Don't be blind to the radiological eye signs - multimodality review of a classic radiology sign

Poster No.: C-1933
Congress: ECR 2014
Type: Educational Exhibit
Authors: A. J. Quigley, S. Kulkarni, S. Stafrace, H. D. M. Klaasen; Aberdeen/UK
Keywords: Education and training, Education, MR, Fluoroscopy, CT, Eyes
DOI: 10.1594/ecr2014/C-1933

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

Describe and illustrate the radiological manifestations of various diseases that resemble an eye on multiple imaging modalities.

Discuss the underlying pathologies responsible for these specific radiological signs.

Background

Radiologists must be familiar with multiple classic signs that may be characteristic for a specific condition on a certain imaging modality, or suggest a certain differential diagnosis. The association of specific radiological findings with animals, phrases and everyday objects increases the chance of the radiologist making the correct association when faced with a certain appearance. A number of radiological appearances have been said to resemble an eye. This is seen in multiple conditions and on many imaging modalities.

We identified these 'eye signs' described in the radiology literature and reviewed the interesting cases collection at our institute. We present a poster illustrating the various eye signs described in the radiology literature and give a brief discussion of the underlying diseases.

Findings and procedure details

The various 'eyes signs' seen in multiple conditions are described on several imaging modalities including CT, MRI and plain film. These include:

1) Eye of the Tiger sign: PKAN (Pantothenate kinase-associated neurodegeneration) (MRI)

2) Bull's eye sign: Intussusception, gastric metastases, cerebral metastasis, cerebral abscesses (multiple modalities)

3) Snake eye sign: Normal facial nerve anatomy (CT)

4) Owl eye sign: Osteolytic metastasis of the vertebral pedicle (Plain film).

5) Black eyebrow sign: Orbital blow out fractures (Plain film)
6) **Ra's eye sign**: Sprengel's shoulder (MRI)

7) **Frog Eye Sign**: Anencephaly (Ultrasound)

8) **Harlequin Eye Sign**: Coronal synostosis (Plain film)

(1) **Eye of the Tiger sign (MRI).**

PKAN (Pantothenate kinase-associated neurodegeneration) was formally known as Hallervorden-Spatz syndrome (1, 2). It is an autosomal recessive disorder and the most common form of neurodegeneration with brain iron accumulation. It is caused by a mutation of the pantothenate kinase 2 gene (**PANK2**). Presentation usually occurs in childhood with abnormal gait, postural deficits with dystonia, tremor and weakness. It is progressive, leading to death in early adult life.

**Imaging Findings:**

MRI shows anteromedial foci of increased T2 signal in the globus pallidus bilaterally, with low T2 signal in the lateral part. The hyperintense "eye" corresponds to the low signal globus pallidus with the central focus of high signal (Fig. 1). The low signal is secondary to the iron deposition. The "eye" caliber and intensity decreases as disease progresses.

(2) **Bull's eye sign (multiple modalities).**

A bull's eye sign, also known as a target sign, can be attributed to multiple various pathologies.

(i) **Intussusception**

This is the insertion of one bowel segment into another. It may be seen most commonly in young children, often after an episode of infection and is thought to be as a result of enlarged lymphoid tissue. It occurs less often in adults often as a result of a benign or malignant lead point in adults.

**Imaging Findings:**

Alternating hypoechoic & hyperechoic concentric rings gives the 'Bull's eye' or target appearance on ultrasound examination (3, 4). Submucosa forms hypoechoic ring and mucosa and muscularis propria form echoic rings. (Fig. 2).
(ii) Gastric metastases:

A malignant gastric ulcer may occur secondary to metastatic deposits in the stomach. These metastases are commonly seen with melanoma, breast cancer and lung carcinoma.

*Imaging Findings:*

A centrally ulcerated submucosal nodule with elevated smooth margins can be seen on a barium meal examination (Fig. 3). The contrast collects in the ulcer crater creating the 'Bull's eye' appearance (5).

(iii) Brain metastasis

Brain metastases most commonly result from lung, breast, melanoma, renal and GI carcinomas. They occur most commonly in the cerebral hemispheres but can also occur within the cerebellum and basal ganglia (6, 7).

*Imaging Findings:*

Following administration of contrast, intense ring enhancement is seen as 'Bull's eye' sign (Fig. 4).

(iv) Brain abscess

An encapsulated pyogenic collection within the brain is called an abscess (8). It develops from a focus of cerebritis. They may result from haematogenous spread, trauma or adjacent infection.

*Imaging Findings:*

Post contrast CT examination shows low mainly low attenuation lesion with a ring of thick enhancement. The central low attenuation represents necrosis. This appearance gives characteristic Bull's eye sign (Fig. 5).

(3) Snake eye sign (CT):

The facial nerve (CN VII) supplies the muscles of facial expression, the stapedius and stylohyoid muscles and the posterior belly of the digastric muscle (9). It also receives taste senstation from the tongue.
Imaging findings:

On coronal cross sectional imaging, just posterior to anterior genu of the facial nerve, the tympanic and labyrinthine segments are seen as two 'dots' which look like eyes of a snake (Fig. 6).

(4) Winking owl sign (Plain film).

Osteolytic spinal metastases are common in patients with breast, lung, melanoma and renal cancer. Vertebral body and posterior elements are common sites. Usually, they are round in shape due to centrifugal growth.

Imaging findings:

On the AP view of thoracic or lumbar spine radiograph, osteolytic destruction of one of the pedicles gives a 'winking owl eye' appearance (Fig. 7). An absent pedicle corresponds to the 'winking eye'. The contralateral pedicle corresponds to the open eye and spinous process corresponds to the beak of the owl (10).

(5) Black eyebrow sign (Plain film).

An orbital blow out fracture is a fracture of orbital floor or medial wall due to impact of an object larger than size of the orbit. Frequently, these fractures are displaced and comminuted. There is increased risk of injury to intra-orbital contents and herniation through the bony defect (11).

Imaging findings:

Due to the fracture of the floor or medial wall, air leaks into the orbit from the ethmoid air cells or from the maxillary sinus. Air rises into the most superior part of the orbit. On plain facial radiograph, lucent intra-orbital air gives the appearance of a black eye brow. This 'black eye brow' sign signifies an orbital floor or medial wall fracture (Fig. 8).

(6) Sprengel Shoulder 'Ra's eye' sign (MRI).

A Sprengel shoulder deformity is a congenital elevation of the scapula that results from the failure of caudal migration of the scapula during fetal life. It is the most common congenital shoulder deformity and is sporadic in nature (12, 13). There is resultant shoulder muscle hypoplasia/atrophy leading to reduced shoulder movement. It is usually unilateral and the degree of scapular elevation can vary. It is more common in females. On examination, the neck on the affected side appears shorter. An omovertebral connection can be seen in up to 50% of cases. This connection is either fibrous, bony
and/or cartilaginous. It runs from the superomediál scapula to the spinous processes, transverse processes or laminae of C4 to C7 (14).

**Imaging findings:**

On MRI in the sagittal plane, the appearance of the omovertebral band, in association with the peripheral fat tissue, has been termed the 'Ra's eye' sign (15) (Figs 9 & 10).

(7) Frog Eye Sign (Ultrasound).

Anencephaly is a form of neural tube defect that occurs secondary to failure of the rostral part of the neural tube to close. It occurs in about 1 in 1000 births (16, 17).

**Imaging findings:**

On ultrasound, there is an absence of the calvaria above the orbits with no cerebral hemispheres and little or no cortical tissue (15). The brainstem and cerebellum may be present. On coronal ultrasound, the absence of the calvaria coupled with prominent orbits gives the fetus the 'frog eye' sign (Fig. 11).

(8) Harlequin Eye Sign (Plain film)

Craniosynostosis is the premature fusion of the various cranial sutures that results in an abnormal skull growth pattern. Coronal synostosis may be unilateral or bilateral.

**Imaging findings:**

Unilateral coronal synostosis results in the 'Harlequin eye' orbital deformity where there is elevation of the lesser wing of sphenoid and posterior displacement of the superior and lateral orbital rims. Bilateral coronal synostosis produces the 'Harlequin eye' deformity bilaterally, with prominent elliptical orbits (Fig. 12) (18).

Images for this section:
Fig. 1: T2 weighted MRI axial image. Linear high signals within hypointensity of globi pallidi bilaterally mimicking eyes of Tiger.
**Fig. 2:** Transverse view on gray scale ultrasound examination shows 'Bull's eye' sign of intussusception.
Fig. 3: Bull’s eye lesion in the stomach on barium meal examination seen as an ulcerated mass with a central crater filled with barium.
Fig. 4: Post contrast axial CT examination shows three metastatic ring-enhancing lesions with characteristic appearance of Bull's eye lesions.
**Fig. 5:** Post contrast axial CT scan image shows a ring enhancing lesion (Bull's eye appearance) within right cerebral hemisphere with perilesional oedema.

![CT scan image](image)

**Fig. 6:** On coronal CT, just posterior to anterior genu of the facial nerve, the tympanic and labyrinthine segments are seen as two 'dots' which look like eyes of a snake (white arrow).
**Fig. 7:** AP radiograph of thoracolumbar spine shows an absent left pedicle of the T10 vertebra. The absent pedicle represents the 'winking eye'. The right pedicle is the open eye and the spinous process represents the beak of an owl.

**Fig. 8:** Plain facial radiograph showing an air crescent in the right orbit superiorly. This air lucency represents the 'black eyebrow' sign of an orbital bow out fracture.
Fig. 9: Fig 9 - Diagram illustrating the Ra eye sign as seen on MRI in patients with a Sprengel shoulder. Image is based on the diagram published by Ref 3.
Fig. 10: Sagittal MRI (T1) showing the Sprengle deformity omovertebral band (white arrow) representing the eye sign in an 8 year old boy.
Fig. 11: Coronal ultrasound of a fetus showing the 'frog eye' sign: prominent orbits and an absence of any calvaria above the orbits.
Fig. 12: AP radiograph in an infant with bilateral coronal synostosis, giving the eyes an elliptical 'Harlequin' appearance.
Conclusion

The radiology literature is coloured by numerous radiological signs which are associated with ocular appearances. Identifying these signs not only narrows the differential diagnosis but also helps the reporting radiologists remember these findings and interpret the associated examinations with greater confidence.

Personal information

Dr. A J Quigley, Aberdeen Royal Infirmary, Aberdeen, UK

Dr. S Kulkarni, Aberdeen Royal Infirmary, Aberdeen, UK shubhangkulkarni@nhs.net

Dr. Sam Stafrace, Aberdeen Royal Infirmary, Aberdeen, UK

Dr. Harman Klaasen, Aberdeen Royal Infirmary, Aberdeen, UK

References


