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13. ABSTRACT *(Maximum 200*

PURPOSE: Determine efficacy of CT and MR in detecting plastic foreign bodies (FB's) in a live goat model.
METHODS: Plastic land mine FB's were surgically implanted in 12 study eyes and orbits. 12 control eyes were surgically manipulated with no plastic implanted. Plain film, CT and MR studies were performed. CT and MR studies were with and without intravenous contrast. Masked evaluators assessed images.
RESULTS: True positive FB detection in plain film was 0.5%. True positive FB detection in study eyes was 30% by CT and 34% by MR ($p=0.3664$). False negative rate was 70% (CT) and 66% (MR) ($p=0.3664$). FB's were frequently misidentified in control eyes. The addition of contrast did not significantly affect FB detection.
CONCLUSION: Plain film, CT and MR inadequately detect intraocular and intraorbital plastic FB's. The addition of contrast does not improve efficacy.

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Ocular Trauma, Plastic Foreign Bodies, Anti-personnel land mines.

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Lilia C Fermin 29 Aug 97

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FINAL REPORT

EFFICACY OF DETECTION OF INTRAOCULAR AND OCULAR ADNEXAL PLASTIC FOREIGN BODIES BY MAGNETIC RESONANCE (MR) AND COMPUTED TOMOGRAPHY (CT) IMAGING IN THE GOAT

Author: MAJ Lilia A. Fannin, MD

TABLE OF CONTENTS

INTRODUCTION

Ocular injuries are common with an estimated occurrence of 2.4 million eye injuries in the US annually, with approximately 60,000 admissions for ocular trauma A growing source of potential eye trauma comes from anti-personnel land mines. Modern day land mines are made of plastic, are widely scattered around the world and are not biodegradable. Because these munitions have become common, there is now a high risk of eye injuries from plastic intraocular or ocular adnexal foreign bodies within the civilian population.

Despite the fact that CT and MR are powerful diagnostic tools in the evaluation of eye trauma, review of the literature shows difficulty in the detection of plastic ocular foreign bodies with MR and CT (1, 2, 3). There are no controlled studies in the medical literature which evaluate the efficacy of CT or MR imaging in the detection of ocular plastic foreign bodies, nor are there any studies which evaluate the use of contrast in detecting plastic foreign bodies. This study evaluates the efficacy of CT and MR imaging of ocular plastic foreign bodies in a goat model.

MATERIALS AND METHODS

Plastic foreign bodies from one of two different types of unused land mines were surgically implanted in the study eye of 12 live goats. The fellow eye was the control. The number of plastic foreign bodies ranged from one to six. The placement sites included the globe and ocular adnexa. The plastic foreign bodies ranged in size, 0.5 mm - 3 mm. The type for foreign body implanted, the number of foreign bodies implanted, the study eye (right or left) and position of implantation were randomly selected (Table 1). The control eye was surgically manipulated in a similar manner to that of the study eye; however, no foreign bodies were implanted.

CT, MR and plain film imaging were performed immediately after implantation of foreign bodies. Standard orbital trauma CT protocol of 3 mm cuts and standard trauma MR protocol was implemented. CT and MR imaging was performed without and with intravenous contrast. Plain film AP and lateral x-rays were then obtained.

The study animals were under general anesthesia throughout the study and the study animals were euthanized immediately after completion of radiographic studies.

Each study animal had 7 "sets" of images (Table 2):

Set 1: Plain film x-ray (AP and lateral)
Set 2: CT without contrast, axials
Set 3: CT without contrast, axials and coronals
Set 4: CT with and without contrast, axials and coronals
Set 5: MR without contrast, axials
Set 6: MR without contrast, axials and coronals
Set 7: MR with and without contrast, axials and coronals

The image sets were evaluated by four masked physicians. The study and control eye images were evaluated separately. Each evaluator reported the number of foreign bodies detected in each imaging set (Table 3).

RESULTS

A total of 180 foreign bodies could possibly be identified from all of the imaging sets. Nine foreign bodies were identified by plain film, 81 by CT without contrast (axials), 91 by CT without contrast (axials and coronals), 83 by CT with and without contrast (axials and coronals), 93 by MR without contrast (axial), 97 by MR without contrast (axials and coronals), 96 by MR with and without contrast (axials and coronals). (Table 4)

True positive FB detection by plain film was 0.5%. True positive FB detection was 25% by CT without contrast (axials) and 30% by CT without contrast (axials and coronals). True positive FB detection was 37% by MR without contrast (axials) and 34% by MR without contrast (axials and coronals (p=0.3664). With the addition of contrast, the true positive FB detection was 25% and 36% respectively for CT and MR.

Plastic foreign bodies were misidentified in the control eyes in all of the radiographic studies. Eight were misidentified by plain film, 36 by CT without contrast (axials), 37 by CT without contrast (axials and coronals), 38 by CT with and without contrast (axials and coronals), 26 by MR without contrast (axial), 35 by MR without contrast (axials and coronals), 32 by MR with and without contrast (axials and coronals).

Detection of plastic foreign bodies by CT and MR was statistically significant when compared to plain film(0.0000). There was no statistical significance between CT and MR imaging. Intravenous contrast did not significantly improve the detection of plastic foreign bodies.

Two goats expired prior to completing MR requiring contrast.

CONCLUSIONS

The assessment of an ocular and orbital plastic foreign body can be a clinical challenge. The mechanism of injury may lead to a high suspicion of a foreign body, however, physical exam may not reveal the foreign body. Clinicians often rely on imaging studies to detect an occult plastic foreign body.

The presence of a plastic foreign body usually demands surgery to remove it. If a plastic foreign body is undetected, a patient may be exposed to possible blinding complications from an occult plastic foreign body. If a plastic foreign body is falsely detected by an imaging study, the patient may undergo unnecessary surgery which may also lead to blindness from surgical complications.

This study demonstrates the difficulty in detecting ocular and orbital plastic foreign bodies. CT and MR are clearly more efficacious in detecting plastic foreign bodies than by plain film. However CT and MR images may not always reveal the plastic foreign bodies and the images may produce findings that are misinterpreted as foreign bodies. More foreign bodies were found by MR than by CT but this was not statistically significant. The addition of coronal views and the addition of radiographic contrast did not improve the detection of foreign bodies.

In conclusion, plain film studies are not reliable in the detection of plastic foreign bodies. CT and MR can detect the presence of plastic foreign bodies, however, the efficacy of these studies are less than 38%. The addition of coronal views and the addition of contrast for CT or MR does not improve efficacy. Despite the low efficacy in detecting plastic foreign bodies, CT and/or MR should be used to evaluate ocular trauma.

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2. Lobue, Deutsch, Lobick, Turner: Detection and localization of nonmetallic intraocular foreign bodies by Magnetic resonance imaging. Arch Ophthalmol: 106:260-261, 1988.

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TABLE 1.

GOAT	STUDY EYE	NUMBER OF FB's	TYPE OF FB
1	right	4	beige
2	right	3	black
3	right	3	beige
4	left	4	beige
5	left	5	black
6	right	2	black
7	right	2	beige
8	left	1	beige
9	right	6	beige
10	left	4	beige
11	left	5	beige
12	left	6	beige

TABLE 2. Description of Radiographic Set Types

SET TYPE	IMAGING MODALITY
1	Plain Film
2	CT, no contrast, axials
3	CT, no contrast, axials & coronals
4	CT, with contrast, axials & coronals
5	MR, no contrast, axials
6	MR, no contrast, axials & coronals
7	MR, with contrast, axials & coronals

TABLE 3. Foreign Bodies Detected by the Four Masked Evaluators.

SET	GOAT	SET TYPE	EYE	NUMBER OF FB's	MAZZOLI	AINBINDER	ROVIRA	COUGHLIN
1	11	6	L	5	2	2	5	2
2	4	5	L	4	2	2	2	2
3	8	1	L	1	0	0	0	0
4	12	1	L	6	0	0	0	0
5	7	2	L	0	0	1	0	0
6	5	5	L	5	3	2	3	3
7	9	3	L	0	0	2	0	0
8	6	4	R	2	2	2	3	2
9	6	6	L	0	0	0	0	0
10	1	4	R	4	1	2	1	1
11	5	2	R	0	0	0	0	0
12	11	2	L	5	1	1	1	0
13	5	1	L	5	0	0	0	0
14	5	3	R	0	0	0	0	0
15	1	7	R	4	4	3	4	1
16	1	3	R	4	2	1	1	1
17	6	3	L	0	0	0	0	0
18	10	3	L	4	1	1	1	1
19	3	5	L	0	1	1	1	1
20	3	1	L	0	0	0	0	0
21	5	6	R	0	0	0	1	0
22	11	4	L	5	1	2	1	1
23	6	1	L	0	0	0	1	0
24	12	4	R	0	0	2	1	0
25	8	5	L	1	1	1	0	1
26	10	5	L	4	2	1	1	1
27	7	4	L	0	0	2	0	0
28	12	3	L	6	2	3	3	2
29	1	6	R	4	4	2	3	2
30	9	7	L	0	0	0	1	1
31	9	2	L	0	1	2	0	0
32	4	6	R	0	2	2	1	2
33	8	3	R	0	0	1	0	0
34	2	6	R	3	3	3	2	3
35	8	4	R	0	0	0	0	0
36	1	5	R	4	3	2	2	1
37	1	2	L	0	0	0	0	0
38	6	2	R	2	2	4	2	2
39	7	5	L	0	0	0	0	0
40	10	2	L	4	0	4	1	1
41	8	2	L	1	0	1	0	0
42	11	3	L	5	1	4	1	1
43	7	6	R	2	1	1	2	1
44	10	4	L	4	1	2	0	1
45	4	2	L	4	1	1	1	0

TABLE 3. continued

46	12	6	R	0	1	1	1	0
47	3	7	R	3	1	1	1	1
48	6	7	R	2	2	2	2	2
49	11	7	L	5	1	1	2	1
50	5	4	R	0	0	1	0	1
51	12	7	L	6	2	4	2	2
52	2	2	R	3	3	4	3	3
53	4	4	R	0	1	1	1	2
54	2	3	R	3	3	3	3	3
55	6	5	L	0	0	0	1	0
56	3	2	L	0	1	2	1	1
57	7	3	L	0	1	1	1	0
58	3	3	R	3	0	6	0	0
59	12	5	R	0	0	0	1	0
60	4	3	R	0	1	1	2	1
61	9	4	R	6	0	6	0	0
62	7	7	L	0	0	0	0	0
63	10	1	R	0	0	0	0	0
64	1	1	R	4	0	0	1	0
65	2	7	R	3	3	2	2	2
66	3	4	L	0	1	4	1	2
67	9	6	R	6	2	2	1	1
68	10	7	R	0	0	0	1	0
69	8	6	R	0	0	0	0	0
70	4	1	R	0	0	0	1	1
71	7	1	R	2	0	0	0	0
72	3	6	L	0	1	2	1	1
73	9	5	L	0	0	0	0	0
74	4	7	R	0	2	0	2	2
75	2	4	L	0	0	3	0	0
76	2	5	R	3	3	4	2	2
77	12	2	R	0	0	6	0	0
78	11	1	R	0	0	0	1	0
79	11	5	R	0	2	1	1	2
80	10	6	R	0	1	4	0	0
81	5	7	R	0	0	2	0	1
82	8	7	L	1	1	4	0	0
83	2	1	L	0	0	1	0	0
84	9	1	R	6	2	3	1	1

TABLE 3. continued

SET	GOAT	RAD TYPE	EYE	# FB's	MAZZOLI	AINBINDER	ROVIRA	COUGHLIN
1	11	6	r	0	2	2	2	2
2	4	5	r	0	2	2	3	2
3	8	1	r	0	0	0	1	0
4	12	1	r	0	0	0	2	0
5	7	2	r	2	0	1	1	0
6	5	5	r	0	0	1	1	0
7	9	3	r	6	1	5	1	0
8	6	4	l	0	0	0	0	0
9	6	6	r	2	4	2	2	2
10	1	4	l	0	0	1	1	0
11	5	2	l	5	5	4	4	5
12	11	2	r	0	1	2	2	1
13	5	1	r	0	0	0	0	0
14	5	3	l	5	6	5	3	3
15	1	7	l	0	1	1	1	0
16	1	3	l	0	0	1	2	0
17	6	3	r	2	2	3	2	2
18	10	3	r	0	0	5	0	0
19	3	5	r	3	1	1	2	1
20	3	1	r	3	0	0	0	0
21	5	6	l	5	3	2	4	2
22	11	4	r	0	1	1	2	1
23	6	1	r	2	0	0	0	0
24	12	4	l	6	2	2	3	2
25	8	5	r	0	0	0	0	0
26	10	5	r	0	0	0	0	0
27	7	4	r	2	0	2	2	0
28	12	3	r	0	0	3	0	0
29	1	6	l	0	1	1	2	0
30	9	7	r	6	3	2	1	1
31	9	2	r	6	2	4	0	1
32	4	6	l	4	2	2	2	2
33	8	3	l	1	0	1	0	0
34	2	6	l	0	0	0	0	0
35	8	4	l	1	0	0	0	0
36	1	5	l	0	1	1	1	0
37	1	2	r	4	2	2	2	1
38	6	2	l	0	0	0	0	0
39	7	5	r	2	1	2	1	1
40	10	2	r	0	0	4	0	0
41	8	2	r	0	0	2	1	0
42	11	3	r	0	1	2	3	1
43	7	6	l	0	0	0	0	0
44	10	4	r	0	0	4	0	0
45	4	2	r	0	2	1	3	2

TABLE 3. continued

46	12	6	l	6	2	4	3	2
47	3	7	l	0	1	2	3	1
48	6	7	l	0	0	0	0	0
49	11	7	r	0	1	3	2	2
50	5	4	l	5	5	6	4	5
51	12	7	r	0	0	0	0	0
52	2	2	l	0	0	0	0	0
53	4	4	l	4	1	1	2	1
54	2	3	l	0	0	0	0	0
55	6	5	r	2	2	2	4	2
56	3	2	r	3	0	1	0	0
57	7	3	r	2	0	2	2	1
58	3	3	l	0	1	2	4	1
59	12	5	l	6	2	4	4	2
60	4	3	l	4	0	3	4	1
61	9	4	l	0	0	4	0	0
62	7	7	r	2	1	2	2	1
63	10	1	l	4	0	0	1	0
64	1	1	l	0	0	0	0	0
65	2	7	l	0	0	0	1	0
66	3	4	r	3	0	1	0	0
67	9	6	l	0	0	0	2	0
68	10	7	l	4	3	1	3	1
69	8	6	l	1	1	0	1	0
70	4	1	l	4	0	0	0	0
71	7	1	l	0	0	0	0	0
72	3	6	r	3	1	1	2	1
73	9	5	r	6	2	1	4	1
74	4	7	l	4	0	3	5	2
75	2	4	r	3	3	5	4	3
76	2	5	l	0	0	0	0	0
77	12	2	l	6	3	3	2	3
78	11	1	l	5	0	0	0	0
79	11	5	l	5	1	2	2	2
80	10	6	l	4	1	2	2	1
81	5	7	l	5	2	4	3	3
82	8	7	r	0	0	0	1	0
83	2	1	r	3	0	0	0	0
84	9	1	l	0	0	0	0	0

TABLE 4.

SET TYPE	IMAGING MODALITY	TOTAL FB's IMPLANTED	TRUE + and FALSE +	FALSE +	TRUE +
1	Plain Film	180	9	8	1
2	CT, no contrast, axials	180	81	36	45
3	CT, no contrast, axials & coronals	180	91	37	54
4	CT, with contrast, axials & coronals	180	83	38	45
5	MR, no contrast, axials	180	93	26	67
6	MR, no contrast, axials & coronals	180	97	35	62
7	MR, with contrast, axials & coronals	180	96	32	64

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