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Radiologic findings in infected and noninfected scleral buckles

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PURPOSE. *To present the radiologic findings in scleral buckle infections and in the early postoperative period after scleral buckling.*
METHODS. *Retrospective multicenter orbital computed tomography (CT) study of 14 patients and brain magnetic resonance (MR) in one patient with scleral buckle infections, some with the referring diagnosis of endophthalmitis, proliferative vitreoretinopathy, orbital cellulitis, or unilateral headache. The control population consisted of early postoperative prospective CT study of 38 consecutive patients with scleral buckle without clinical infection.*
RESULTS. *Diffuse scleral thickening and preseptal soft tissue swelling were noted in acute scleral buckle infections. Scleral thickening decreased radiologically following prompt antibiotic therapy in five patients with acute infections. Silicone sponge had low attenuation without infection and high attenuation with infection. In chronically infected scleral buckle, the sclera was thickened around the buckle, with scleral melt under the buckle. MR showed increased signal intensity in the preseptal region in one patient with chronic fungal infection. In the controls, two had thickening of the sclera without soft tissue swelling.*
CONCLUSIONS. *CT or MR can assist in the early diagnosis and management of scleral buckle infections. (Eur J Ophthalmol 2007; 17: 804-11)*

KEY WORDS. *CT orbit, MR orbit, Scleral buckle, Scleral buckle infection*

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INTRODUCTION

Magnetic resonance (MR) and computed tomography (CT) are used by retinal surgeons to monitor eyes with various intraocular tamponade and media opacities (1-4), and eyes with hydrogel exoplant expansion or fragmentation (5-7). We investigated the role of CT or MR in the diagnosis of scleral buckle infections.

MATERIALS AND METHODS

In a retrospective multicenter study, we collected patients with radiologic documentation of scleral buckle infections (ocular pain and redness, limitation of extraocular motility, adnexal swelling, with or without ocular discharge, and absence of scleral buckle exposure). Acute infections were defined as infections detected

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TABLE I - CLINICAL AND RADIOLOGIC CHARACTERISTICS OF 13 PATIENTS WITH INFECTED SCLERAL BUCKLES (SB)

Patient no./sex/age, yr	Initial diagnosis/no. of weeks after scleral buckle/acute vs chronic SB infection	CT or MR/radiologic findings	Maintenance antibiotic/follow-up after SB, mo/complications/culture results
1/M/67	Endophthalmitis/2	CT/high attenuation of episcleral sponge; mild scleral thickening	Cefta + Gen IV 1 wk/28/ocular infection improved markedly; grayish sponge removed combined with PPV and silicone oil injection/no cultures taken
2/M/48	Endophthalmitis/1	CT/scleral thickening decreased on antibiotic therapy	Cefta + Gen IV 4 d then Ofl PO for 1 mo/70/patient refused repeatedly SB removal and had total retinal detachment with PVR/no cultures taken
3/M/57	PVR/2/acute	CT/scleral thickening decreased on antibiotic therapy	Van + Cefta IV 1 wk then Cefa PO 1 wk then Van + Gen IV for 2 wk/34/SB kept in place for fear of globe rupture combined with PPV and silicone oil injection/conjunctiva grew coagulase positive staphylococci
4/M/21	Acute SB infection/1/acute	CT/scleral thickening decreased on antibiotic therapy	Cefa + Gen IV 2 wk/8/phthisis bulbi (extensive penetrating corneoscleral laceration)/conjunctiva grew coagulase negative staphylococci epidermidis
5/F/50	Acute SB infection/1/acute	CT/scleral thickening decreased on antibiotic therapy	Van IV 2 d then Azi + Ofl PO 3 wk/32/no cultures taken
6/M/46	Acute SB infection/1/acute	CT/scleral thickening	Oxa IV 2 d then Ofl PO 3 wk/12/no cultures taken
7/M/17	Acute SB infection/1/acute	CT/scleral thickening	Cefa IV 2 d then Cefa + Ofl PO 10 d/36/no cultures taken
8/M/50	Acute SB infection/1/acute	CT/scleral thickening	Azi + Cefa PO 3 wk/14/no cultures taken
9/F/77	Acute SB infection/1/acute	CT/scleral thickening decreased	Cefta + Van IV 1 d then Ofl PO 2
		on antibiotic therapy	wk/27/no cultures taken
10/F/62	Acute SB infection/1/acute	CT/scleral thickening	Cefa + Ofl 2 wk PO/8/no cultures taken
11/F/65	Chronic SB infection/52/chronic	CT/hard silicone eroding through thickened sclera	SB removal with PPV and silicone oil injection/72/no cultures taken
12/F/65	Headache/129/chronic	MR/Increased signal and enhancement of preseptal region	SB removal with topical amphotericin B and oral antifungal agents/30/buckle grew *Aspergillus*
13/M/30	Orbital cellulitis/1/acute	CT/scleral thickening	Cefta + Van IV 1 d then Azi 43 d/12/no cultures taken
14/M/80	Acute SB infection/1 y/acute	CT/scleral thickening/adnexal swelling	Conjunctiva grew *Pseudomonas aeruginosa*; SB removal/1 y
15/M/83	Acute SB infection/6 mo/acute	CT/high attenuation of episcleral sponge/severe preseptal swelling/EOM swelling/scleral thickening not noted in this silicone–oil filled eye (CT done without contrast)	Conjunctiva grew *P aeruginosa*; SB removed/6

CT = Computed tomography; MR = Magnetic resonance; Cefta = Ceftazidime; Gen = Gentamicin; PPV= Pars plana vitrectomy; Ofl = Ofloxacin; PVR= Proliferative vitreoretinopathy; Van = Vancomycin; Cefa = Cefazolin; Oxa = Oxacillin; Azi = Azithromycin

within 1 to 2 weeks of ocular symptoms, while chronic infections referred to cases with longstanding symptoms. Cultures of the conjunctiva were done in selected subjects as the majority of eyes had no discharge from prior oral and topical broad-spectrum antibiotics. Cultures of the buckle were made when the buckle was removed. Orbital CT was performed in 11 subjects using Philips spiral Tomoscan AV (Eind Hoven-Best, Netherlands) and in 2 patients using GE LightSpeed VCT series (General Electric, Milwaukee, WI), 2 mm axial and coronal slices, and iopromide contrast (Ultravit 300, Schering AG, Germany). One patient had first-generation CT of orbits in 1988 (General Electric). MR was done using the 1.5 Tesla Signa imaging system (General Electric), 3 mm thickness, and gadolinium contrast.

In order to differentiate between postsurgical inflammation and scleral buckle infection, we chose a group without scleral buckle infection to study the radiologic changes in this control group. In this subsequent prospective study, consecutive patients undergoing scleral buckle (from May 1998 to May 2000) by one of us (A.M.M.) constituted the control population (provided no scleral buckle infection). Two patients with extensive retinal cryotherapy and four cases with extruded scleral buckle (two hard silicone and two silicone sponges) also had CT imaging. Controls were given intraoperative (1.2 gm Augmentin intravenously, subconjunctival Lincocin and Decadron) and postoperative prophylactic antibiotic (oral azithromycin or ofloxacin or cephalexin for 6 days along with topical chloramphenicol and fluoroquinolone). Silicone exoplants were soaked in gentamicin at the start of surgery. CT of orbits was done using the Philips spiral Tomoscan AV. Orbital CT of patients with infected scleral buckle and of controls were reviewed in a masked fashion unaware of the clinical history. This study was approved by the Institutional Review Board.

RESULTS

CT was carried out in the first postoperative week in 9 acutely infected scleral buckle cases (Tabs. I and II) and in the control group (38 cases). Two subjects had scleral buckle infection 1 year and a half year respectively after surgery. In chronic infections (2 cases), CT was performed 1 year and MRI 30 months postoperatively. The referring or initial diagnosis included endophthalmitis (2 cases), proliferative vitreoretinopathy (1 case), orbital cellulitis (1 case), and headache (1 case).

The infected buckle group consisted of 10 men and 5 women with mean age of 56 years and mean follow-up after scleral buckling of 28 months (6–72 months). The radiologic findings in infected scleral buckles revolved around the preseptal region, the sclera, and the scleral buckle. The preseptal area showed localized or diffuse soft tissue swelling in all 15 cases. Extraocular muscle thickening over the buckle was noted in two cases on coronal views. Diffuse scleral thickening was observed in 13 out of 14 cases by CT (Figs. 1 and 2). In one case with chronic infection, focal scleral melt under the scleral buckle was noted amidst diffuse scleral thickening (Fig. 3). Scleral thickening was noted to decrease after prompt systemic antibiotic therapy in five patients who had repeat CT. Hard silicone had high attenuation regardless of infection (Figs. 1 and 2). Silicone sponge had low attenuation similar to orbital fat (Fig. 4). Infected silicone sponge had high attenuation (Fig. 4). Scleral buckles were removed in two cases with chronic infection, three cases of acute infection, and an attempt at removal was aborted in one case with acute infection because of thinned out sclera. The infection resolved in all nine acute infections (without removal of sclera buckle) maintained for several weeks on azithromycin (three patients), ofloxacin (six patients), or cephalexin (two patients) with a mean follow-up of 27 months (range 8–70 months). One case treated in 1988 ended in phthisis, probably from the

TABLE II - YEARLY PROFILE OF SCLERAL BUCKLE (SB) INFECTION RELATED TO ONE SURGEON (A.M.M.)

Year	No. of patients	No. of infected SB	Percent infected SB
1993	18	0	0
1994	20	0	0
1995	14	0	0
1996	18	0	0
1997	16	1	0
1998	30	3	10
1999	42	3	7.1
2000	31	1	3.2
2001	23	1	4.3
2002	30	0	0
2003	31	0	0
2004	12	0	0
2005	29	0	0
2006	41	0	0
Total (14 y)	355	9	2.5%

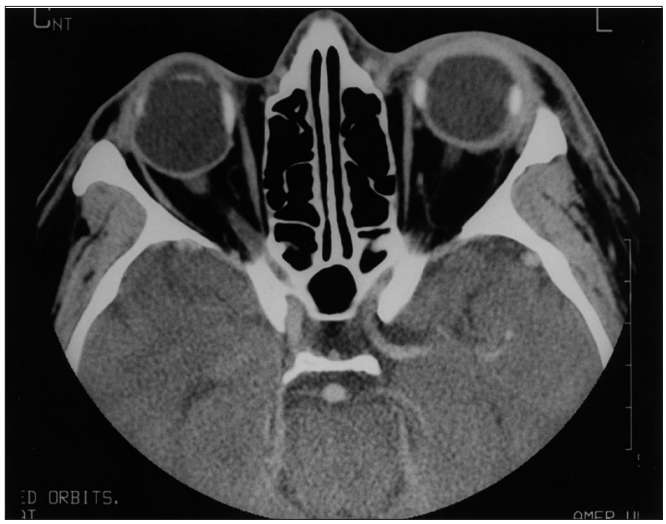

Fig. 1 - *Diffuse scleral thickening of the left eye after scleral buckle (Case 6). The right eye underwent scleral buckle 10 years earlier.*

Fig. 2 - *Computed tomography demonstrates diffuse scleral thickening in the left eye after scleral buckle (Case 10).*

original extensive corneoscleral laceration.

Seventy-eight consecutive patients underwent scleral buckling from May 1998 to May 2000. Four developed scleral buckle infections and were included in Table I. Out of the remaining 74 patients, 38 consented to orbital radiography. The control population consisted of 30 men and 8 women with mean age of 42 years and mean follow-up of 26 months (1week–5 years). Out of 38 controls, 2 patients had scleral thickening without soft tissue swelling and without signs of infection. Scleral buckling was done using hard silicone in 35 eyes, hard silicone combined with a radial sponge in 2 eyes, and a radial sponge in 1 eye. Two patients (mean age 73 years, one man and one woman) had extensive retinal cryopexy with negative CT findings. Likewise, four patients with extruded scleral buckles (two sponges and two hard silicone; mean age 56; mean follow-up 39 months) had negative CT findings.

Investigations into the causes of scleral buckle infection at one institution (AUB) (Tab. II) revealed three factors: patient-related, scrub nurse-related, and operating room-related. One patient with prior glaucoma surgery had friable conjunctiva. Many infected scleral buckle cases had emergency surgery after regular working hours with scrub nurses not familiar with retina surgery. On several instances the scrub nurse touched the silicone exoplant or did not soak the implant in antibiotic until late in surgery. A new labor law in 1998 prohibited hospitals from hiring foreign nurses, which constituted

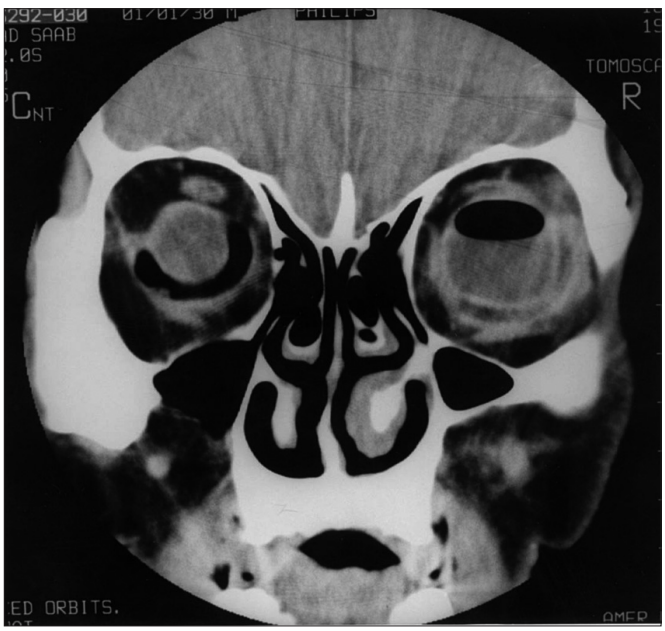

Fig. 3 - *Axial computed tomography shows erosion of the hard silicone exoplant into the vitreous of the left eye with effacement of the underlying sclera (Case 11).*

the bulk of on call nurses at the hospital (AUB). Air conditioning was shut down after regular working hours in the ophthalmology operating room. The Infection Control Program detected a high rate of nosocomial infections (5.5% in 1999) related to contaminated air supply to the operating room. The hospital took measures to correct

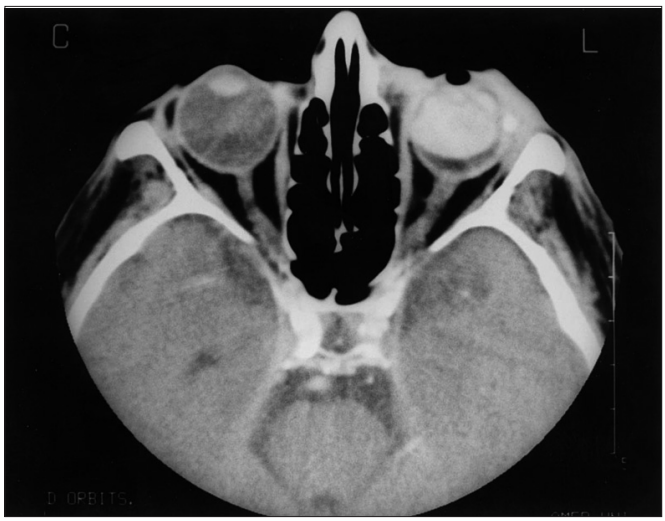

Fig. 4 - *Enhanced computed tomography of the right orbit reveals inferior and lateral orbital inflammation (Case 1). There is low attenuation of the circumferential silicone sponge on the right side with higher attenuation of the left silicone sponge. There is mild scleral thickening of the left eye compared to the right eye.*

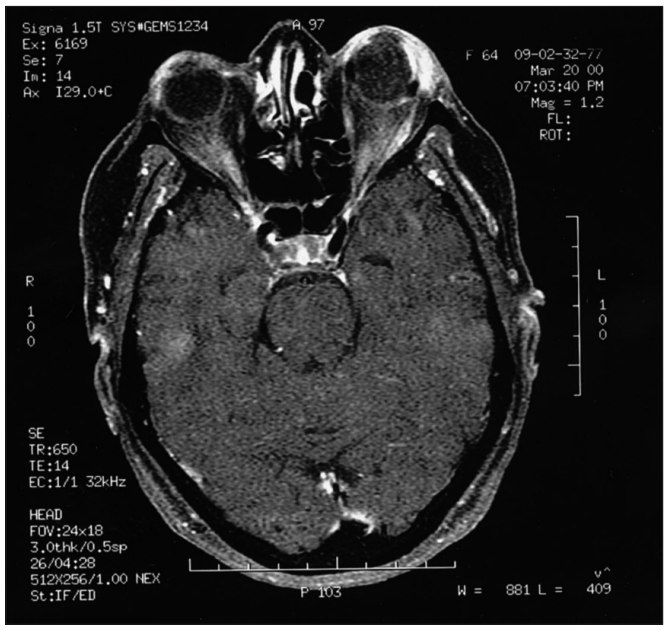

Fig. 5 - *T1-weighted image (repetition time/echo time=650/14; FOU 24×18) with gadolinium contrast and fat suppression shows hypointense silicone exoplant and increased signal intensity of the preseptal region in the left eye (Case 12).*

the above deficiencies. Since then (2002–2006), no infected scleral buckles occurred in that institution (AUB).

DISCUSSION

Infection of scleral exoplants continues to present a problem at the start of the 21st century, and occurs in 1–10% of retinal detachment surgeries (8-16). The flora of the eyelids and conjunctiva are one major source of bacterial contamination of scleral buckles (15). The microorganisms involved in scleral buckle infections include a majority of staphylococci (17) followed by pseudomonas, proteus (15, 18-20), atypical mycobacteria (21-24), and fungi (25, 26). The conjunctiva grew coagulase-positive staphylococci (Case 3), coagulase-negative staphylococci (Case 4), and pseudomonas (Cases 14 and 15), in addition to the buckle growing Aspergillus in one case (Case 12).

The substitution of diathermy by cryotherapy and the preoperative antibiotic soaking of exoplants have helped to decrease both the severity and the incidence of buckle infections (15). Such infections tend to affect eyes with reoperations (27) or with multiple scleral exoplants (15). The clinical presentation may occur from 1 day to 30 years (28) after operation and include ocular pain, conjunctival chemosis, mucopurulent discharge, proptosis, eyelid swelling, reduced ocular movements, a creamy white area of retina on the buckle, vitreous inflammation, and acute macular edema (28, 29). A scleral abscess could mimic endophthalmitis (29). To this end, CT may help to differentiate endophthalmitis from a scleral abscess with associated vitritis. Circumferential irregular thickening of the sclera appeared as one radiologic feature of scleral buckle infections. Scleral thickening was also noted radiologically in posterior scleritis, perisclerits, and orbital cellulitis (30-33).

It could be argued that manipulation of the sclera (dissection of Tenon capsule and episclera, grasping with forceps, suturing, cryopexy) led to postoperative inflammation of the sclera, and that resolution of scleral thickening after administration of antibiotics represented the natural course of sterile postoperative inflammation. Along this line of thought, scleral thickening in the two control cases could represent inflammatory scleritis. Moreover, some antibiotics prescribed (like azithromycin) have anti-inflammatory activity (34) and could have participated in rapid resolu-

tion of ocular inflammation. Evidence against the inflammatory postoperative theory of scleral thickening includes 1) two "control" patients had extensive cryoretinopexy alone and did not develop scleral thickening radiologically and 2) findings of infected scleral buckle when the eye was explored in Cases 1 and 3.

In established scleral buckle infections, topical and systemic antibiotics have little value and the standard therapy remains to remove the infected buckle (18, 35). In established infections, systemic antibiotics may decrease orbital inflammation without affecting the bacterial load of scleral buckles due to glycocalyx formation by bacteria (19, 29, 36) and insulation of the buckle by fibrous tissue (37). Early diagnosis and prompt medical treatment with the new wide-spectrum antibiotics may help to control some cases of buckle infections without the need for buckle removal. It is possible that subclinical scleral buckle infection occurred in two controls with scleral thickening, and resolved without symptoms as these patients were on prophylactic antibiotics.

The authors have shifted gradually from cefazolin to ofloxacin and then to azithromycin. The low incidence of side effects, the high compliance with the dosing schedule, the broad spectrum of activity against Gram positive and Gram negative bacteria commonly found on the conjunctiva, and the unique pharmacokinetic properties make azithromycin a promising drug for prophylaxis or therapy of scleral buckle infection when detected early. Some pharmacokinetic properties of azithromycin include long half-life, concentration in local tissue reservoirs and inflamed tissues, preferential accumulation by polymorphonuclear leucocytes and macrophages, and conjunctival tissue concentration over 100 times the serum level (38, 39). Besides the azalide antibiotics, the fluoroquinolones (like ofloxacin) were found to be very effective in intracellular killing in an abscess model (40) and in experimental models of foreign body–associated infections (41), and to have high intraocular and subretinal penetration (42).

Scleral rupture or melt occurs in chronically infected scleral buckle, in scleral buckles infected by atypical mycobacteria (21), or with buckle erosion (37). CT can inform surgeons about the status of the sclera so that the need for donor sclera can be planned for a combined scleral buckle removal and scleral graft. Also such patients can be informed about the risks of buckle removal such as globe disruption. Smiddy et al (20) detected globe rupture under the scleral buckle in 7 cases out of 45 cases with infected scleral buckles, an incidence of 15.6%. Similarly, Le Rouic et al (43) found 4 scleral perforations among 90 consecutive eyes that underwent removal of episcleral buckle.

CT can identify the nature of the buckle material (44, 45). Solid silicone strip and tire have a very high attenuation by CT while noninfected silicone sponges have a low attenuation (44, 45), as confirmed in the present study (Figs. 1–5). An infected scleral sponge becomes of high attenuation. Hydrogel encircling bands, introduced in the early 1980s, were recognized in the early 1990s to have late complications consisting of orbital swelling and diplopia requiring band removal. Pathologic studies of hydrogel material after removal showed hydrolysis with foreign body reaction and dystrophic calcification. Hydrogel fragmentation had a characteristic imaging appearance consisting of a circumferential orbital mass associated with rim enhancement (46).

Besides fluorescein angiography (47) and B-scan ultrasonography (31, 33), CT can be a helpful modality in the management of scleral buckle infections. It helps in diagnosis, following the response to antibiotic therapy, and assessing the status of the sclera. CT studies need to be limited to selected cases because of radiation exposure.

Proprietary interest: None.

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