture. In the majority of cases, according to Patterson, the inflammatory reaches the orbit as the result of caries or necrosis of the bony wall between the affected air cells and the orbit. It seems certain, no matter what the mode of spread is, that great swelling and inflammation of the fibro-fatty tissues of the orbit may occur in the absence of pus formation.

Pathology

Much of the pathology of orbital cellulitis has already been discussed above under the headings of etiology and of anatomy. However, the types of organisms found, the blood picture and other pathological findings have not been mentioned. It is very evident that the organisms in cases of injuries might be either staphlococcus, Streptococcus, a fungus, etc. Orbital cellulitis secondary to osteomyelitis would in all probability be due to a Staphlococcus infection. Those cases secondary to erysipelas, scarlet fever and pharyngitis would very probably show Strept. Other organisms found are Bacillus tuberculoaS, the spirochaetes of Syphilis, actinomycetes, the various fungi reported above and the cases of larvae of Cordylobia as reported by MacCallan (1).

An explanation of proptosis which results in cases of orbital cellulitis should be attempted here. Trotter (28) in a paper to the Ophthalmological Society in 1923 on the cause of proptosis, suggested that the rigid walls of the orbit might especially conduce to a persistence of solid edema from lymphatic obstruction which follows infection of the cellulitic and erysipelaous type. Wolfe (28) states that if we consider the effect of a hemorrhage or inflammation in such a place, the necessary edema produced
would cause venous obstruction and later increased transudates exactly as has been seen in the skull. A vicious cycle is set up. It is clear that at one stage the amount of absorption must be equal to the increase in volume due to transudation.

Wolfe thinks this may explain the recovery of cases of orbital cellulitis which cleared up making a simple incision into the orbital tissues without the evacuation of pus. The rapid onset of blindness noted in many cases of orbital cellulitis is no doubt due to pressure exerted on the optic nerve itself, or its blood supply.

Mayou (26) states that in some cases of orbital cellulitis leucocytes have been found in the vitreous and that the orbital condition has produced acute inflammation in the uveal tract. This, as he explains, is caused by the close contiguity of the pus with the eyeball. He reports a case of pus in the vitreous which contained no organisms, yet the pus in the interior of the abscess in the orbit contained Staphylococcus, so that it is probable that the exudation into the eye is the result of toxicity rather than the true infection of the eyeball with the organism. Abscesses of the optic nerve are very rare. Cases have been recorded as the result of infection from the face or spreading from the meninges.

Ballenger (3) states that infections may be transmitted from the sinuses to the orbit by way of the blood or possibly the lymph stream without any bony perforations. Ballenger found only twelve cases of orbital cellulitis in the Children's Memorial Hospital in Chicago. Of these twelve cases only three had orbital abscesses. One child had a Diphtheritic infection of the orbital tissues following a Diphtheritic infection of the nose and throat.
One case had a *Staphylococcus albus* infection with periorbital swelling, proptosis and paralysis of the external rectus. He recovered after a spontaneous rupture in the outer canthus of the eye. There was one case of *Staphylococcus aureus* infection which developed a periorbital swelling with proptosis. All cases recovered. The temperature varied from 99°F to 105°F, with an average of about 101.6°F. The white blood count varied from 10,400 to 30,000 with an average of about 16,300. The organisms were recorded in six cases. A *Streptococcus* was found in two instances. A Klebs-Loeffler, *Pneumococcus*, *Staphylococcus albus* and a *Staphylococcus aureus* were found once each.

**Symptoms and Findings**

Most of the writers in discussing the symptoms of orbital cellulitis also discuss the nasal symptoms which lead up to the condition in the orbit, as orbital cellulitis is very frequently a sequel to some nasal condition.

Parsons (29) describes the symptoms of orbital cellulitis proper, as, great swelling of the lids with chemosis, proptosis, severe pain with impaired mobility, fever and often cerebral symptoms. The pain is severe and is increased by movement of the eye or by pressure upon it. Movement of the eye is painful, and there may be diplopia owing to the limitation of movement. Vision may not be affected, or it may be reduced owing to retrobulbar neuritis. The fundus is difficult to examine; it may be normal or show engorgement of the veins and optic neuritis, passing later into optic atrophy. An abscess is formed which usually points somewhere in the skin of the lids near the orbital margin, or may empty into the fornix conjunctivae. Panophthalmitis may supervene. There is grave danger of extension to the meninges and brain, leading to death from purulent meningitis or cerebral
abscess. The orbital cellulitis may lead to cavernous sinus thrombosis, and is always difficult to diagnose from it.

Babbit states that a case presents with marked, rather uniform swelling in the orbital cavity, which may appear without much premonition and is of acute inflammatory character, with more or less extension of edematous swellings to surrounding parts, as the cheek, temple, and nasal border and the frontal region. In a considerable percentage of cases the eye seems pushed forward in its socket, a true exophthalmos. The bulbar and palpebral conjunctiva are swollen and edematous, and there is often marked proptosis of the upper lid. The eye may be rotated upward, outward or downward from the inflammatory pressure of the adjacent sinus involved. The eye is acutely sensitive to light and pressure, and the patient, if not too ill, complains bitterly of pain. The diminished vision, Babbit thinks is due to the swelling and increased tortuosity of the retinal veins. There should be little tendency to papilledema or functional disturbance of the oculomotor or abducent nerves. The orbital swelling has the tawny, semi indurated feel of cellulitis. There may be some discoloration and often tends to creep over to the other side, that is the unaffected side. There may be actual edema around the other eye. Septic evidence may be marked with high fluctuating temperature, chills, sweat and delirium.

Norman Patterson (2) considers the nasal symptoms very important in children. The nasal symptoms include obstruction, which especially in children, owing to the small size of the nasal cavities, may be absolute on the affected side. Such obstruction, by interfering with nasal drainage, may act as an important factor in determining the passage of infection into the orbit.
Other symptoms include headache, the situation, character and periodicity of which will vary with the sinus or sinuses involved. With the involvement of the orbit the pain becomes more localized. There is a wide variation in the size and position of the sinuses, occasionally there is no pain in the orbit, yet operation reveals pus.

Orbital inflammation may appear suddenly soon after the onset of nasal catarrh. At first the signs may be slight. Later there may be pronounced swelling and congestion, which commencing in the neighborhood of the inner canthus of the eye, extends until both eyelids, but more especially the upper, are markedly swollen, with obliteration of the natural folds and marked conjunctival edema, the patient being unable to open the eye. The pain is increased by ocular movements.

In inflammation of the frontal sinus there is swelling and tenderness of the region of the sinus. If orbital cellulitis occurs secondary to this condition, swelling and inflammation will appear in the lower edge of the orbit, according to Patterson (2).

Diagnosis

In 1923 Fisher (1) said that the evidences of orbital inflammation and the source of the infection in cases of orbital cellulitis made the diagnosis from non-inflammatory conditions easy. MacCallan (1), however, states that cases have been reported in which there is difficulty, and in which mistakes were made. Trotter (1) differentiates between inflammatory conditions, and encroachments upon the orbital space by a swelling such as a neoplasm, by the nature of the displacement of the eye. In the inflammatory group, the displacement is antero-posterior above,
while in the second group the antero-posterior projection is combined with some other displacement.

In making a diagnosis, transillumination should be carried out in all cases of orbital inflammation. Exploratory puncture may play an important part in the diagnosis. X-ray studies of the sinuses should be made. Thrombosis of the cavernous sinus may be secondary to orbital cellulitis or it may arise from direct spread from one of the nasal sinuses. Other complications of orbital cellulitis are extra-dural abscess, meningitis, cerebral abscess, and pyemic abscesses in distant parts. The onset of the orbital cellulitis may be associated with a fresh rise in temperature or an actual chill. The patient may show signs of a general toxemia. The urine should be examined for albumen, sugar or blood. A blood count should be made before deciding operation. In manifestations of septemia a blood culture should be made.

E. Temple Smith (13) states that the essential feature of orbital cellulitis is proptosis of the eye associated with signs of inflammation. Proptosis alone is not sufficient for a diagnosis. Proptosis unassociated with inflammation may be caused by a cyst, a mucocele, a new growth, or what not. Until one meets the combination of a congested eye and swollen pink eyelids with proptosis, the diagnosis cannot be established. Once made, a grave prognosis should be given and the help of a specialist sought. It is at times very difficult to be sure whether or not proptosis is present when chemosis of the conjunctiva and a swollen lid are the most prominent features. But it is on the existence of this sign that the diagnosis will depend. Orbital cellulitis must not be diagnosed because edema of the eyelid is present, or even cellulitis of the eyelid. The later is often
due to the spread of infection from a hordeolum or impetiginous sore in the neighborhood; and edema of the scalp or face or a dacrycystitis, and is then present in the loose cellular structure of the lids.

Again, an intense purulent conjunctivitis, gonorrhoeal or diphtheritic, may occasionally give rise to a pink and swollen lid. The diagnosis will be established by the presence of a profuse discharge or a membrane on the everted lids. If a local cause can be discovered for the swollen lid, whether abscess, conjunctivitis, dacrocystitis, or foreign body, it can be treated along appropriate lines. If none such can be found and proptosis is present or strongly suspected a grave prognosis must be made of the case, as it is one of orbital cellulitis.

The nose should always be examined in cases of orbital inflammation, most cases reveal signs of sinus suppuration. Pressure on the ethmoid swelling may cause pus to exude from the nose. Davis states that when frontal sinus suppuration involves the orbit it causes a downward and outward displacement of the eyeball, and a swelling over the floor of the frontal sinus and at the inner edge of the supra-orbital ridge. Ethmoidal suppuration displaces the eyeball outwards and forwards. An X-ray film of the nasal sinuses should always be made to confirm the diagnosis.

The important conditions to be differentiated from orbital cellulitis are thrombosis of the cavernous sinus, Tumors of the orbit or of the optic nerve, cerebral abscess, and basal aneurism of the cerebral arteries. A symptom which is common to all these conditions is unilateral exophthalmos.

Davis (5) states that a patient with cavernous sinus thrombosis is desperately ill, often with rigors, the edema has a
bluish tinge and extends to the face and other eye. "Diplopia and paresis of the ocular muscles is the early sign. The pupil is dilated, inactive and blindness occurs rapidly." A primary source of infection as a boil or cellulitis of the middle ear may be present.

Tumors of the orbit or of the optic nerve have been mistaken for orbital cellulitis especially when nasal sinus suppuration and a tumor exist together or when the condition of the nose suggests sinus disease. Differential diagnosis is made in this case by an ophthalmic surgeon or by the process of exclusion. According to Uhlhoff, unilateral exophthalmos if no primary disease exists in the orbit, may mean a tumor has grown into the orbit from the cranial fossa. In case of primary disease of the orbit, cerebral symptoms are lacking. In the latter the associated affections of the cranial nerves will indicate a local lesion and will be restricted to the same side as the exophthalmos. Metastatic tumors in the orbit and on the eyeball may co-exist with remote metastatic brain tumors, and in that case produce unilateral exophthalmos. Apart from the exophthalmos, also, the nature of the intraocular changes sometimes gives a clue to the nature of the brain tumor, according to Uhlhoff (16).

Basal aneurism of the cerebral arteries, especially of the internal carotid, may by causing enlargement of the ophthalmic artery or compression of the cavernous sinus lead to unilateral exophthalmos. This is rare and as a rule easy to diagnose because of the etiology.

In cerebral abscess and cerebellar abscess the exophthalmos is always unilateral and on the same side (ipsilateral) but very rare. In cerebral abscess with unilateral exophthalmos it is
partly a case of direct communication of brain abscess with the orbit -- a process in which subperiosteal and epidural abscesses in the neighborhood of the cranial fossa play the most important part. The breaking of an abscess of cerebral origin into the orbit appears to be less frequent. In other cases an empyema of the frontal sinus formed the point of origin of both the abscess of the frontal lobe and the orbital abscess, but this is also rare. An isolated affection of the orbital cavity without brain abscess is much more frequent.

Exophthalmos is met with most frequently in septic cerebral sinus thrombosis (70%), and is mostly distinguished by being unilateral. It is always accompanied and characterized by severe inflammation and orbital symptoms.

Prognosis

Not only does orbital cellulitis in itself have a grave prognosis if not properly treated, but there is very great danger of extension to the meninges and brain, leading to a fatal issue from purulent meningitis or cerebral abscess. Thrombosis of the cavernous sinus may result from orbital cellulitis, and is always difficult to diagnose from it. McMillin (4) states that even when the patient recovers permanent damage is likely to follow, such as loss of sight, ptosis etc. According to Ballenger's statistics, the prognosis in case of children is much better than in adults. Of twelve cases studied by Ballenger in the Children's Memorial Hospital in Chicago all recovered. E. Temple Smith (13) states that a grave view must be taken of orbital cellulitis.
Treatment

The type of treatment advised by Parsons is first to apply hot fomentations, but do not rely on them too long. An early incision as in orbital periostitis is very important. Even if pus is not found, the tension is relieved and a track is prepared for its evacuation. Several incisions along the walls of the orbit are indicated if there is no sufficient guide to the position of the focus. If the source of infection is obscure, the nose and other likely seats must be investigated, and the primary focus treated.

Methods suggested by E. Wolfe to relieve tension are: (1) An incision into the orbit outside the muscle cone. (2) An incision into the orbit with splitting of the lid in a vertical direction and a division of one or both tarsal ligaments. (3) The division of one of the ocular muscles. This allows the eye to move forward to diminish the pressure behind it, but also opens up the muscle cone and Tenon's capsule and gives a good view of the back of the eye and anterior part of the optic nerve. (4) Opening Tenon's capsule by a conjunctival incision. (5) Temporary resection of part of the orbital wall as in Kronlein's operation. (6) Eleefeld has attempted draining the edematous tissues by means of a hypertonic sugar solution.

Norman Patterson (2) suggests that in children it is not wise to delay the external incision too long, as, owing to the small size of the nose there is greater danger of meningitis and other complications. It is generally sound policy in older patients not to be in too great hurry to incise the orbital swelling. Many cases will clear up without surgery. If in spite of the treatment swelling and pain increase, then it will be necessary
to make an opening from the outside. Several general symptoms, high temperature, chills or any signs of intracranial complications will settle the matter in favor of operation. Patterson states that the old procedure of puncturing the region of the inner canthus with a Von Graefe knife, followed by the use of sinus forceps or incising through the conjunctiva, has been largely discarded. This method gives poor drainage and the wound is liable to close too soon; but its chief objection is that in opening the subperiosteal abscess the fibro-fatty tissue of the orbit is infected. The best incision is the one just below the inner third of the eyebrow. This incision will give an adequate exposure of the inner wall. Through this incision the surgeon works backwards and downwards. If the incision does not pass beyond the inner extremity of the eyebrow there should be no visible scar when it is healed. The incision is carried down to the periosteum. The wound is then retracted and the periosteum is incised along the lower border of the supra-orbital margin. The periosteum lining the inner wall is now separated from the underlying bone in a backward and downward direction, and if an abscess is present, it will be opened. The orbital periosteum and the orbital contents are now with a special retractor displaced outwards and downwards. If there is much hemorrhage a suction apparatus will prove useful. The inner wall of the orbit is inspected, and any carious or necrotic portions of the bone should be removed. In acute cases the golden rule should be to do as little as possible. Mere opening of the abscess and treatment of the diseased ethmoidal cells finishing up with a large opening into the nose will probably cure the patient. The involved sinuses are treated as needed by a rhinologist, as an assistant.
Sometimes all of the nasal sinuses may require surgical treatment, but this should not be done at one sitting. When the primary cause lies in the posterior ethmoid or sphenoid cells, pus may be present far back in the orbit. In addition to the orbital operation, counter drainage into the nose is again called for. In cases of astral origin, or those due to osteomyelitis of the superior maxilla, or to supuration in a dental sac, an incision may be required below the orbit, and it may be necessary to remove a portion of the inferior orbital wall. In the traumatic cases anatomical landmarks may be obscured or obliterated from destruction of the tissue or later from adhesions. A missile may have traversed the orbit, nasal cavity, and cranial cavity, and be lodged in any of these regions. If the patient at the time of a penetrating wound or fractured skull is suffering from sinus supuration, infection is sure to travel along the track of the injury. An X-ray should be taken in all cases before treatment is begun. In all cases when the orbit is opened up, drainage should be carried out and kept up until such time as it is thought safe to allow the external wound to close. Drainage in the nose will always be necessary as well.

The after treatment consists of antiseptic sprays for the nose. The patient must be told not to blow his nose. The wound in the orbit should be dressed daily after it has been syringed. The drain is changed as needed. The dressings should be moistened lint and should be changed often. Treat any nasal trouble after the orbital condition clears up. The patient should be told not to swim or dive afterwards.
"The treatment of orbital cellulitis, then resolves itself into the evacuation of pus in the orbit, if present, and a careful search for the primary cause of the inflammation with the help of colleagues. Some cases of orbital inflammation subsides without operative interference. While the assistance of skilled nose and throat surgeons cannot be over estimated, it must not be forgotten that theirs is not the last word on the subject, and that the primary origin of the inflammation may lie in the teeth, the bladder or the prostate etc." --From MacCallan (1).

Case Reports

Beck (30) reports the following case which shall be Case 1. "A boy four years of age had a violent acute rhinitis, which did not clear up on the right side but continued to suppurate. On the tenth day of the disease the rhinologist in charge was called to the house of the patient. He found a very sick boy with a temperature of 104° F., and who had a chill. The right eye was slightly puffed. The child continued to complain of a severe headache. The next day there was marked edema of both lids of the right eye, particularly the upper. The examination of the nose, right side showed almost complete blocking by edematous tissue and pus discharge. The left side of the nose was negative. The throat was negative, except for some post nasal discharge. The tonsils were enlarged. The ears were negative. Temperature was 102° F.; pulse 130. Eyes V. R. 20/20 V. L 20/20. There was chemosis of the conjunctiva of the right eye, iris negative and the ophthalmoscopic examination revealed a distinct tortuosity of the veins. The tension was normal and the movements were restricted. The left eye was practically normal. Blood examination revealed a leucocytosis of a grave sepsis. There were 32,000 leucocytes with 82% polys. Blood cultures were negative."
The organisms in the above case were mostly pneumococcus with a few streptococcus mucosus capsulatus, and some staph.

The X-ray showed a cloudy ethmoid. The diagnosis of cellulitis of the orbit with probably abscess formation secondary to sinusitis was made and it was decided to operate. Under general anesthesia Dr. Beck made an exploratory of the nasal wall of the orbit from beginning to end but found no pus or point of perforation. He drained this area. On the second day after the operation an abscess pointed near the external part of the upper lid, which when incised discharged a large amount of pus, which on culture showed streptococcus and pneumococcus. Complete recovery took place rapidly after the abscess was opened. The blood count came down immediately. It was the chill, high leucocyte count and choked disc which made Dr. Beck think he was dealing with a case of cavernous sinus thrombosis. Such a diagnosis was also suggested by the external appearance of the eye.

Case II. This is a case reported by T. M. Bride (32).

"A man 58 years of age. A history of pain and discomfort in and around the right eye for about three weeks. First seen Oct. 16, 1922.; the right eye proptosed and pushed slightly downward also. All movements fairly good. Fundus normal and vision not appreciably affected. Teeth bad. Double ethmoidal sinusitis and suppuration.

This case was operated on by Mr. F. G. Wrigly, who drained both the ethmoidal sinuses. The proptosis rapidly subsided, and in a short time complete cure resulted."

Bride states that this case is of interest because many of this type have to be drained from an orbital incision.
Case III. Mayou (25) reports the case of G. D. A girl 16 years of age who, on Dec. 25, 1916, "developed a boil on the bridge of the nose, which suppurated and was opened several times by her doctor. A fortnight after the appearance of the boil the left eye became proptosed and then went down. At the same time the right eye became proptosed and both upper lids became red and painful. There was no history of any nasal trouble. On January 13th, 1917, there was proptosis of both eyes, more on the right side than the left, and both lids were red and edematous; the eyes were pushed somewhat downwards, and there was limitation of movement in both. The temperature was 100.4° F. Pulse 140. Resp. 26. The nose was examined by rhinoscopy and X-rays; there was nothing abnormal to be seen. On Jan. 13th an incision was made down to the bone of the right upper and inner margin of the orbit. The periosteum was stripped up and an abscess opened and drained. The temperature did not go down. On Jan. 15th the left eye had become proptosed and the right was still bad. The left orbit was opened by and incision along the supraorbital margin down to the periosteum, which was stripped up over the whole of the inner surface of the orbit, but no abscess was found. The wound was closed by sutures. In the right orbit the wound was enlarged and the ethmoid cells were opened up and found to be full of creamy pus. The anterior end of the middle turbinate was removed and a drainage tube passed from the wound and out at the anterior nares. On the eighteenth there was a marked improvement in the right eye, but the left was worse; the proptosis greater and there was a small opacity in the cornea. On the 20th, the right orbit was much better.
The left eye had become more swollen, and under chloroform another search was made for pus; the old wound was opened up, the cellular tissue of the orbit explored with sinus forceps, and a large abscess was opened on the outer side of the orbit behind the lacrymal gland and a drainage tube was inserted. On the 22nd of Jan., the right eye was very much better and the proptosis less. The left eye was more proptosed and the lids more edematous. Exploration with the sinus forceps was made in the cellular tissue and a large abscess containing two or three ounces of pus was opened on the inner side. A counter opening was made in the lower orbital margin and a tube passed through from one side to the other. After opening the abscess the temperature which was between 100° F. and 102° F. subsided and the proptosis went down. On Jan. 21st, a small superficial abscess was opened below the left eyebrow near its inner end. On Feb. 2nd, the right lower lid became swollen, red, and edematous near its inner end. An incision was made and pus found, which was evidently a secondary abscess from the necrosis of the orbital plate of the ethmoid. On Feb. 6th, another secondary abscess was opened in the lower lid of the left side. The pus of staphlococcal origin. Feb. 7th staphlococcus vaccine was given and repeated once per week. The tube passed through the nose in the right orbit was left out and a week later the tube in the left orbit was removed and the patient made an uneventful recovery. March 31st, neither fundus showed any signs of optic neuritis or other abnormalities. The vision of the right eye was 20/20 and the left 20/40. The latter vision was accounted for by a slight corneal nebula due to exposure and is rapidly clearing up.
Case IV. This is a case reported by McClelland (33).

"J. E. M. age 3 seen Nov. 30th 1919. Right eye prominent. Child very ill. High temperature, rapid pulse and great pain around the eye." The child was also constipated. "The eye 'began to swell' was pushed outwards upwards and forwards."
The eyelids were forced apart, and could not be closed even with considerable force. The eye was treated by ointment on lint for protection of the eyeball itself. Hot fomentations were applied at night, as well as in the day. On Dec. 5, 1919 Dr. McClelland made a wide incision into the upper part of the swelling, and exposed the post orbital fat which herniated through the wound. Three days later he opened below and inwards, and a large amount of pus came out. The pus later came from between the lids. The child became very ill but recovered in a few days with upward and outward strabismus and limitation of movement. The fundus remained normal. A state of monocular vision existed. The acuity improved some and was still improving at the time Dr. McClelland reported the case. This was ten months after the onset of the symptoms. There was also less squinting at the time of the report than ten months before.

Case V. Reported by Doctor McMillan (4).

"J. K. Female age 15. Admitted to the Knightswood Fever Hospital Dec. 3, 1915, suffering from scarlet fever. The temperature fell to normal the following day, but on the 5th ran up to 104.4° F. Pulse 120. Resp. 24, severe frontal headache, pain in the eyes, and general malaise. On the 5th the headache was less severe, but there was definite swelling and edema of the right upper lid. Movements of the eye were fairly good and the pupillary reaction normal. There was considerable pain over the superciliary ridge. The temperature had fallen
to 102.4°F. On the following day, the general condition had improved, headache also better. Temperature 100.2°F, but the right eye rather more edematous and painful. On the 8th the patient was more comfortable. The right eye was closed and the movements of the eyeball were limited upward and inwards. Pupils reacted normally, the conjunctiva bloodshot, there was proptosis of the eyeball, and edema of the forehead on the right side. On the 13th transillumination showed no involvement of the frontal sinus or antrum. The patient was placed under general anesthesia and the parts explored with the right forefinger under the lid; at the inner third of the supraorbital plate an elastic swelling was felt into which a von Graefe knife was plunged through the lid and guided between the forefinger and the bone into a cavity. Pressure forceps introduced and opened allowed about a teaspoonful of pus to escape. The orbital plate was found eroded and a drainage tube was left in the wound. A culture showed streptococcus. Recovery was quick and uneventful. Patient dismissed Feb. 10, 1915. The wound had closed and the cicatrix firm. There was a slight drop of the lid. Headache at times. The patient looked well and happy.

Case VI. MacCallan reports the case of "a man admitted to the Royal Eye Hospital in 1928, complaining of fullness of the right eye, which had been present about seven months. Recently the right eye had become inflamed." When seen by Dr. MacCallan, "there was slight proptosis, chemosis of the conjunctiva and defective movement. He was taken to Westminster Hospital where defective translucency of the right antrum was found. The antrum was opened and pus found. The following day proptosis had
diminished, and the movements of the eye had become normal."

--- MacCallan (1).

Summary

I. Orbital cellulitis is due to deep injuries, retained foreign bodies, extension of inflammation from neighboring parts, as the sinuses and teeth, facial erysipelas; metastasis in pyemia, meningitis, infective fevers etc.

II. The anatomy of the orbit and neighboring structures must be known to understand the routes of spread of the inflammation.

III. Pathology: The organisms causing orbital cellulitis may be any one of the pyogens, or Klebs Loeffler bacillus, the spirochaete of syphilis, Koch's bacillus, the fungi or it may at times result from toxemia.

IV. The symptoms and findings are swelling of the lids with chemosis. There is proptosis, limited movement, pain on pressure and movement, diplopia, retina may be normal or the veins may be engorged. Pus may or may not be found on incision.

V. Diagnosis is by transillumination, x-ray, history of infection about the face or sinuses and the typical symptoms of the condition. It must be differentiated from cerebral sinus thrombosis, metastatic tumors of the orbit, extra dural abscess, meningitis etc.

VI. The condition is treated by hot fomentations, early incision to relieve tension and to get drainage if pus is present. Look for source of infection in nose and other likely seats, and treat the primary focus.
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ORBITAL CELLULITIS

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