ROTHSCHILD FOUNDATION HOSPITAL

HEAD AND NECK EXPERTISE

Tumeurs orbitaires – Kit de survie

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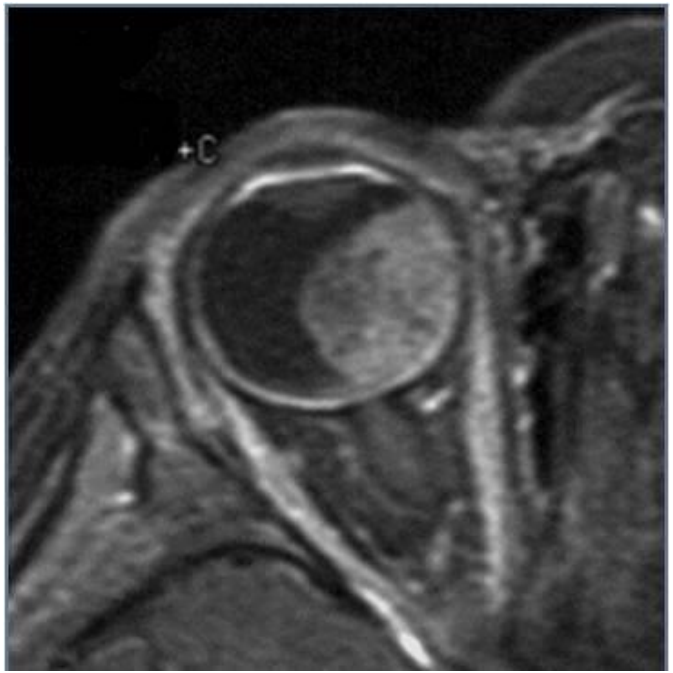
Conflit d’intérêts

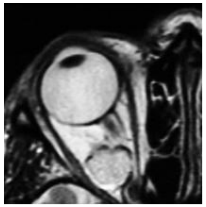
Aucun

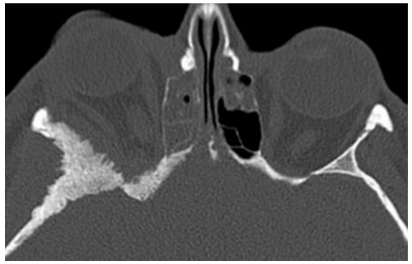
On ne parlera pas de tumeurs oculaires

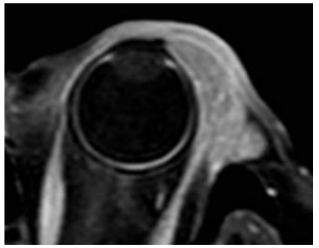
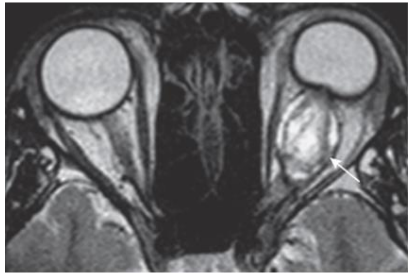
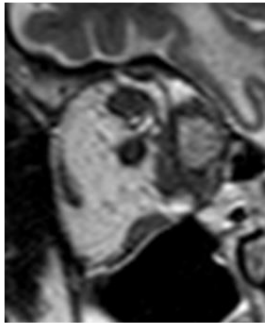
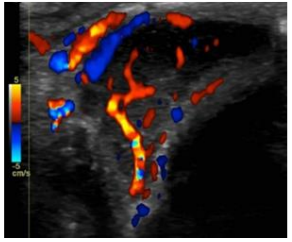
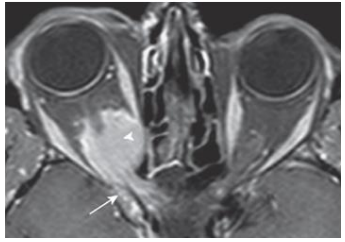
… parce que oculaire = œil !



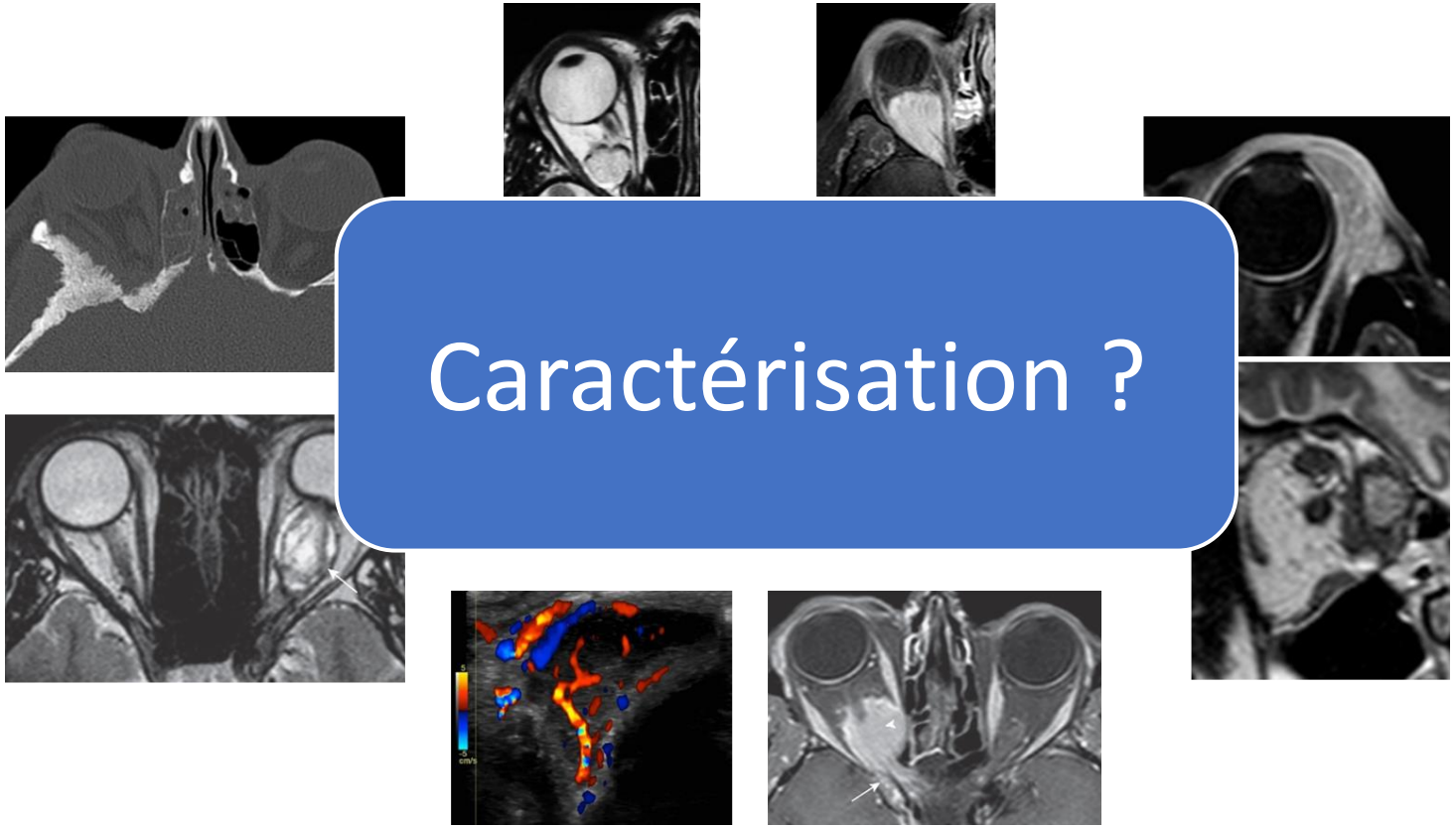
Tumeurs orbitaires





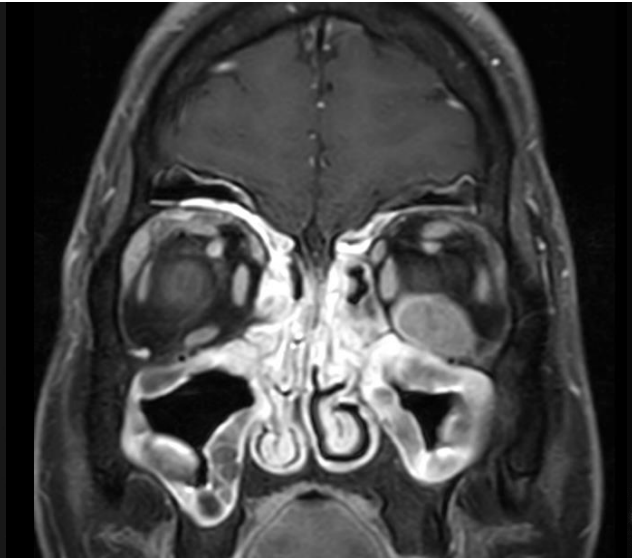
Tumeurs orbitaires



Cas 1 – LA séquence à toujours faire !

77 ans, diplopie verticale, pas de douleur

FS T2WI

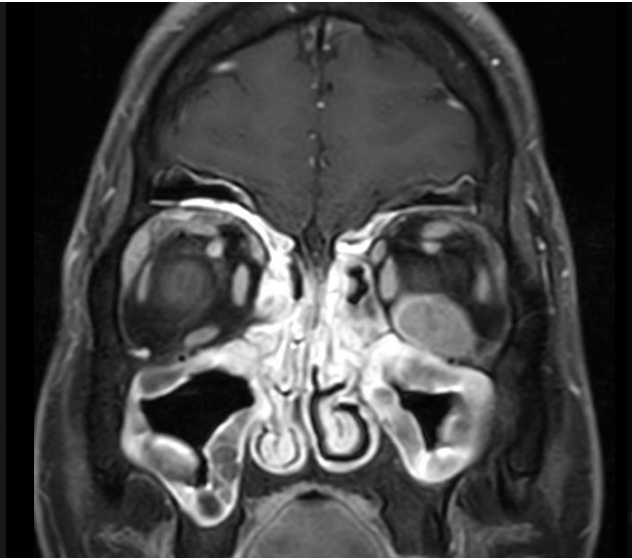


FS CE T1WI

FS CE T1WI

Cas 1 – LA séquence à toujours faire !

FS T2WI

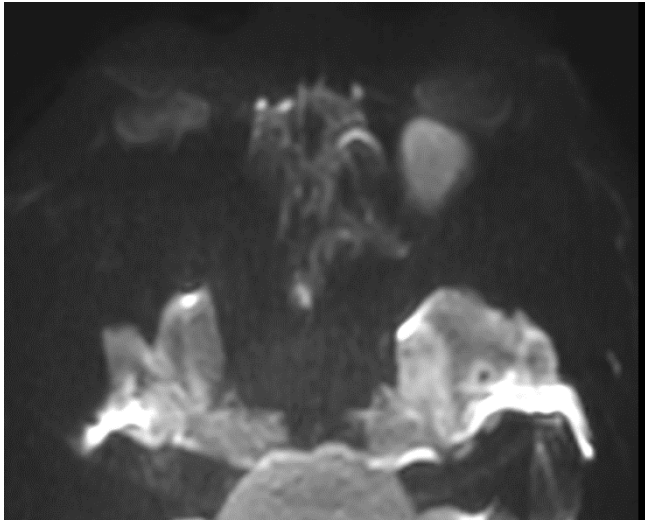


FS CE T1WI

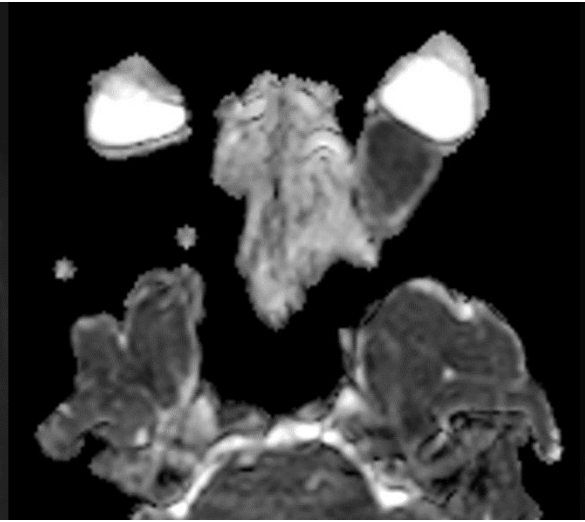
FS CE T1WI

Quelle séquence est manquante ?

Cas 1 – LA séquence à toujours faire !



DWI

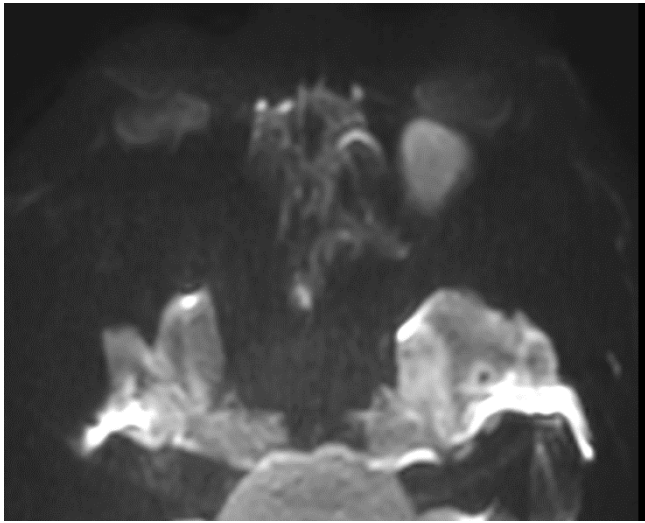


ADC

FS CE T1WI

Diffusion !

Cas 1 – LA séquence à toujours faire !



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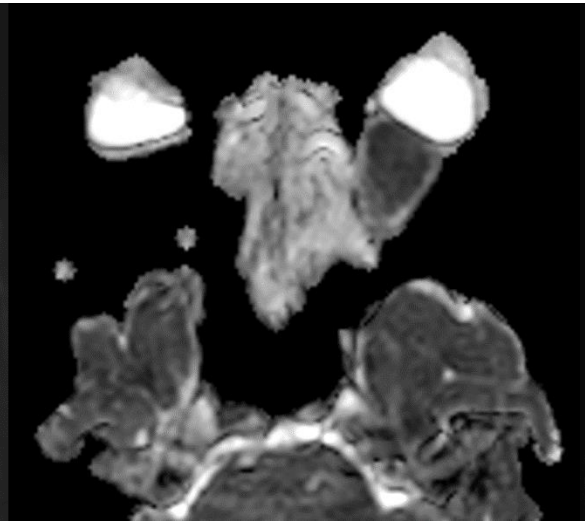


ADC

FS CE T1WI

Diagnostic ?

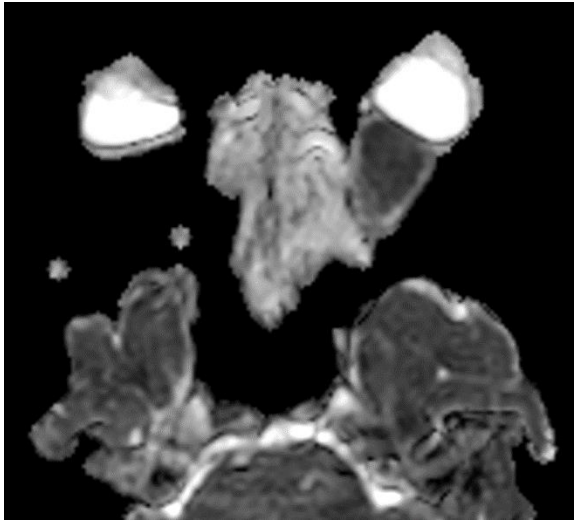
Lymphome orbitaire

ADC = excellent marqueur pour caractérisation

ADC bas (<0,6) = lymphome

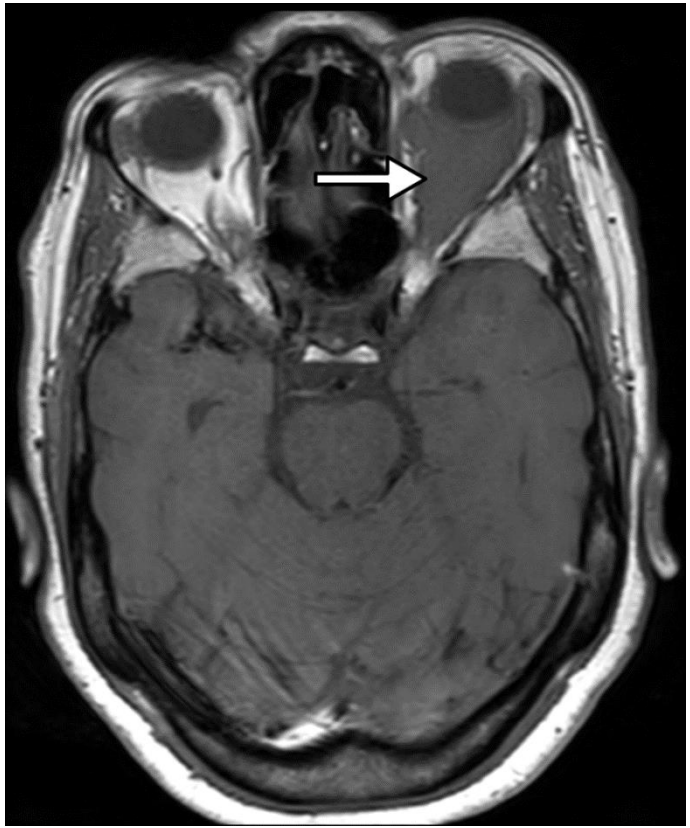
ADC bas (<1 10-3 mm^2/s or rADC <1,2) = malin

ADC +++



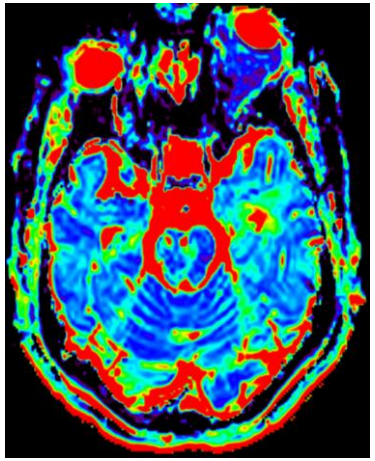
Sepahdari Radiology 2010 ; Haradome AJNR 2014 ; Xu JMRI 2016

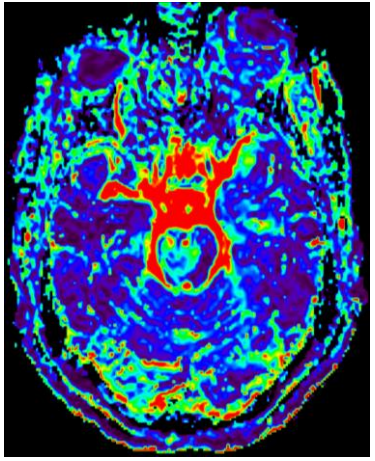
Lymphome orbitaire



IVIM

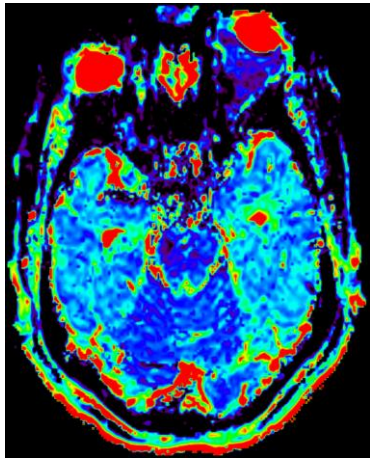
ADC

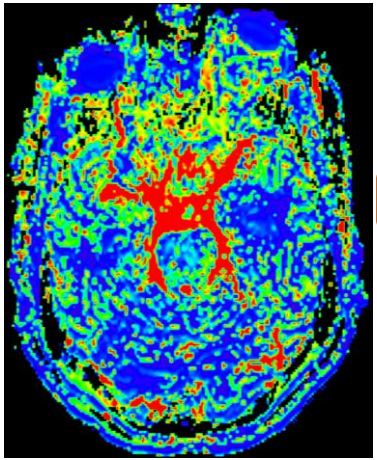




D

f





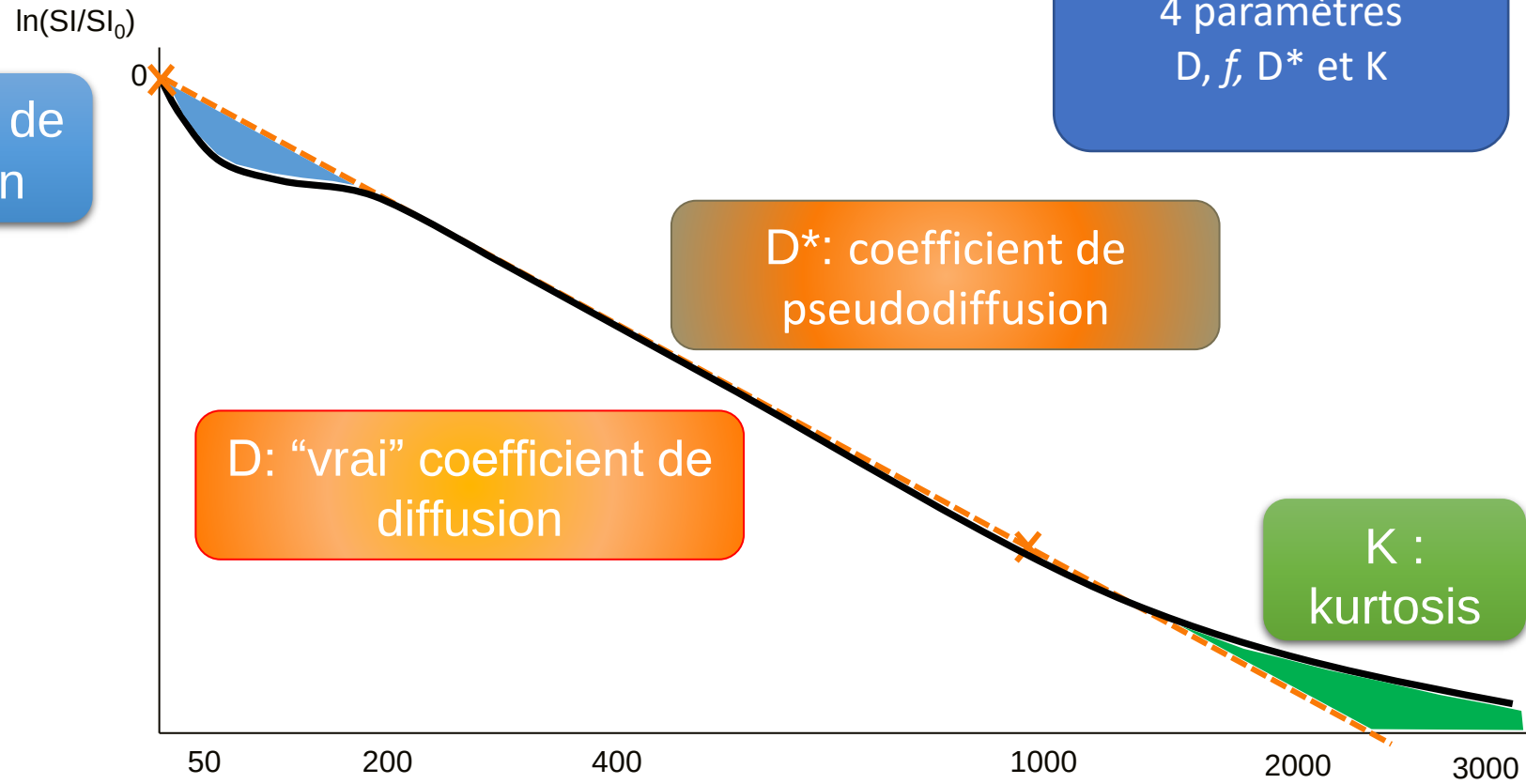
D*

Lecler Eur Radiol 2021

Principes de l'IVIM

4 paramètres
D, *f*, D* et K

f : fraction de perfusion

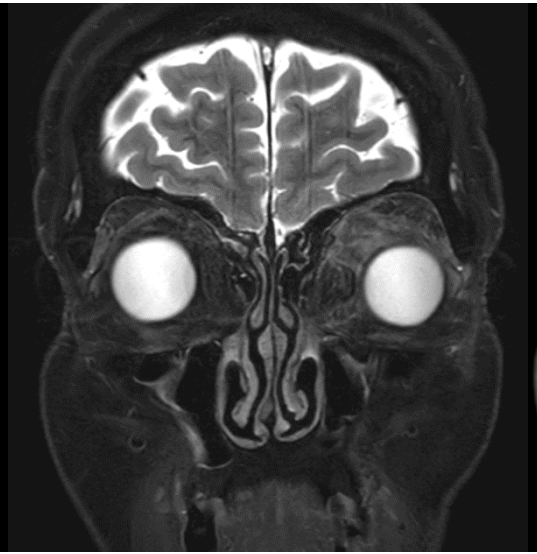


$$S=S_0[(1-f).exp^{(-b.D)}+f.exp^{-b(D+D^*)}]$$

Cas 2 – LA séquence à toujours faire !

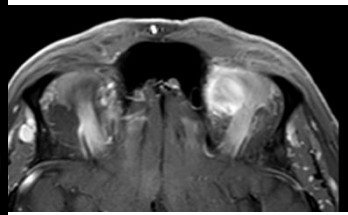
27 ans, douleur orbitaire gauche

T2WI



FS T2WI

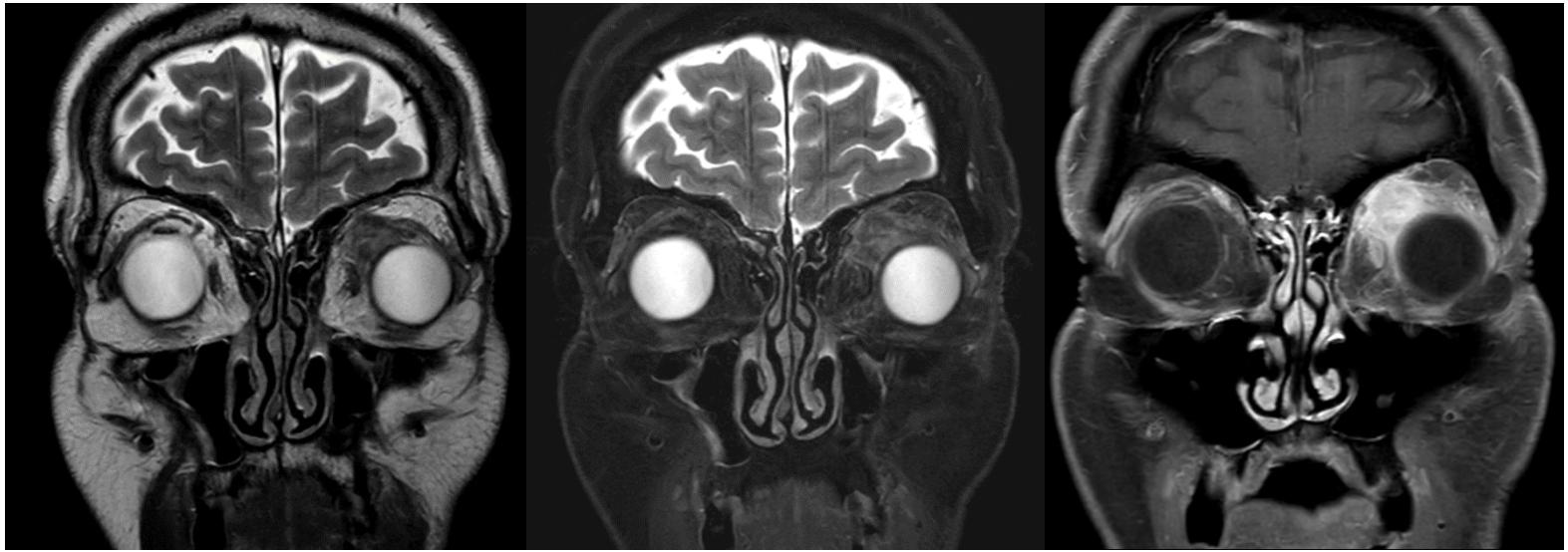
FS CE T1WI



FS CE T1WI

Cas 2 – LA séquence à toujours faire !

Quelle séquence est manquante ?



T2WI

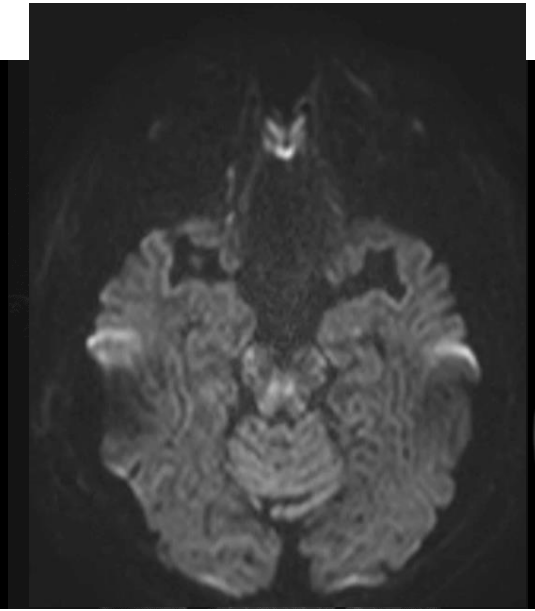
FS T2WI

FS CE T1WI

Cas 2 – LA séquence à toujours faire !

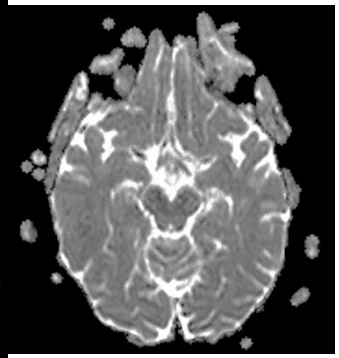
Diffusion !

T2WI



DWI

FS CE T1WI

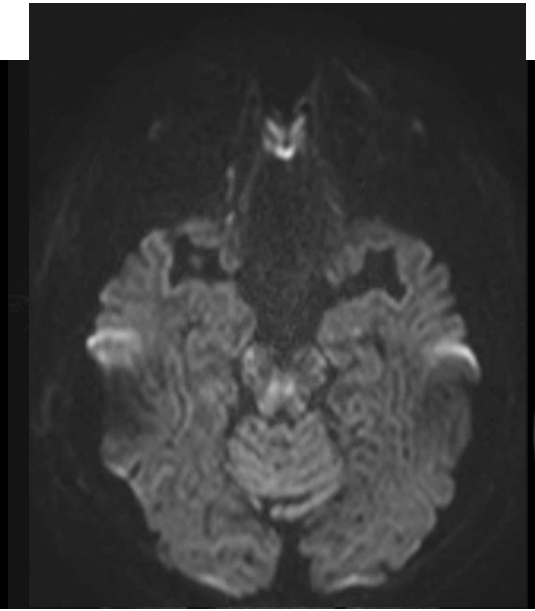


ADC

Cas 2 – LA séquence à toujours faire !

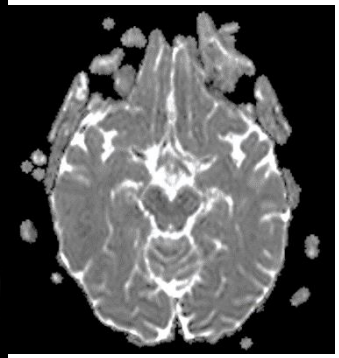
Diagnostic ?

T2WI



DWI

FS CE T1WI



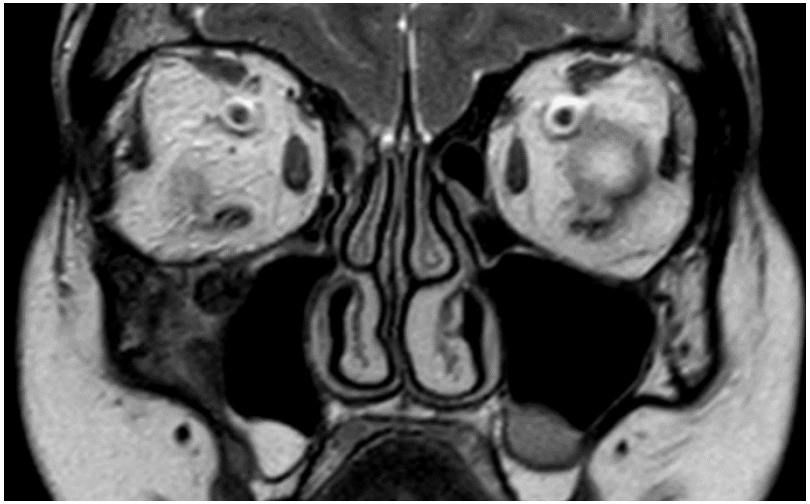
ADC

Inflammation orbitaire

Spécifique ou non spécifique

Vaste gamme étiologique !

Y-a-t-il un signe spécifique ici ?



IgG4-ROD

Spécifique ou non spécifique

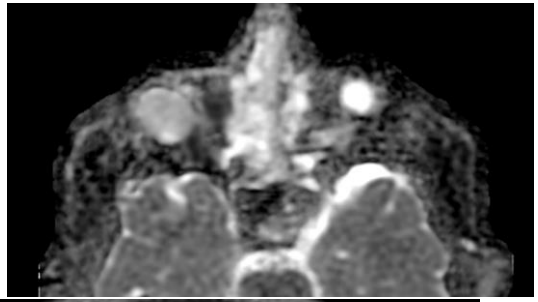
Vaste gamme étiologique !

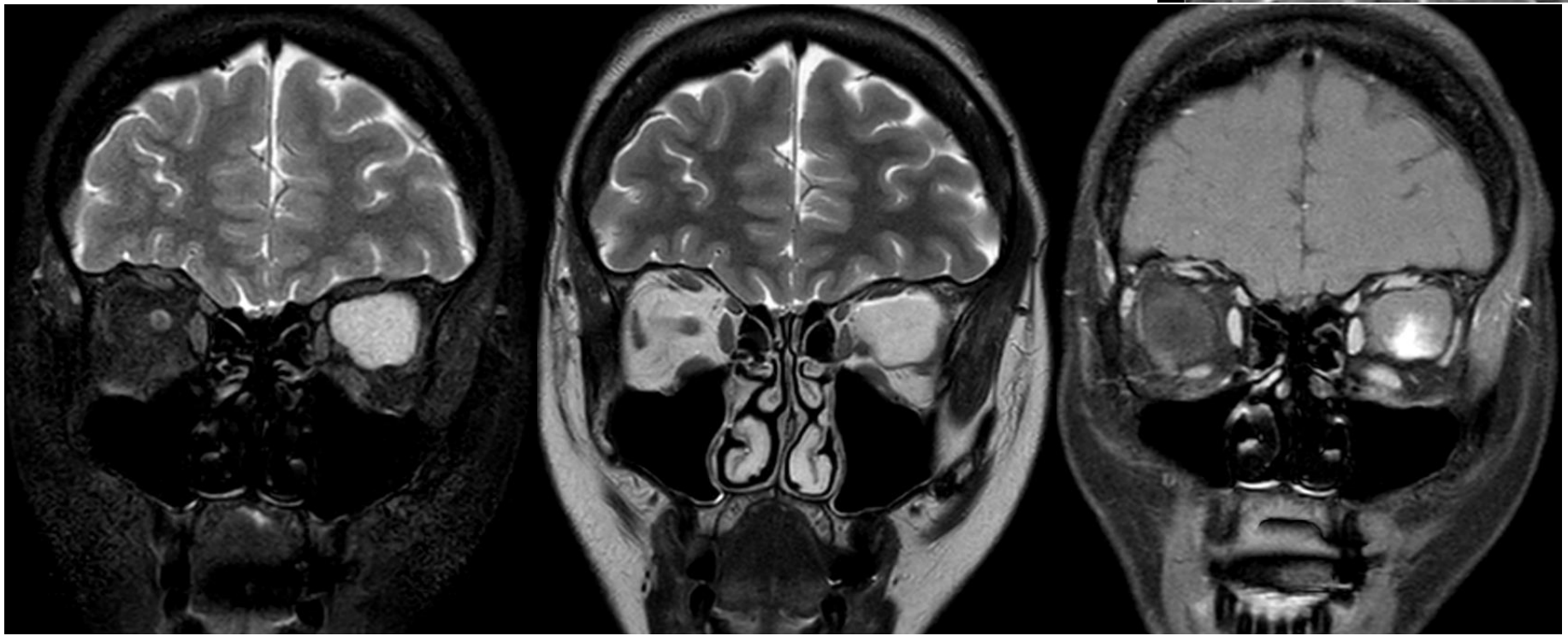
ENIO

Bensoussan and Lecler Eur Radiol 2017

Cas 3 – LE diagnostic le + fréquent !

41 ans, céphalées

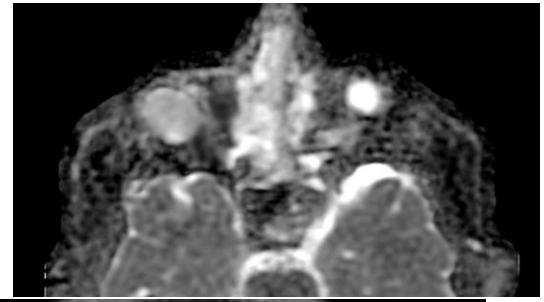


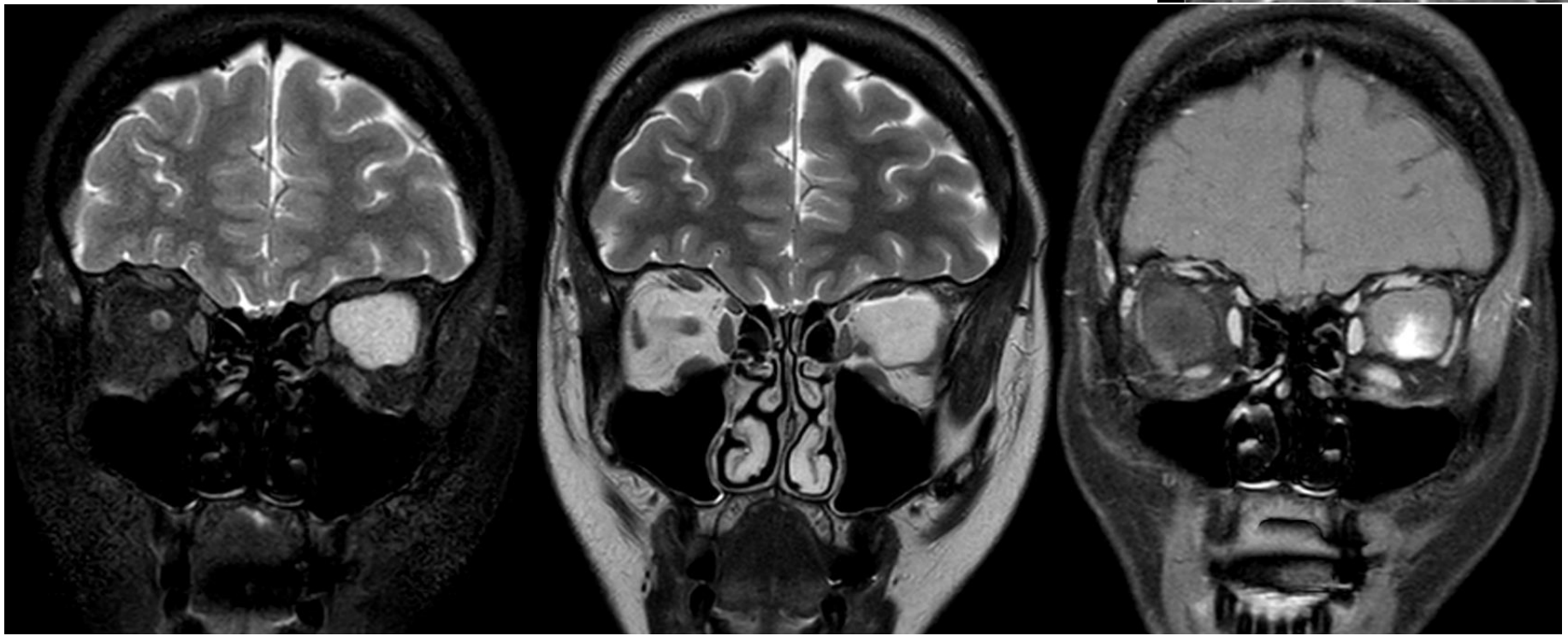


Cas 3 – LE diagnostic le + fréquent !

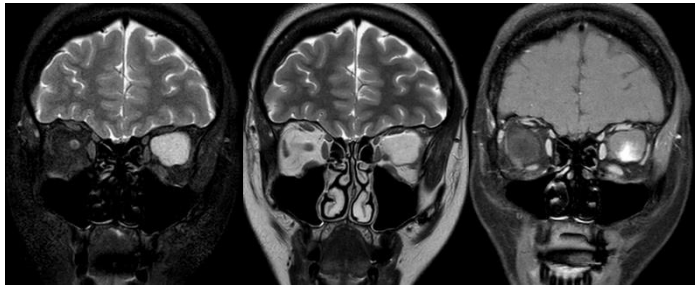
41 ans, céphalées

Quelle séquence manque-t-il ?

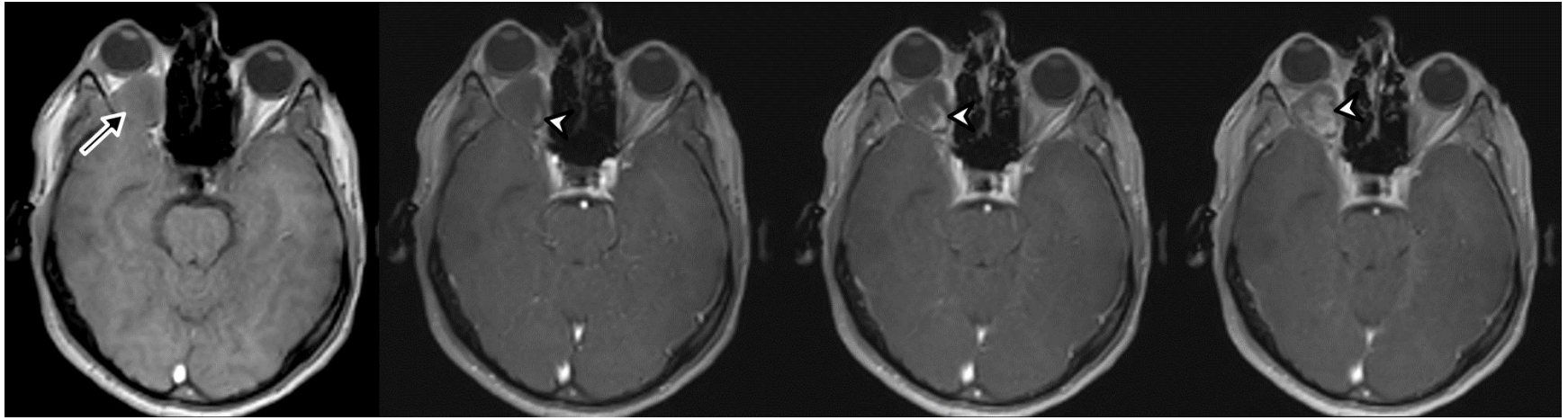




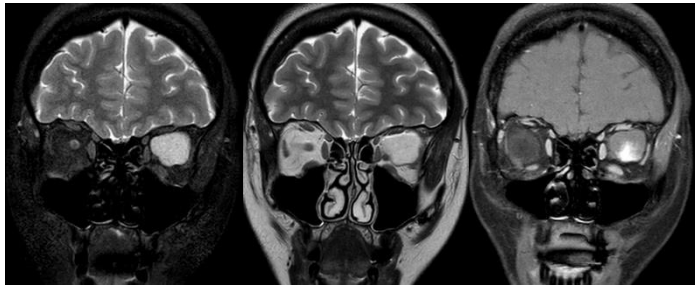
Cas 3 – LE diagnostic le + fréquent !



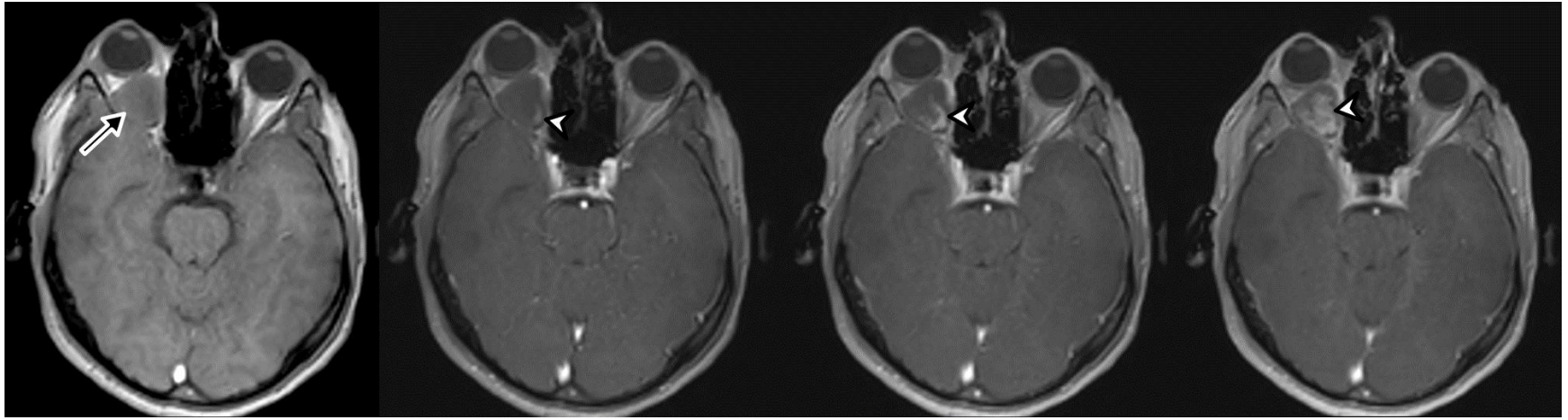
Séquences injectées dynamiques



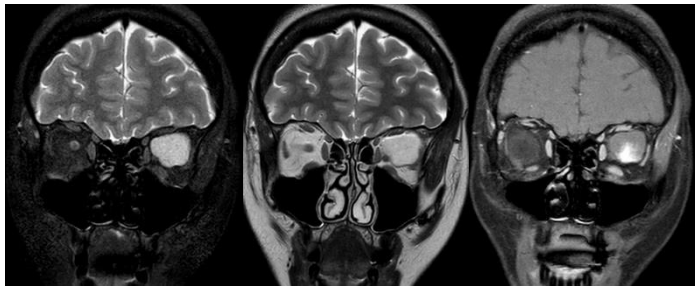
Cas 3 – LE diagnostic le + fréquent !



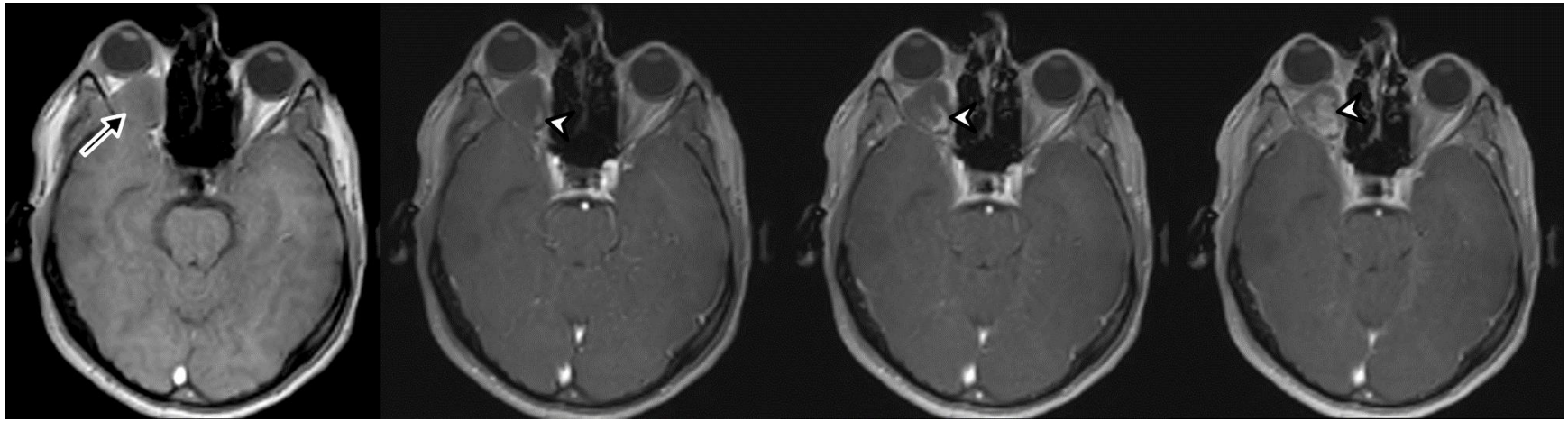
Diagnostic ?



Cas 3 – LE diagnostic le + fréquent !



Hémangiome caverneux ?



Malformation veineuse orbitaire caverneuse

ISSVA classification for vascular anomalies ©

(Approved at the 20th ISSVA Workshop, Melbourne, April 2014, last revision May 2018)

This classification is intended to evolve as our understanding of the biology and genetics of vascular malformations and tumors continues to grow

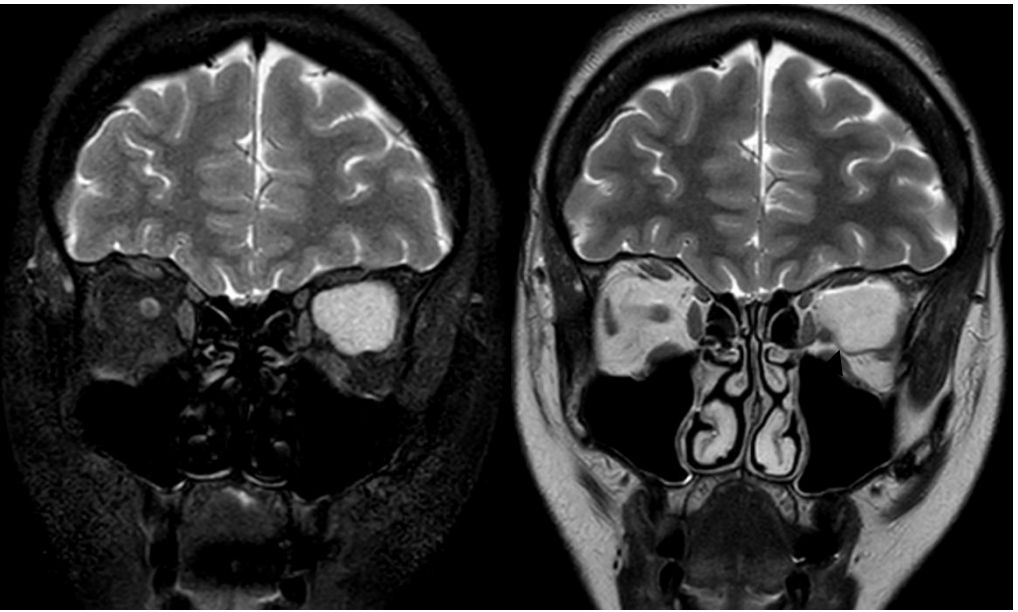
Overview table

Vascular anomalies				
Vascular tumors	**Vascular malformations**			
	Simple	**Combined °**	**of major named vessels**	**associated with other anomalies**
Benign Locally aggressive or borderline Malignant	Capillary malformations Lymphatic malformations Venous malformations Arteriovenous malformations* Arteriovenous fistula*	CVM, CLM LVM, CLVM CAVM* CLAVM* others	See details	See list

Hémangiome caverneux ?

Malformation veineuse orbitaire caverneuse

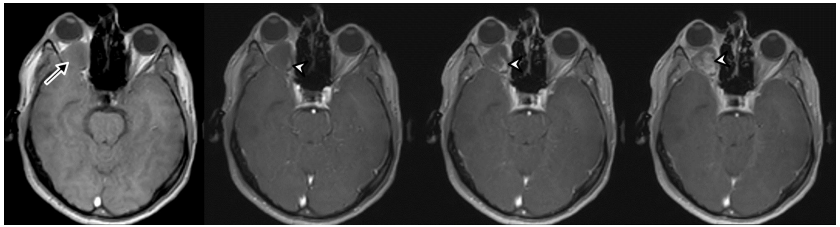
Hypersignal T2 franc



Water DIXON T2-WI

In-phase DIXON T2-WI

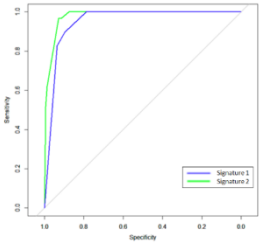
Rehaussement progressif centripète



Dynamic contrast-enhanced FS T1-WI

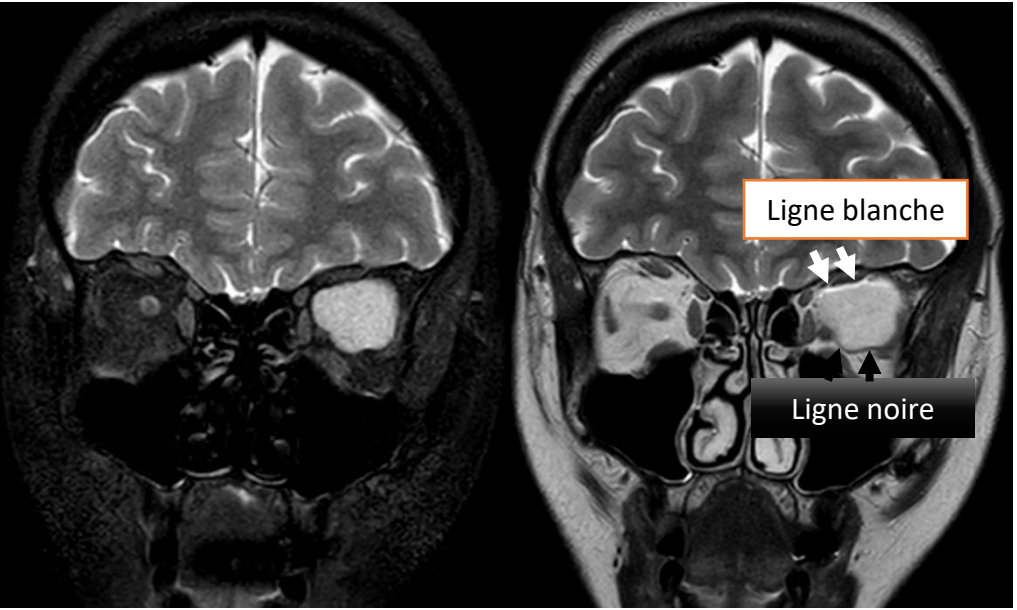
Lésion la + fréquente de l'adulte

Malformation veineuse orbitaire caverneuse



Hypersignal T2 franc

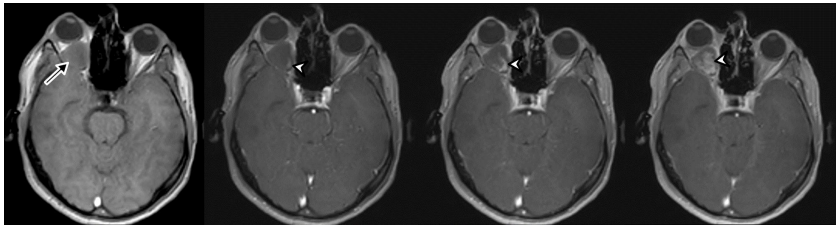
Artéfact de déplacement chimique



Water DIXON T2-WI

In-phase DIXON T2-WI

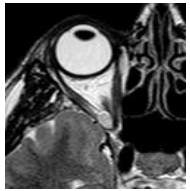
Rehaussement progressif centripète



Dynamic contrast-enhanced FS T1-WI

Pas d'injection pendant le suivi

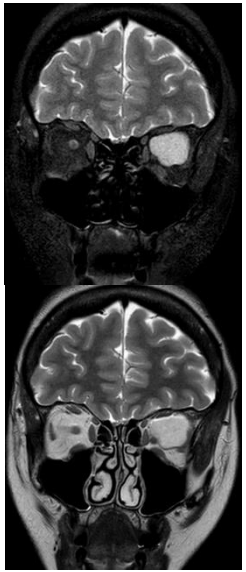
Pas de chirurgie (sauf…)

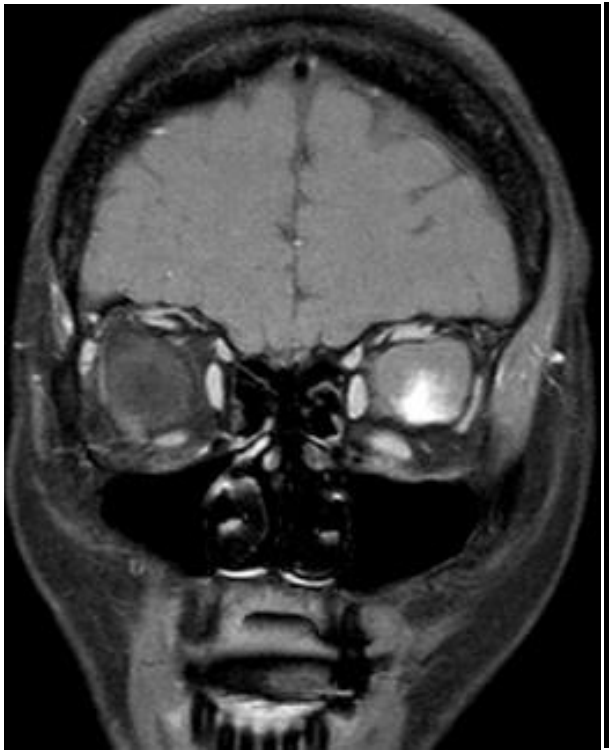


Elbaze, Lecler et al European Radiology 2022

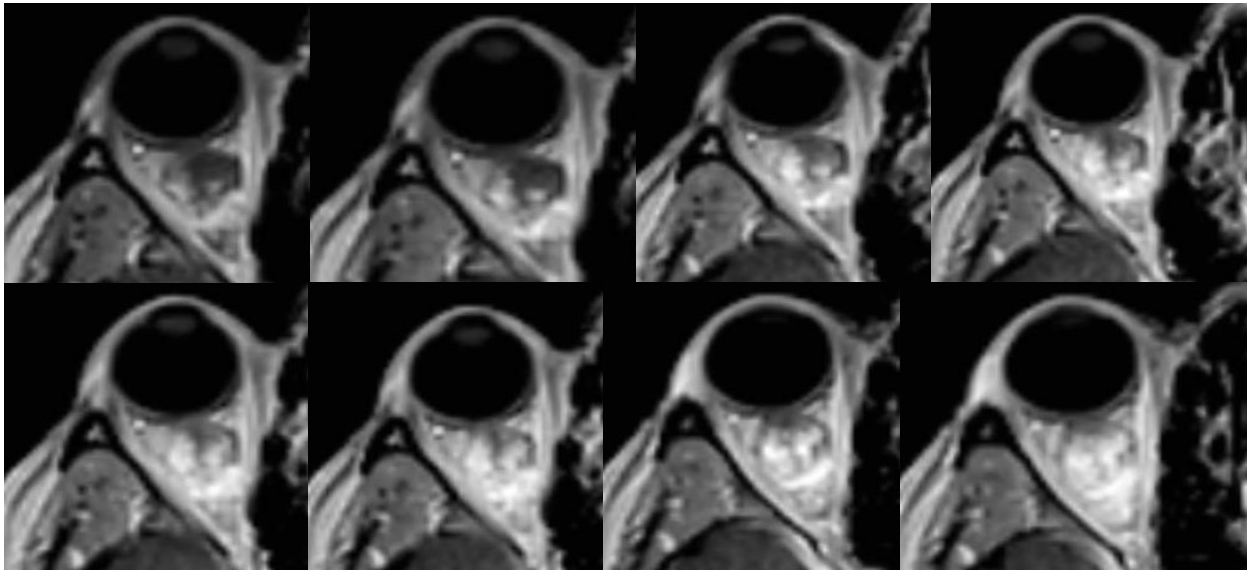
En cas de mauvais protocole…

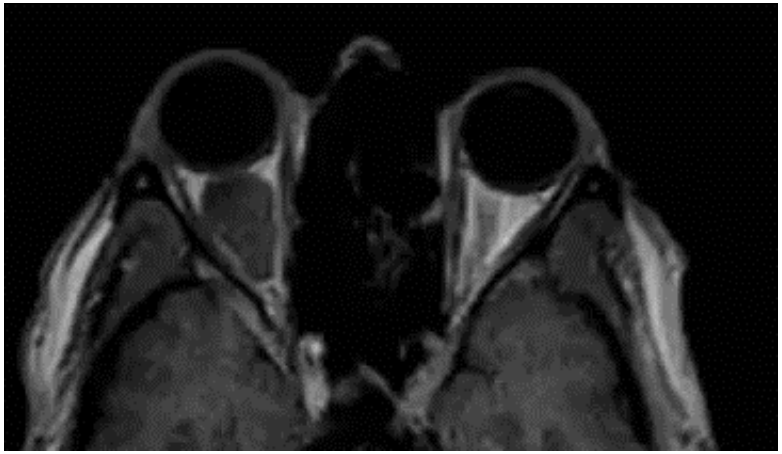
Si vous avez de la chance !





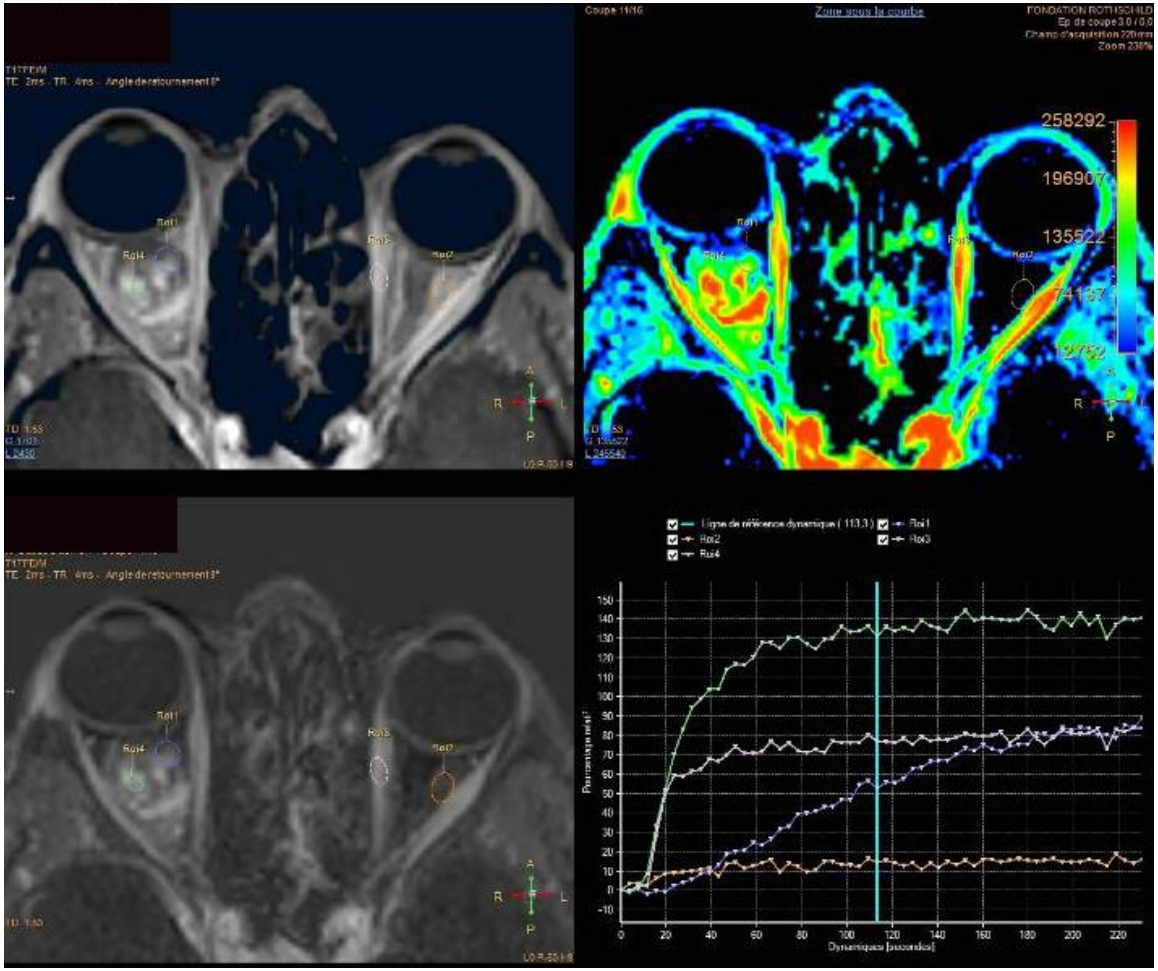
Refaire une séquence T1 (temps tardif)





Le mieux c’est la perfusion !

Analyse qualitative

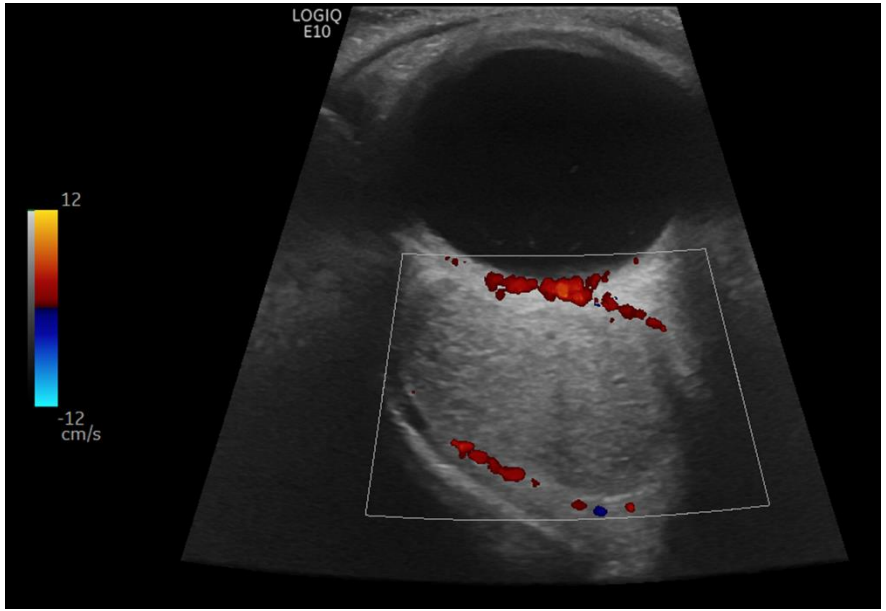


Analyse quantitative

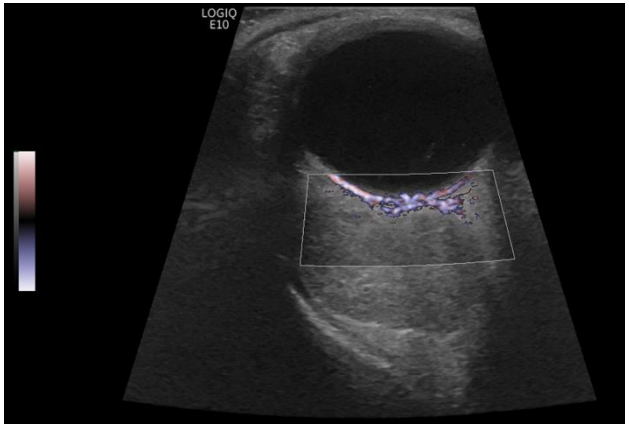
Lecler JMRI 2017 ; Lecler AJNR under review (2023 ?)

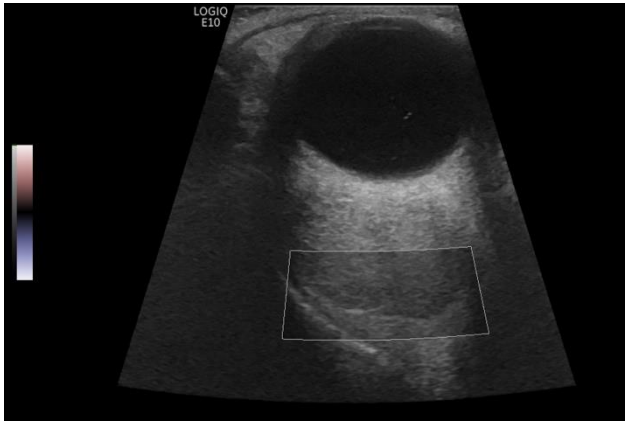
Voici maintenant l'échographie du patient

Est-ce que ca confirme votre diagnostic ?



Doppler

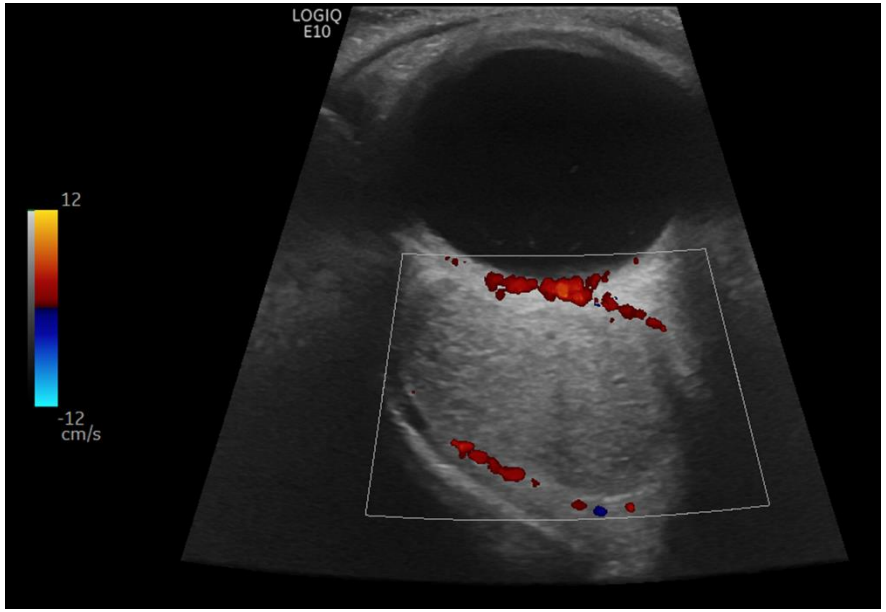




MVI

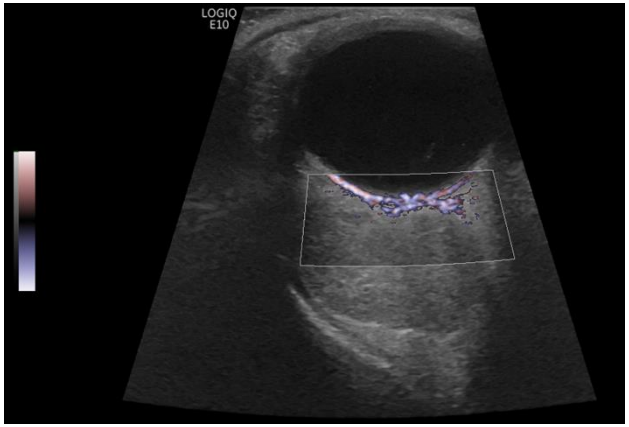
Voici maintenant l'échographie du patient

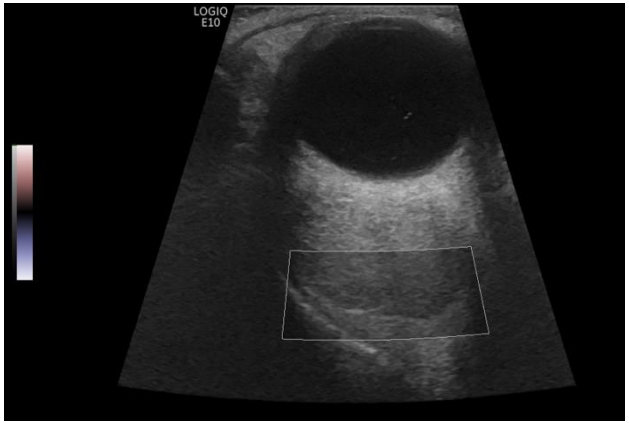
Oui !



Doppler

Pas de vascularisation visible !

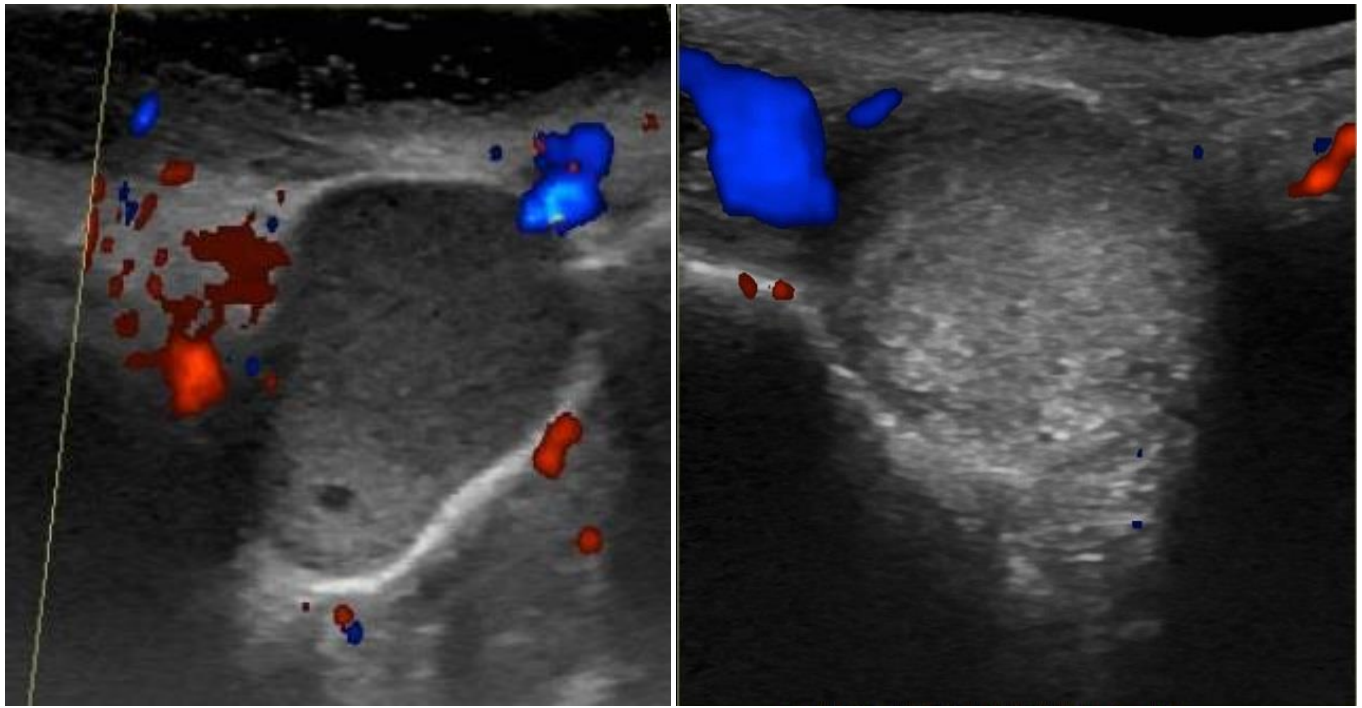




MVI

Cas 4 – Toujours commencer par l'échographie !

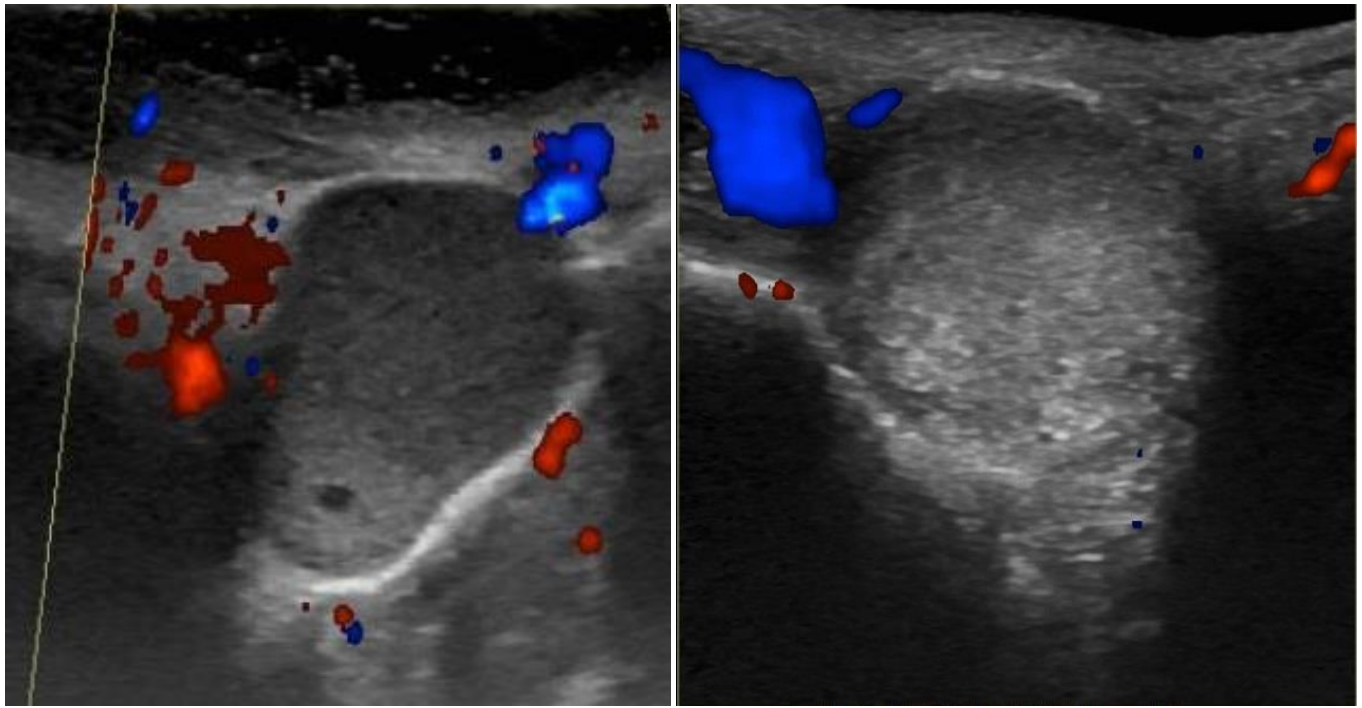
6 mois, masse molle de la queue du sourcil



Diagnostic ?

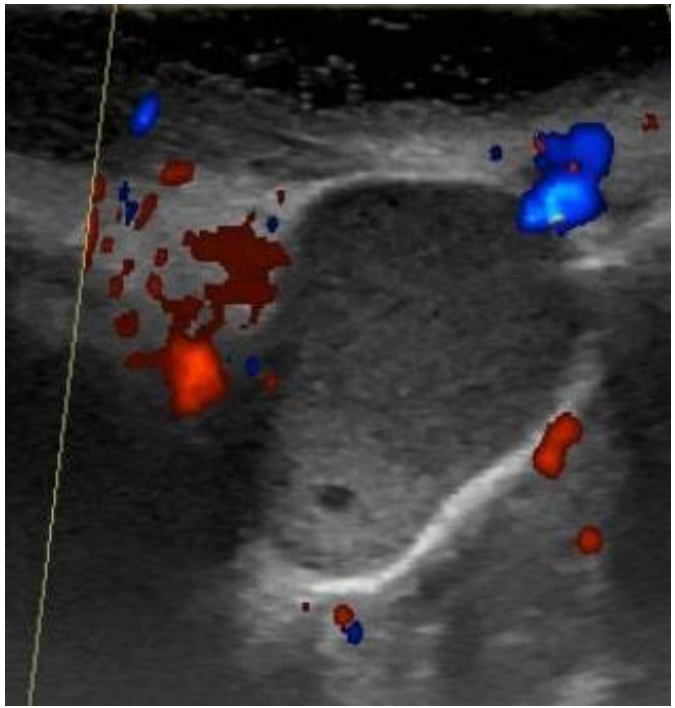
Cas 4 – Toujours commencer par l'échographie !

6 mois, masse molle de la queue du sourcil

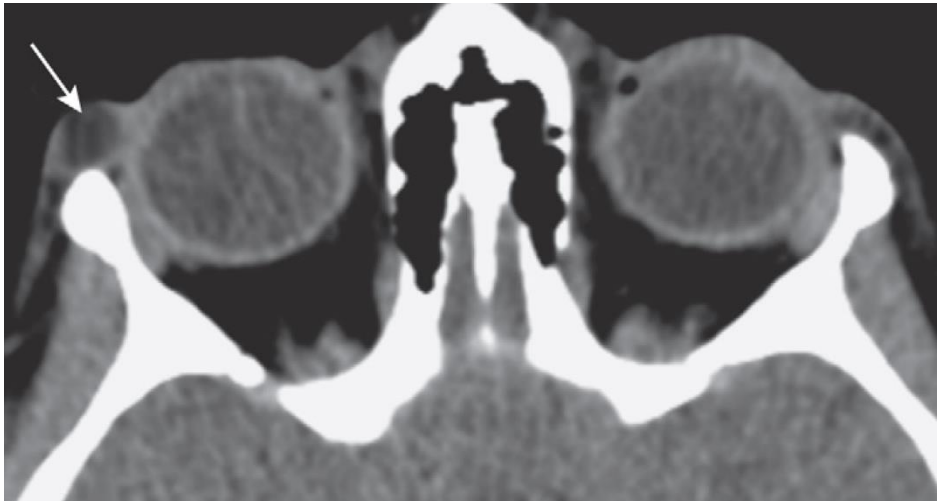


Kyste dermoïde

Kyste dermoïde

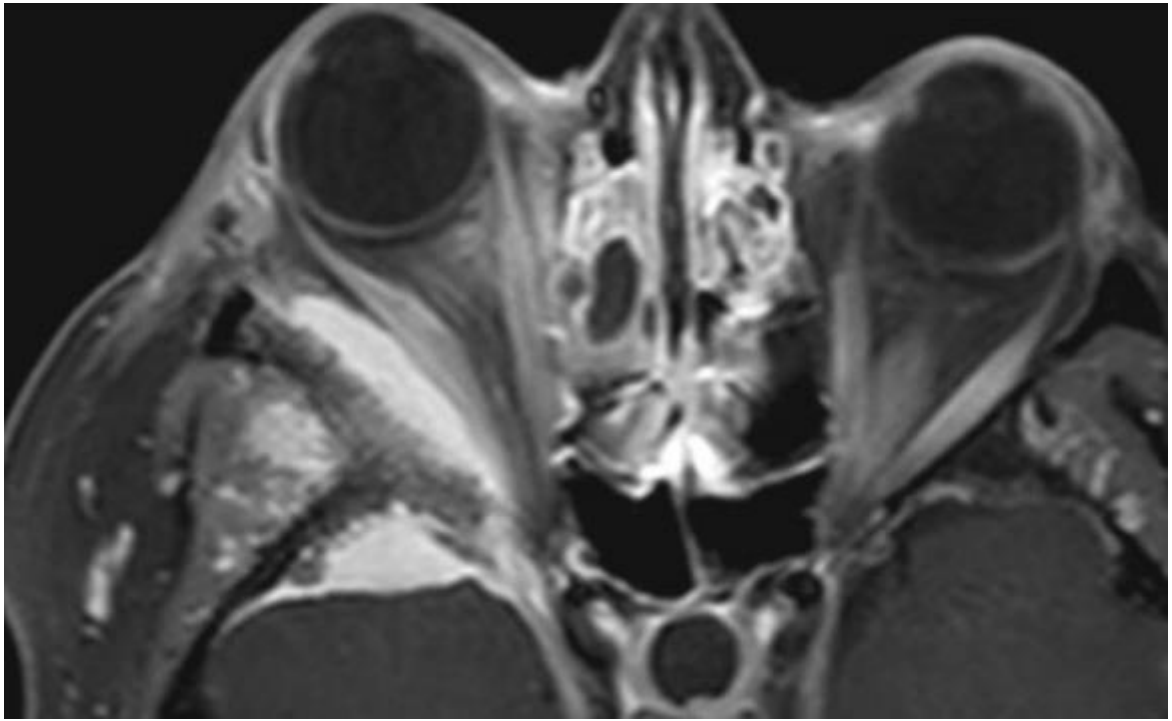


Pas besoin du scanner !



Eviter le scanner pour les tumeurs orbitaires, surtout chez l'enfant !

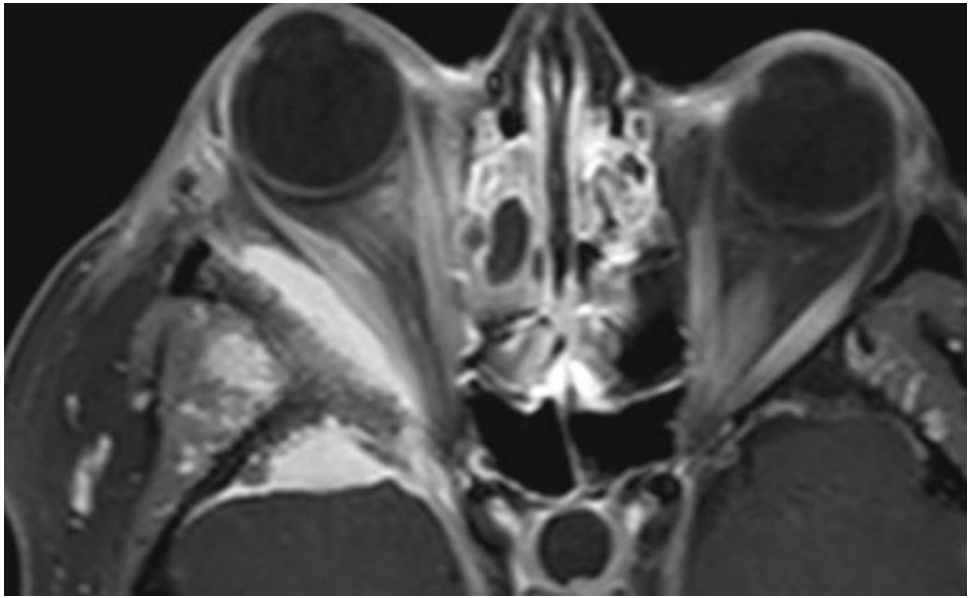
Cas 5 – Utiliser quand même le scanner (parfois !)

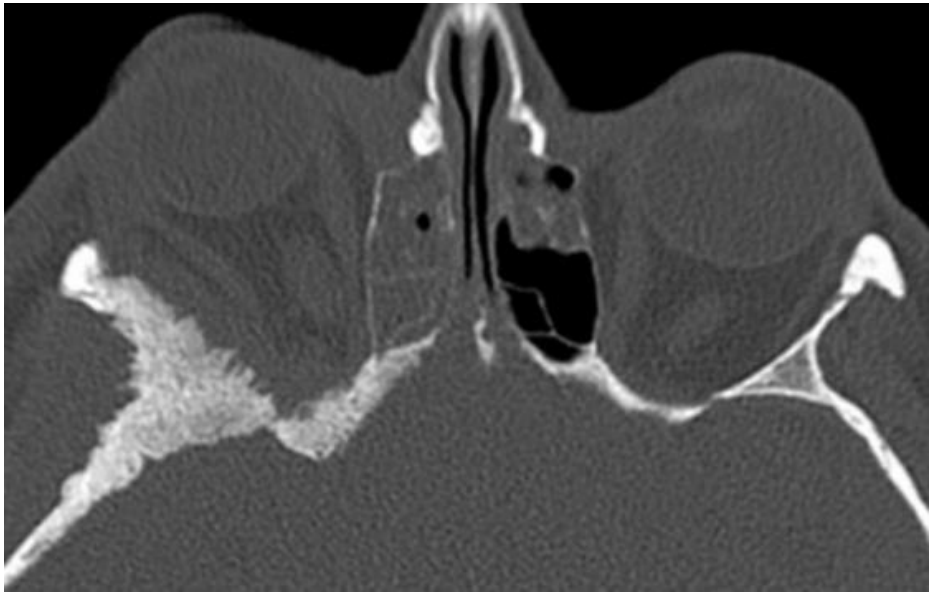


Ca a l’air malin !

Cas 5 – Utiliser quand même le scanner (parfois !)

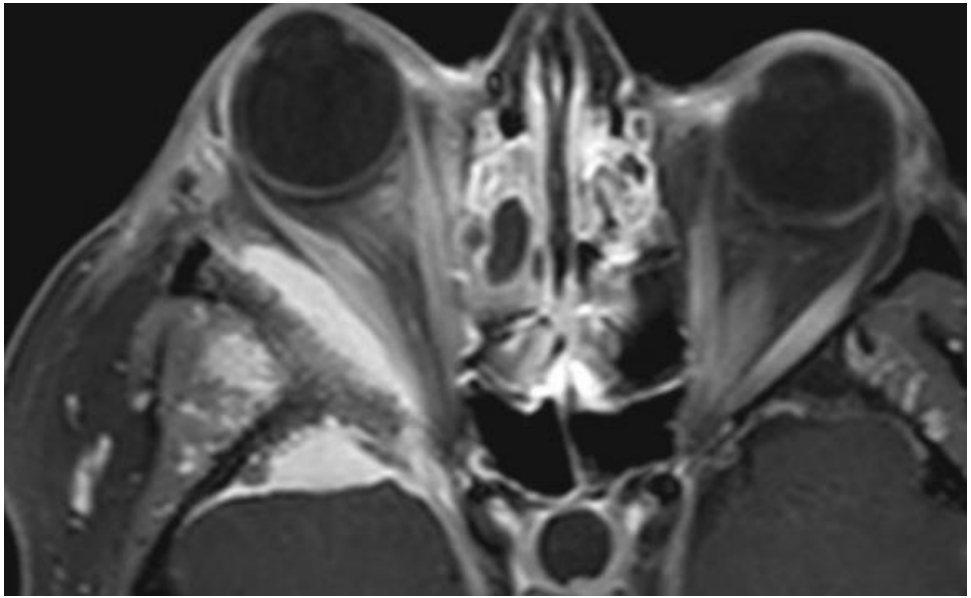
Scanner toujours utile pour voir l'os !

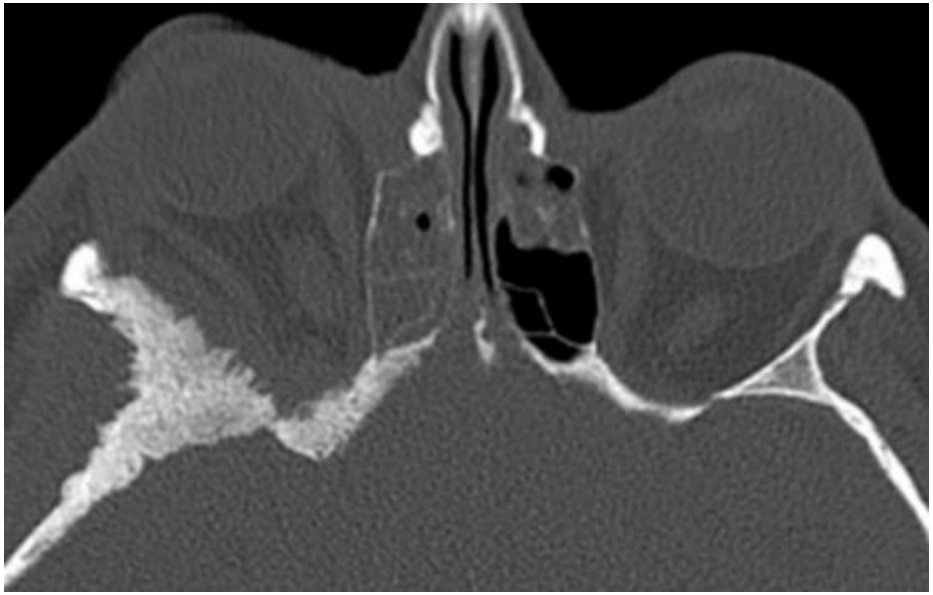




Diagnostic ?

Cas 5 – Utiliser quand même le scanner (parfois !)

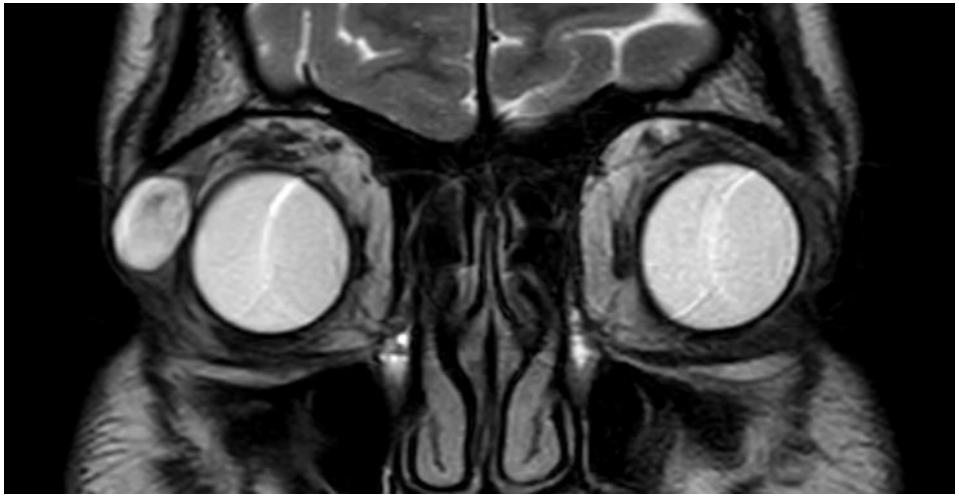


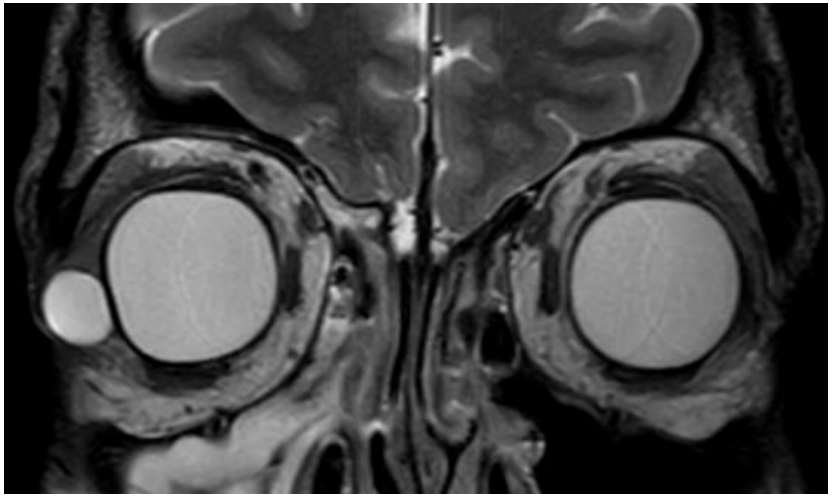


Méningiome sphéno orbitaire

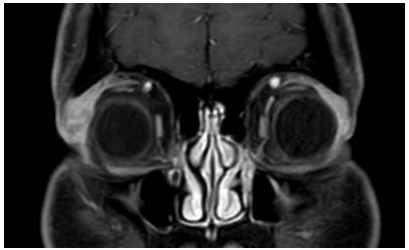
Cas 6 – Toujours injecter les « kystes »

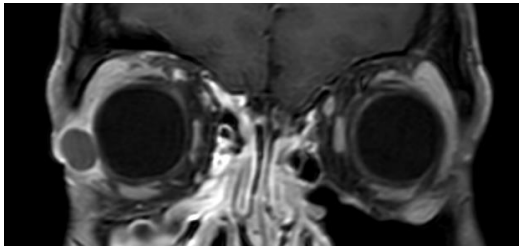
Où est le « faux » kyste ?

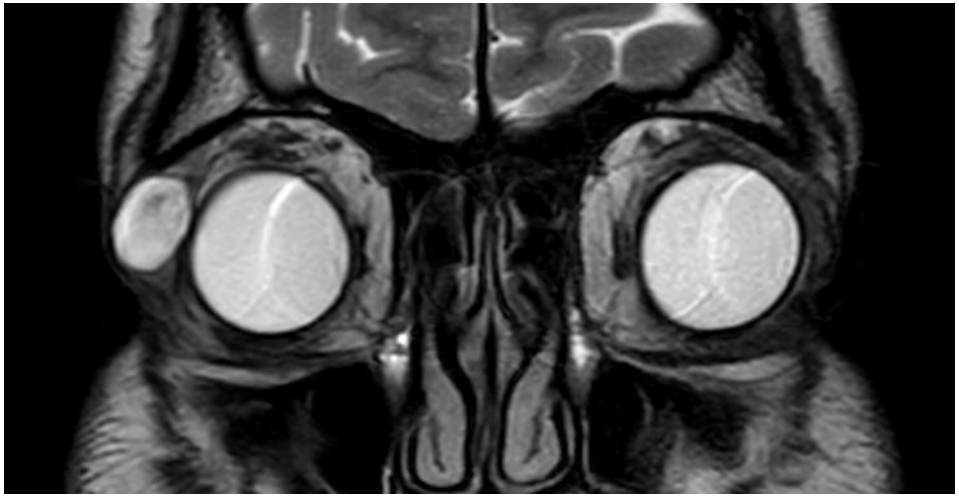


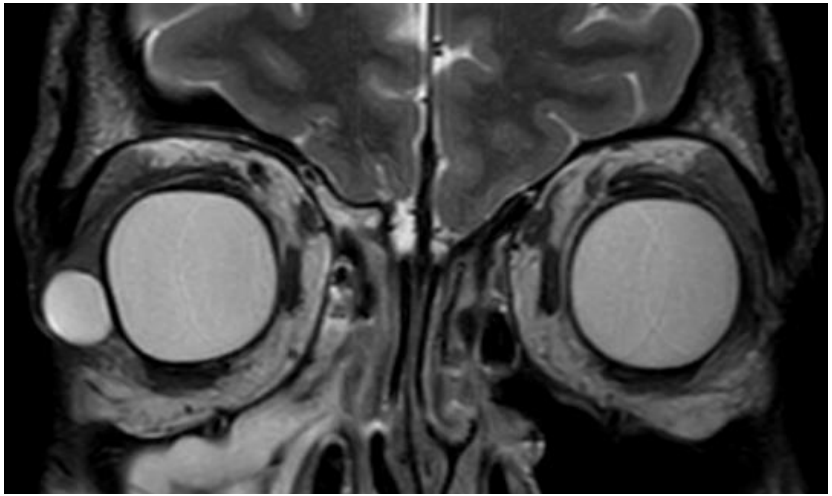


Cas 6 – Toujours injecter les « kystes »





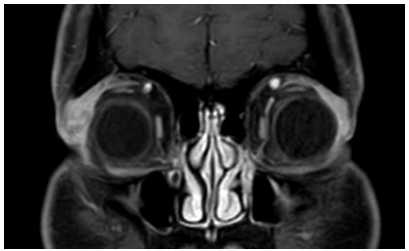




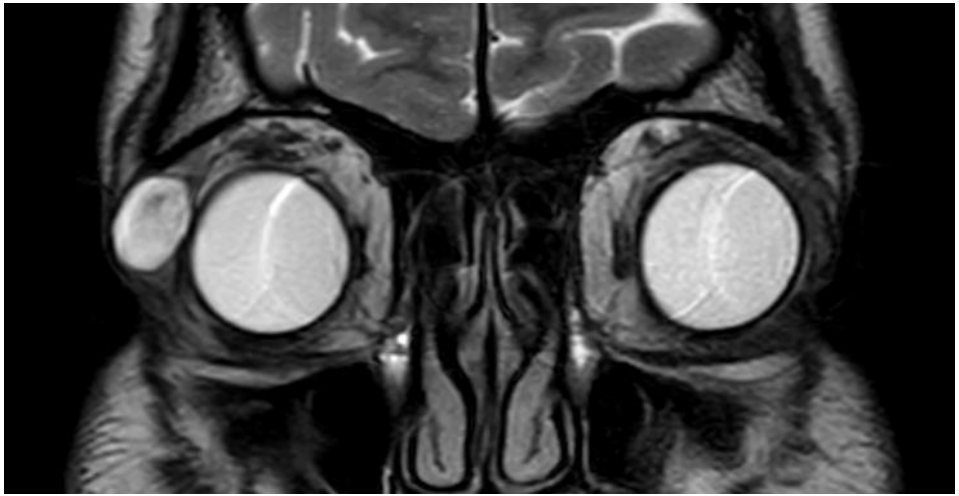
« Faux » kyste

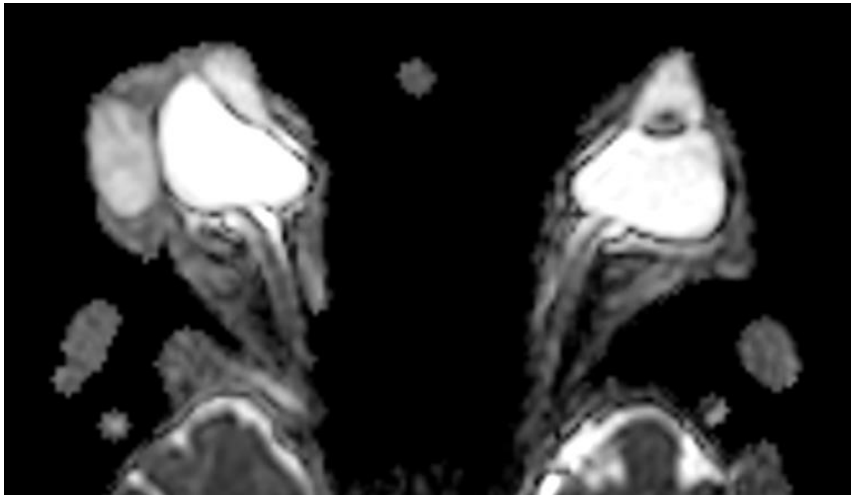
« Vrai » kyste

Cas 6 – Toujours injecter les « kystes »



Diagnostic du faux kyste ?





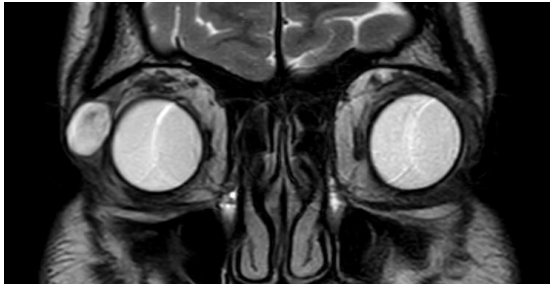
« Faux » kyste

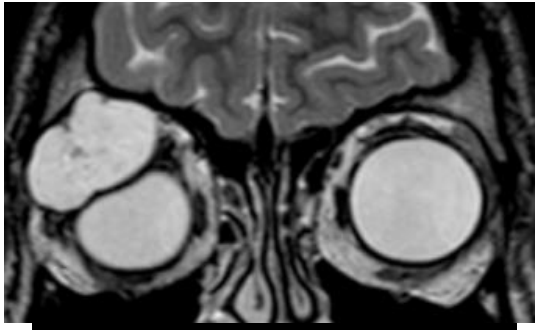
Adénome pléomorphe de la glande lacrymale

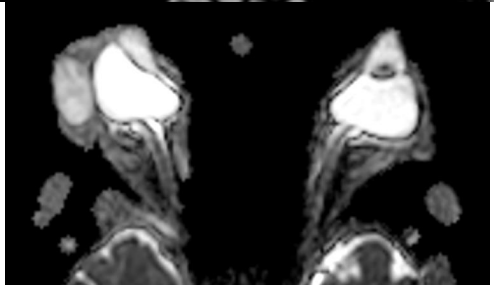
Tumeur épithéliale bénigne

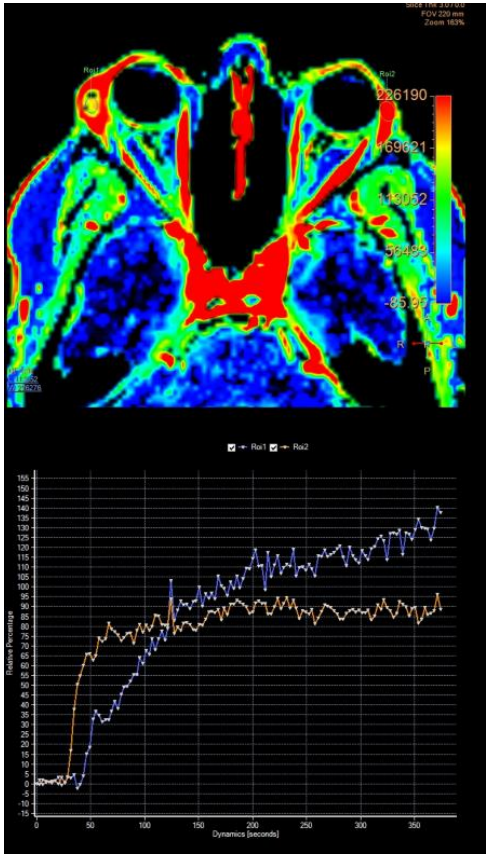
Résection en bloc indispensable (éviter la récidive ou transformation)

Mêmes caractéristiques IRM que dans la parotide



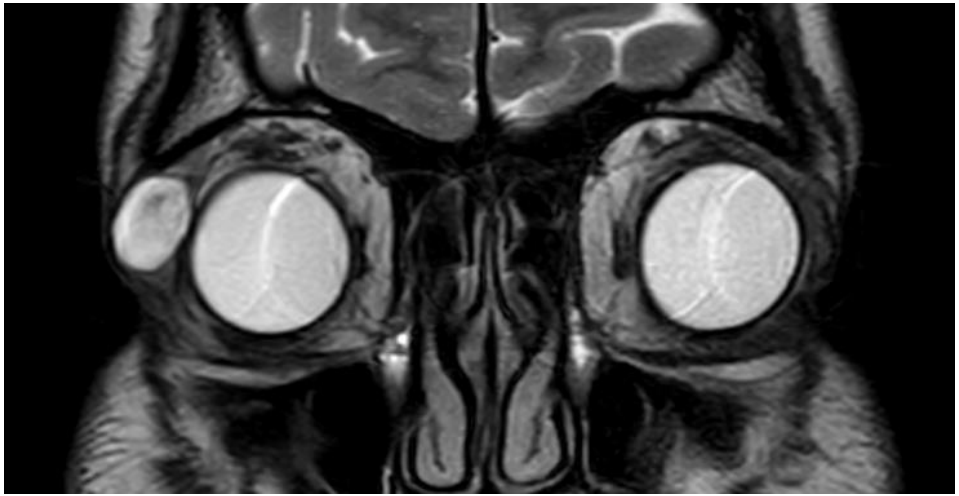


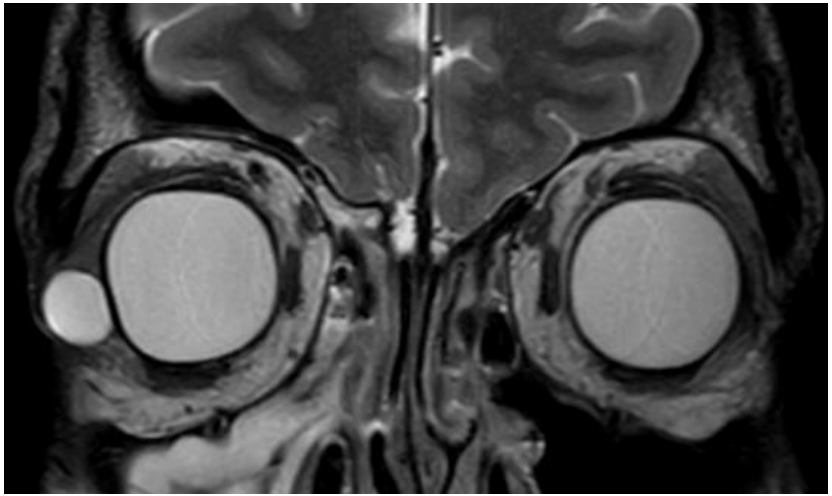




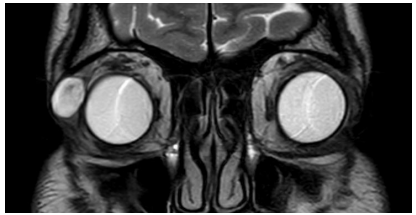
Cas 6 – Toujours injecter les « kystes »

Comment rattraper si pas d'injection possible ?

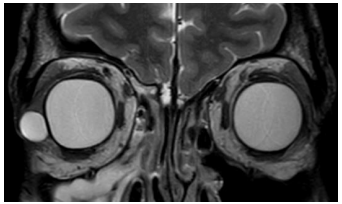


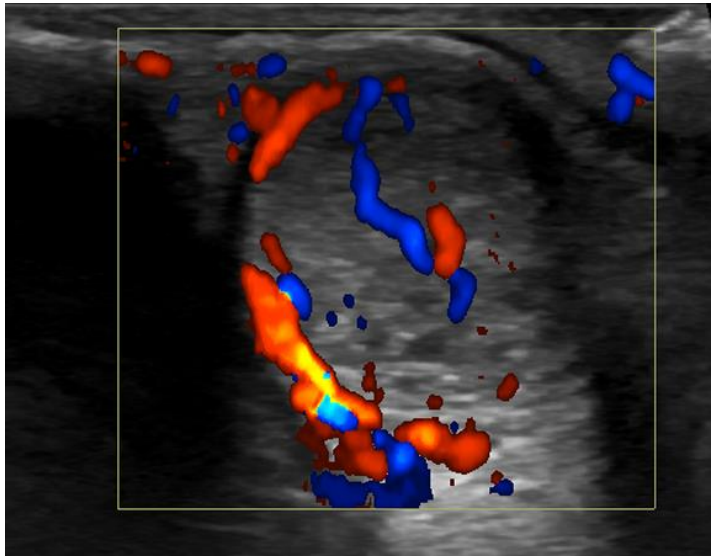


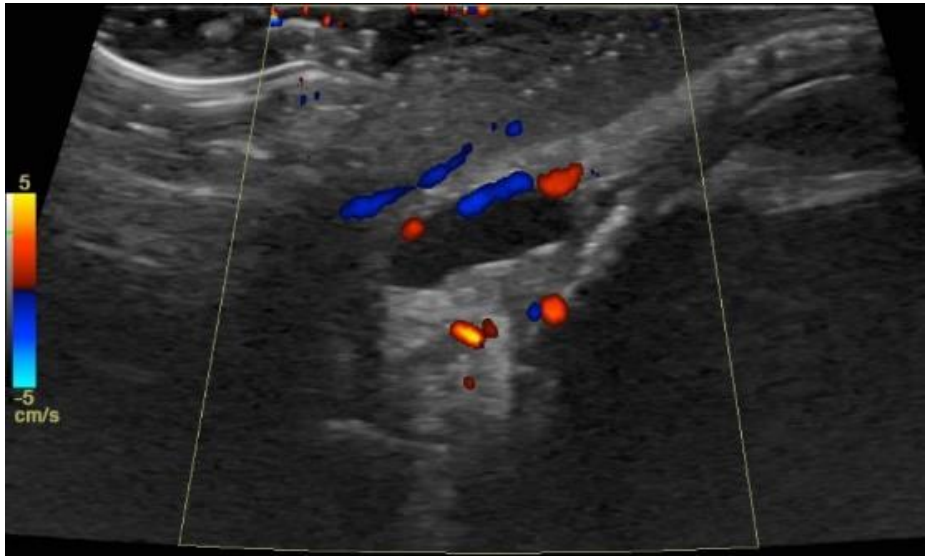
Cas 6 – Toujours injecter les « kystes »



Echographie Doppler !







Adénome pléomorphe

Dacryops

Cas 7 – Savoir diagnostiquer des tumeurs de la glande lacrymale

Est-ce que l'échographie Doppler a un intérêt pour diagnostiquer des tumeurs de la glande lacrymale ?

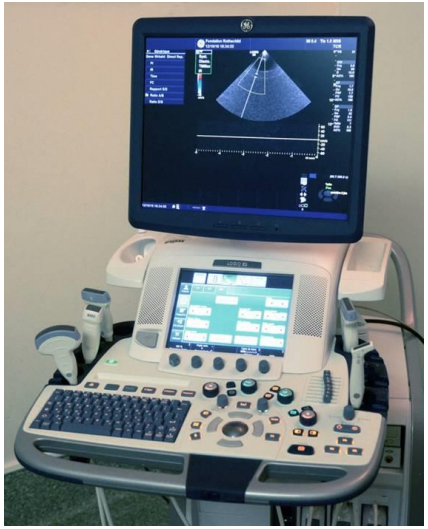
AL

Est-ce que l'échographie Doppler a un intérêt pour diagnostiquer des tumeurs de la glande lacrymale ?

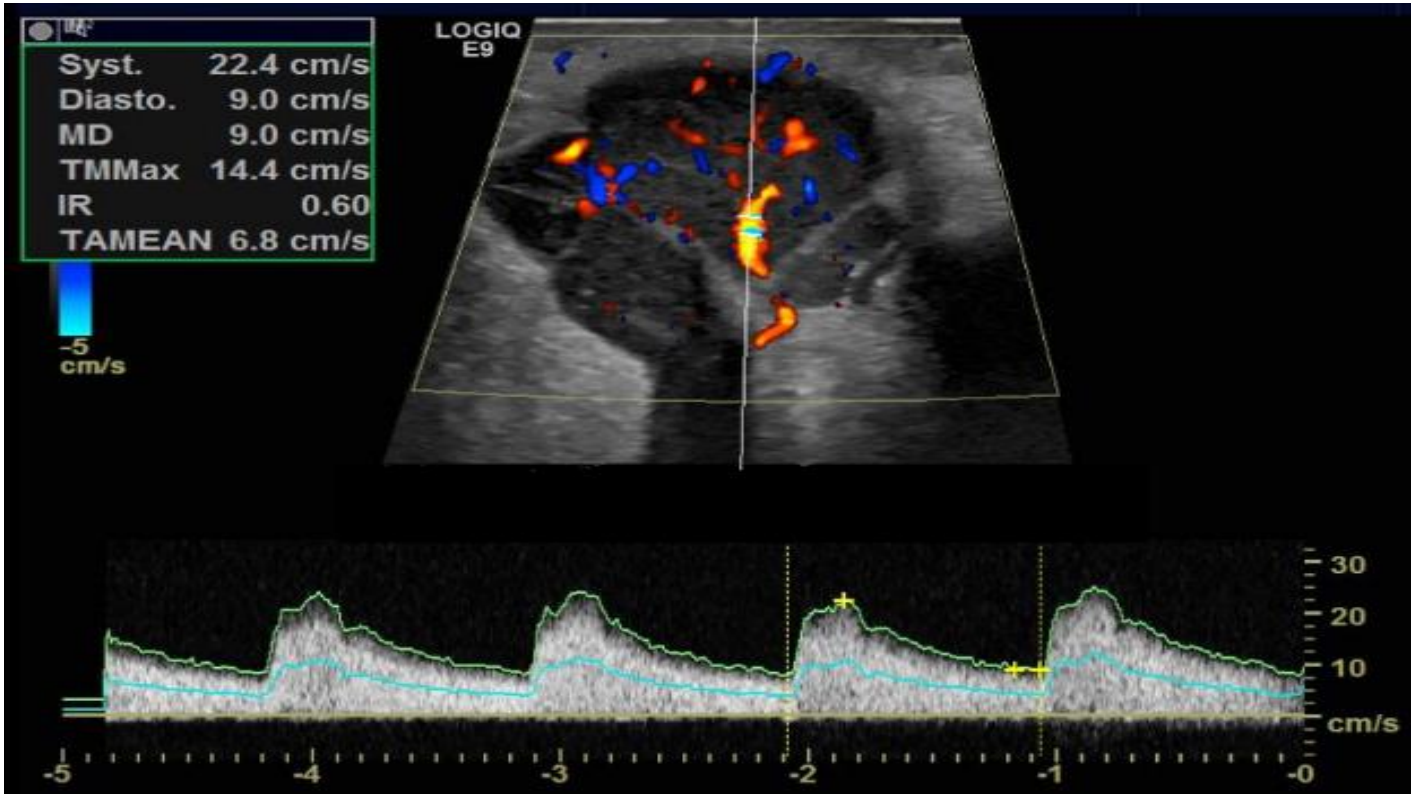
L'échographie Doppler peut être utile dans l'évaluation des tumeurs de la glande lacrymale, bien que ce ne soit pas le principal outil de diagnostic pour ce type de tumeur. L'échographie Doppler est une technique d'imagerie qui permet de visualiser les flux sanguins dans les vaisseaux. Elle utilise les ultrasons pour produire des images en temps réel.

Dans le cas des tumeurs de la glande lacrymale, l'échographie Doppler peut fournir des informations sur la vascularisation de la tumeur. Elle peut montrer la présence de vaisseaux sanguins anormaux ou de zones d'hypervascularisation, ce qui peut être un indicateur de malignité.

Cependant, l'échographie Doppler seule ne peut pas confirmer le diagnostic de tumeur de la glande lacrymale. Elle est généralement utilisée en complément d'autres techniques d'imagerie, telles que l'imagerie par résonance magnétique (IRM) ou la tomodensitométrie (TDM). L'IRM est souvent préférée car elle offre une meilleure résolution et permet une visualisation détaillée des tissus mous autour de la glande lacrymale.



Cas 7 – Savoir diagnostiquer des tumeurs de la glande lacrymale

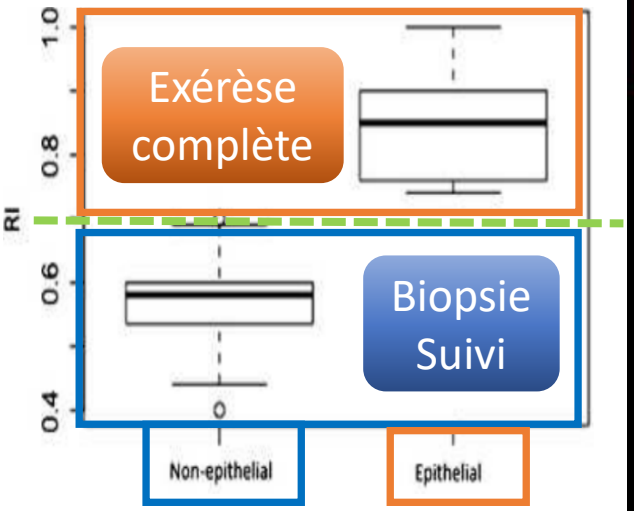


Quel diagnostic ?

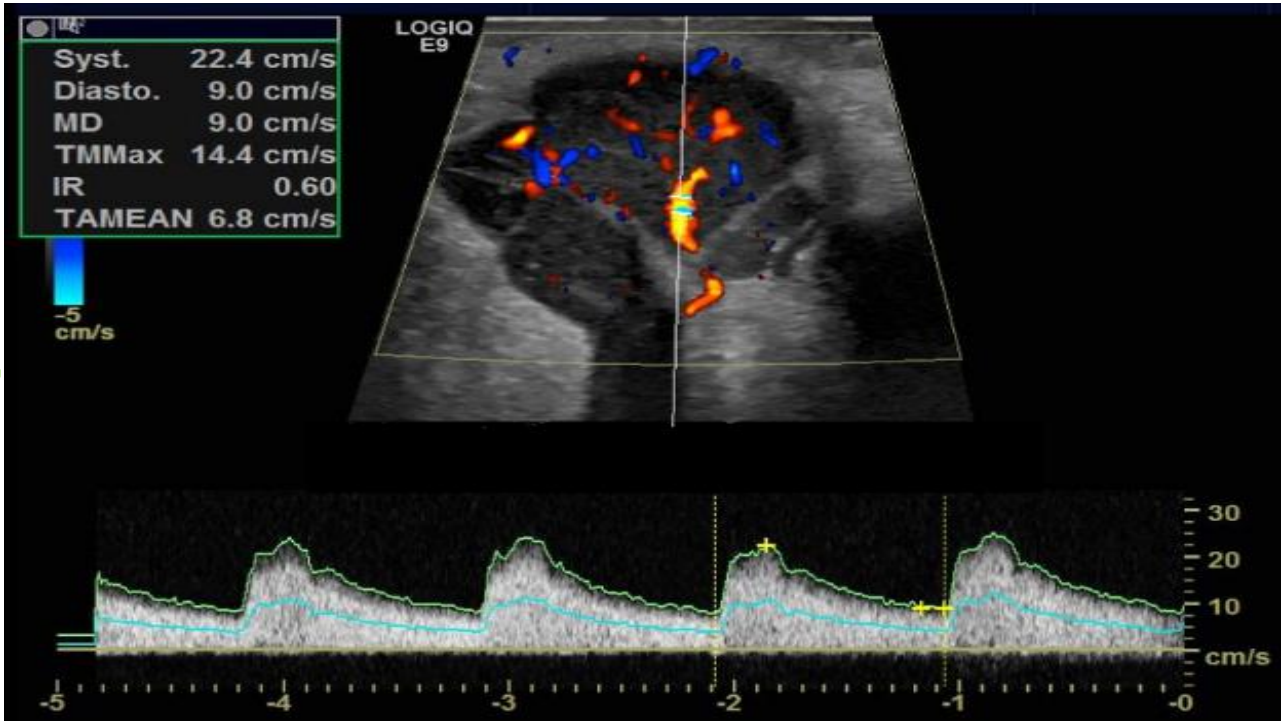
Cas 7 – Savoir diagnostiquer des tumeurs de la glande lacrymale

Index de résistance IR

Seuil 0,7



Lésion non épithéliale (lymphome)



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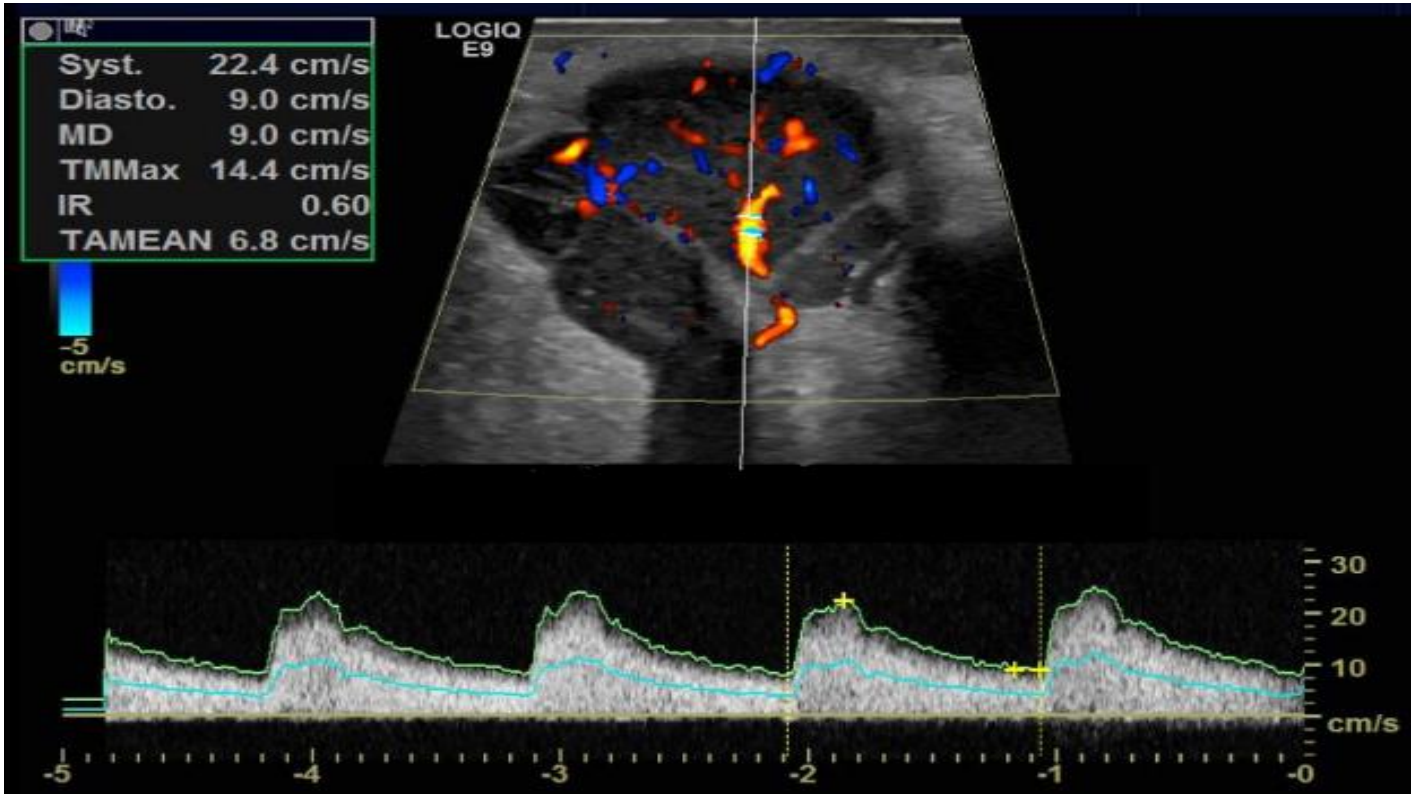
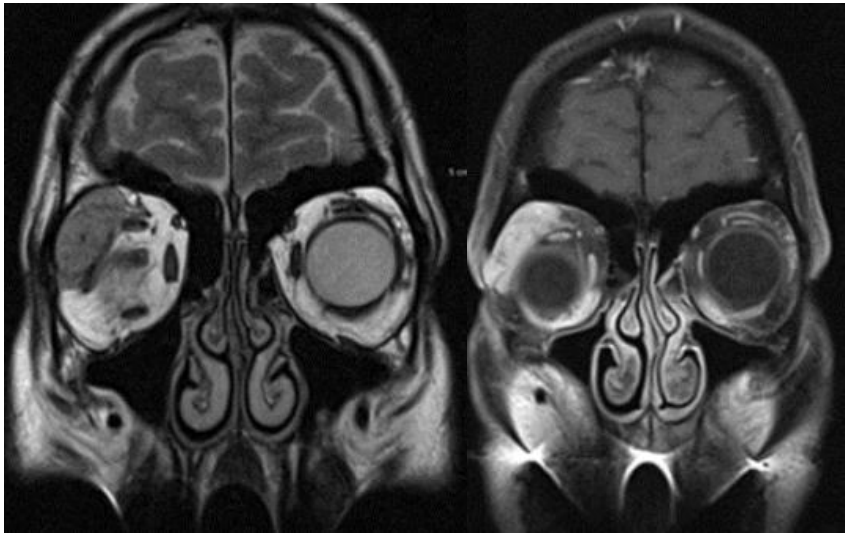
Cas 7 – Savoir diagnostiquer des tumeurs de la glande lacrymale



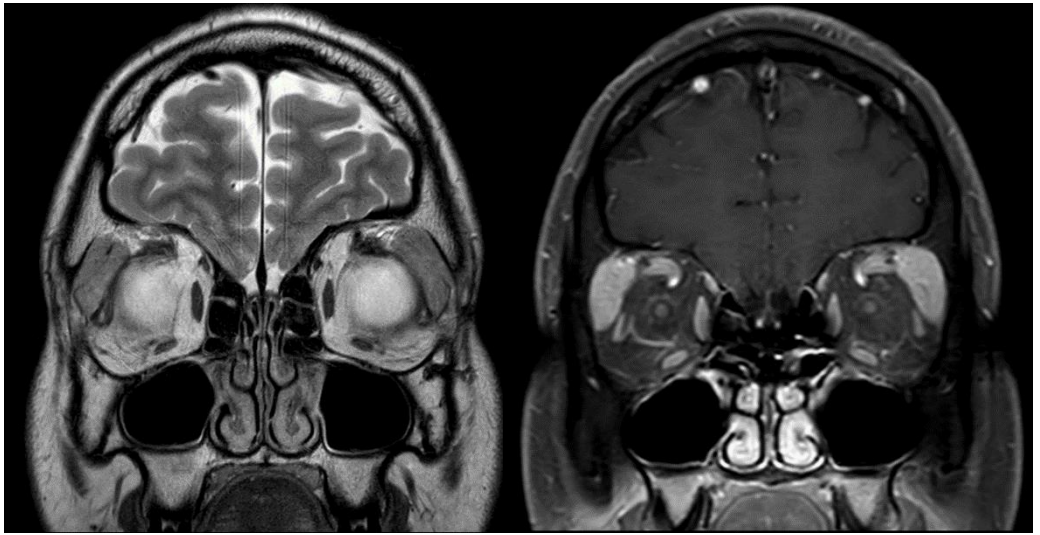
Quel examen complémentaire ?

Cas 7 – Savoir diagnostiquer des tumeurs de la glande lacrymale

Patient 1

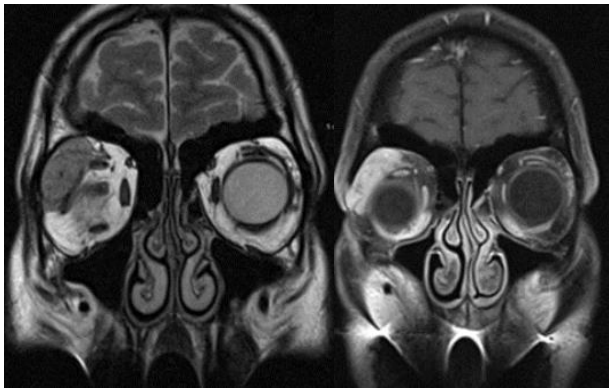


Patient 2

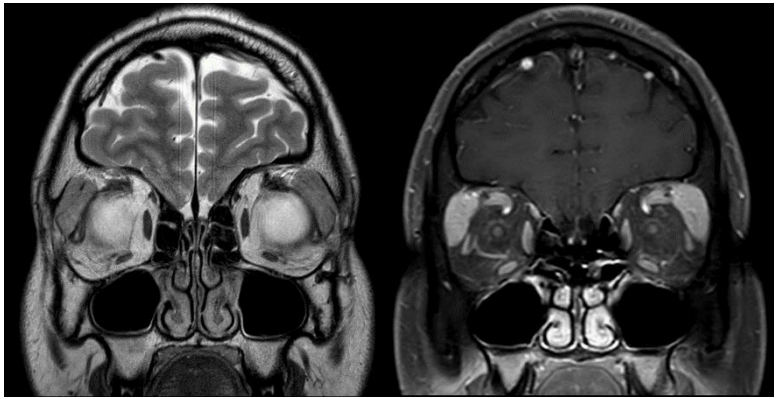


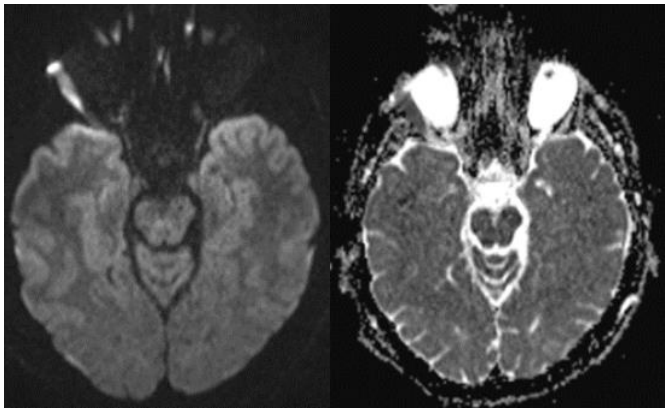
Cas 7 – Savoir diagnostiquer des tumeurs de la glande lacrymale

Patient 1

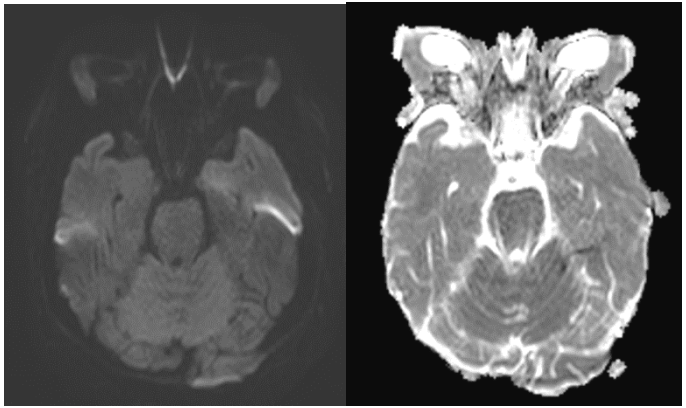


Patient 2





DWI !

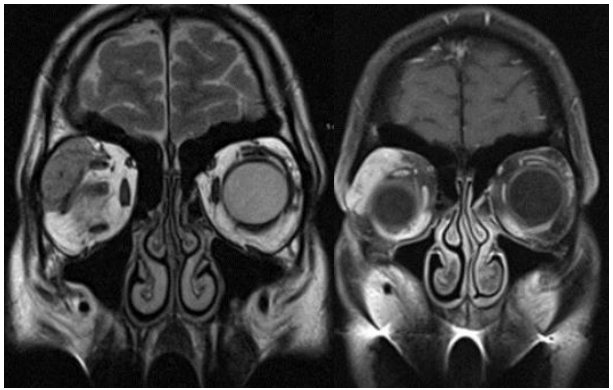


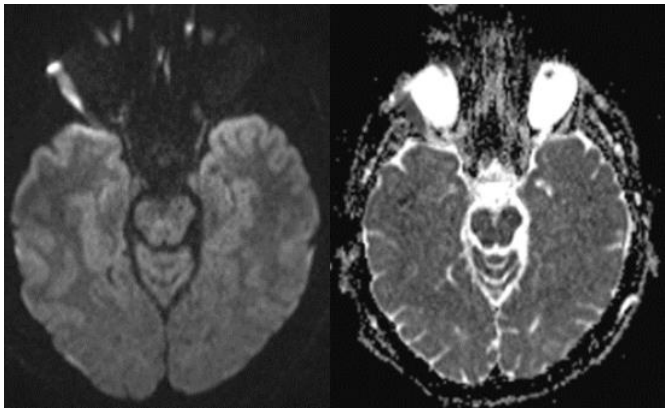
Cas 7 – Savoir diagnostiquer des tumeurs de la glande lacrymale

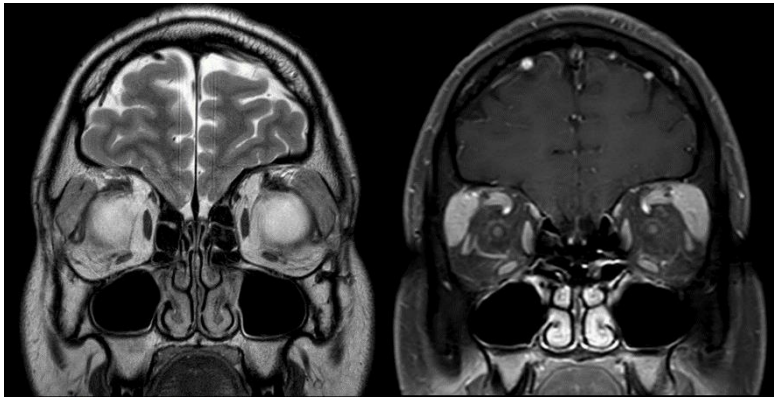
Patient 1

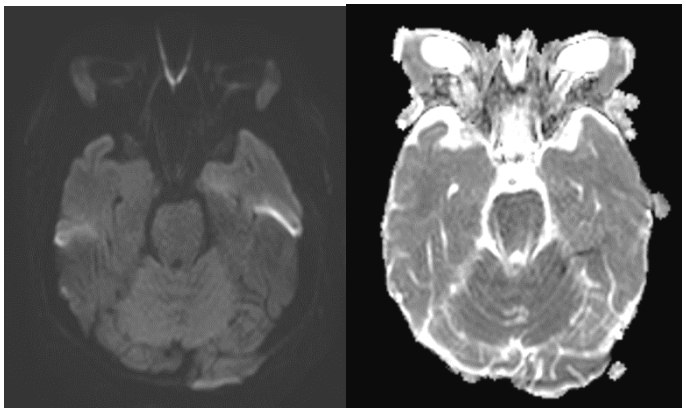
Diagnostic ?

Patient 2



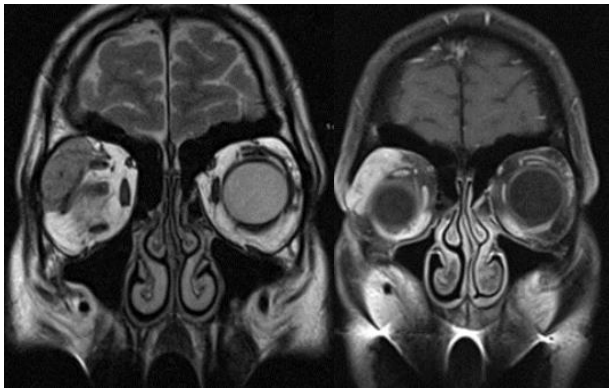


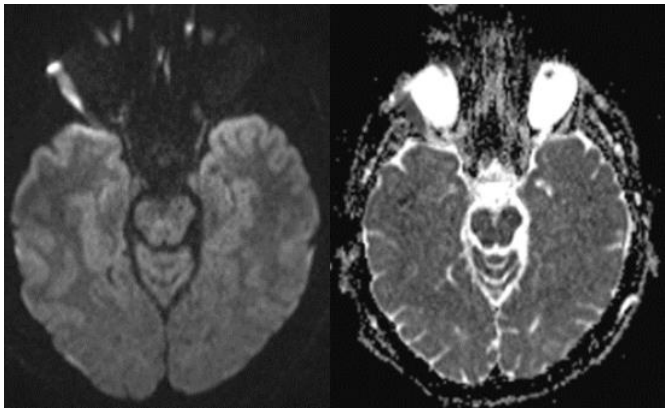




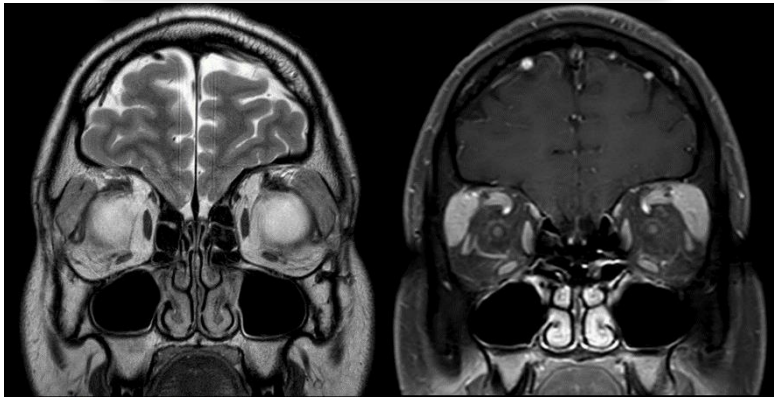
Cas 7 – Savoir diagnostiquer des tumeurs de la glande lacrymale

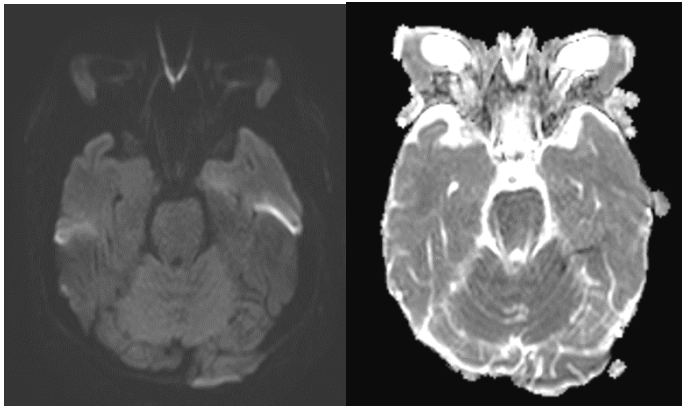
Lymphome





Dacryoadénite



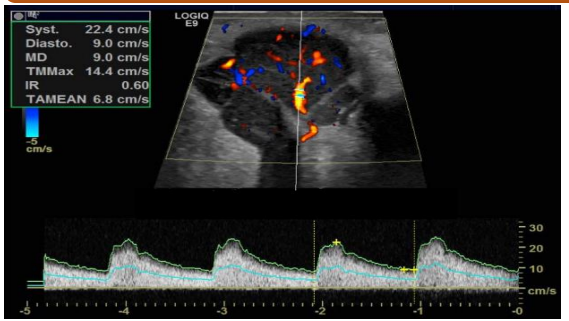


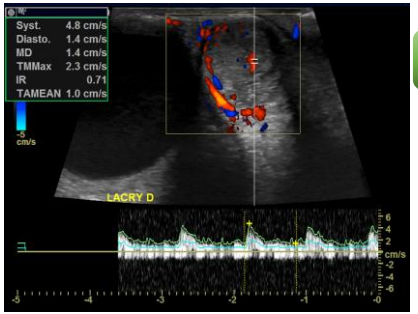
Algorithme décisionnel

Echographie Doppler

IR < 0,7

Non épithélial





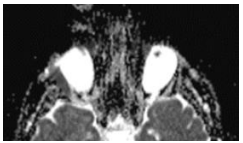
IR > 0,7

Epithélial

IRM avec Diffusion

ADC bas

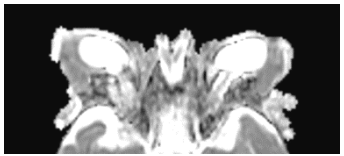
Lymphome



Biopsie suivi

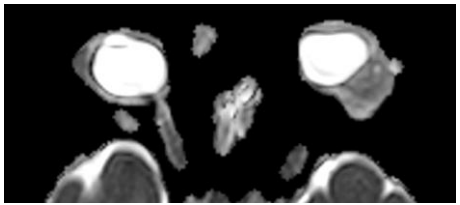
ADC élevé

Dacryoadénite



ADC bas

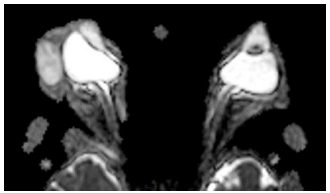
Carcinome



Exérèse complète

ADC élevé

Adénome pléomorphe



Lecler European Radiology 2015

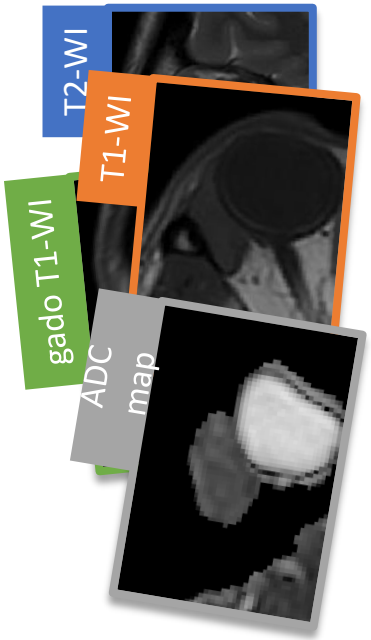
La révolution de l'IA : la radiomique

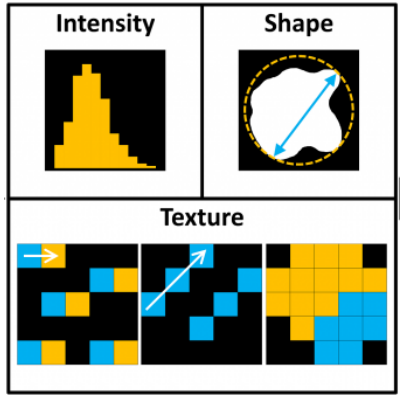
Data-driven
Research field

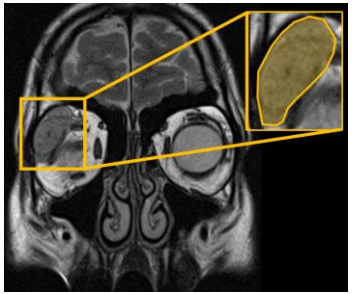
High number
of features

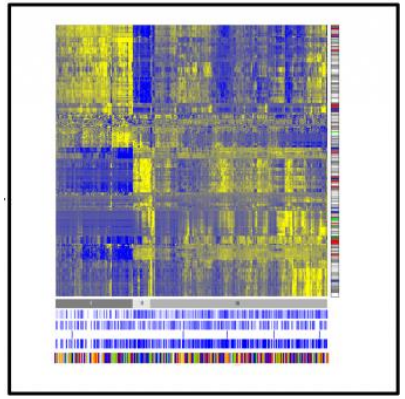
Correlation to
diagnosis / prognosis

Imaging Biomarkers









Reproducible

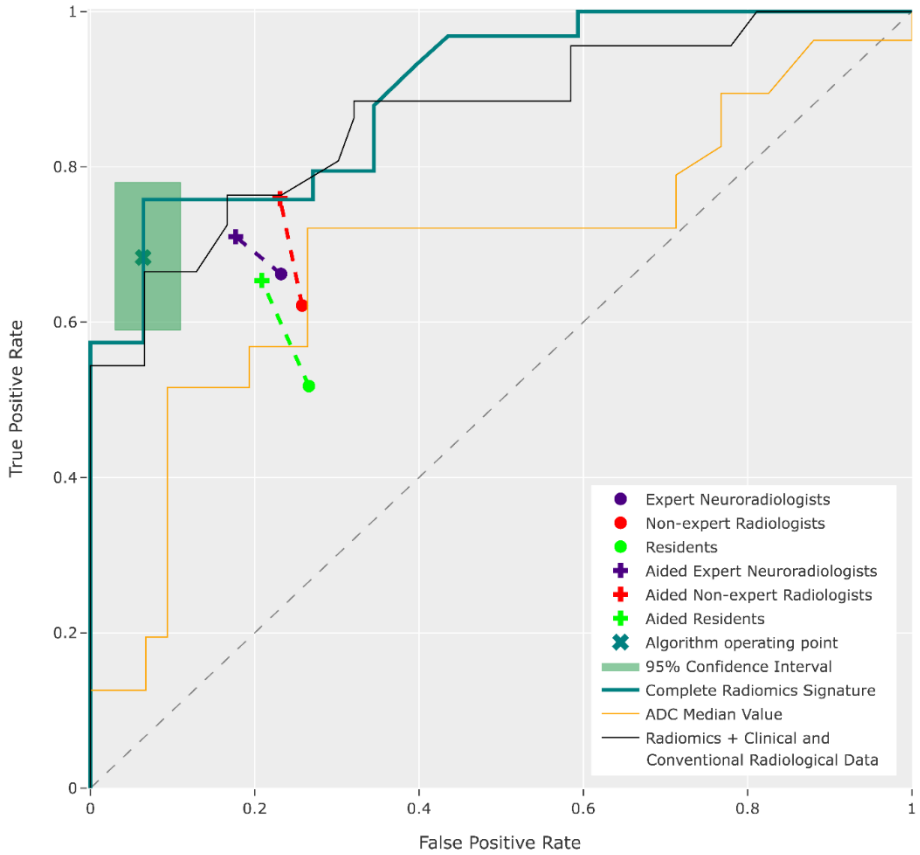
Non-redundant

Informative

Features

Radiomics Signature

La révolution de l'IA : la radiomique



Radiomics signature > ADC Median Value (p=0.02)

AUC 0.87 (95%CI [0.83-0.90])

Radiomics signature > Expert Neuroradiologists (p<0.01)

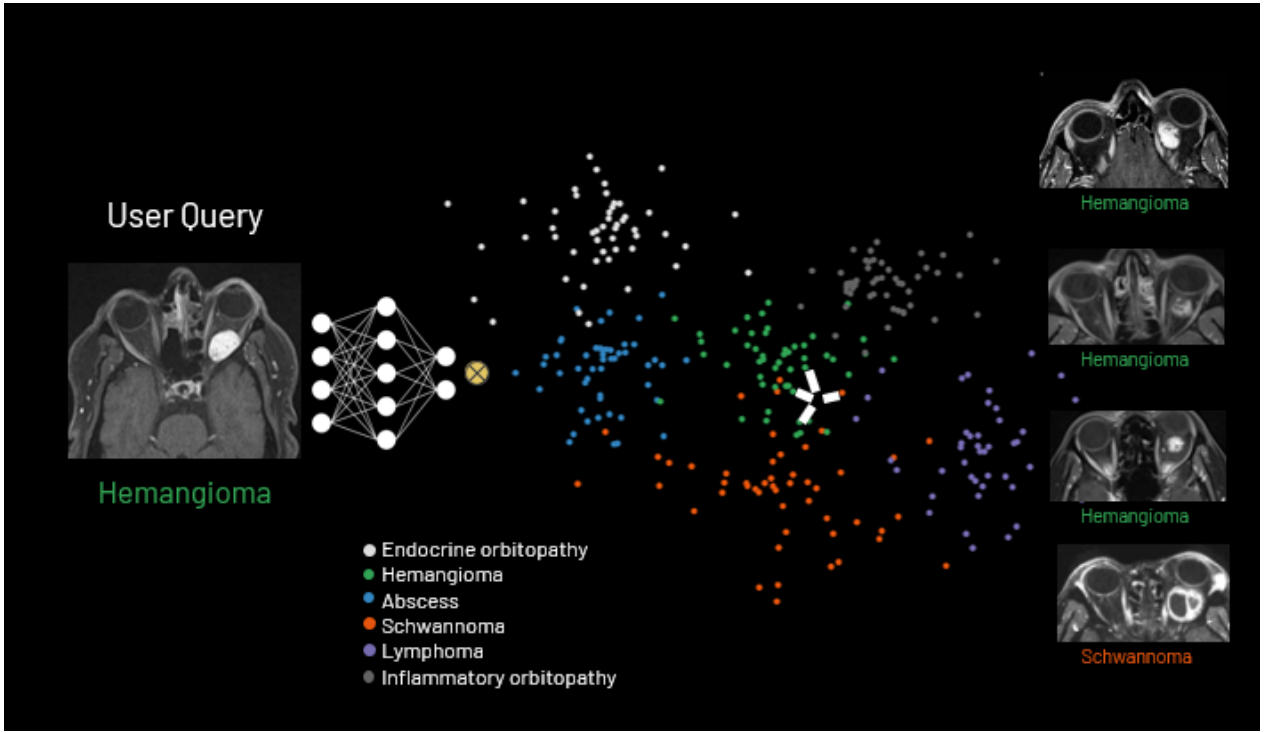
Radiomics signature + Human > Human
For Residents (p = 0.002)
For General Radiologists (p = 0.02)
+/- for Neuroradiologists (p = 0.06)

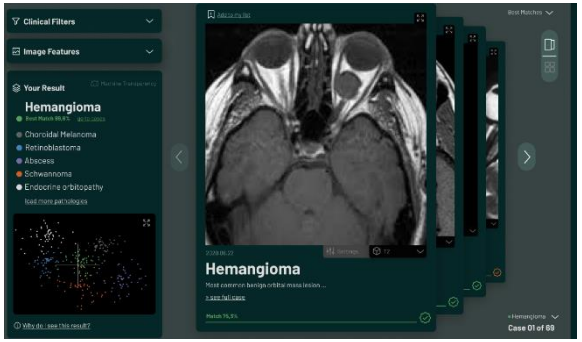
No increase in FP : no more biopsies.

Duron, Lecler et al Investigative Radiology 2021

La révolution de l'IA : le machine learning

RadioEye: Machine Learning for Image-Retrieval and Interpretation





katharina.erb@charite.de

Courtesy Erb-Eigner K, Department of Radiology, Charité-Universitätsmedizin Berlin, Germany

Conclusion

Cas typiques

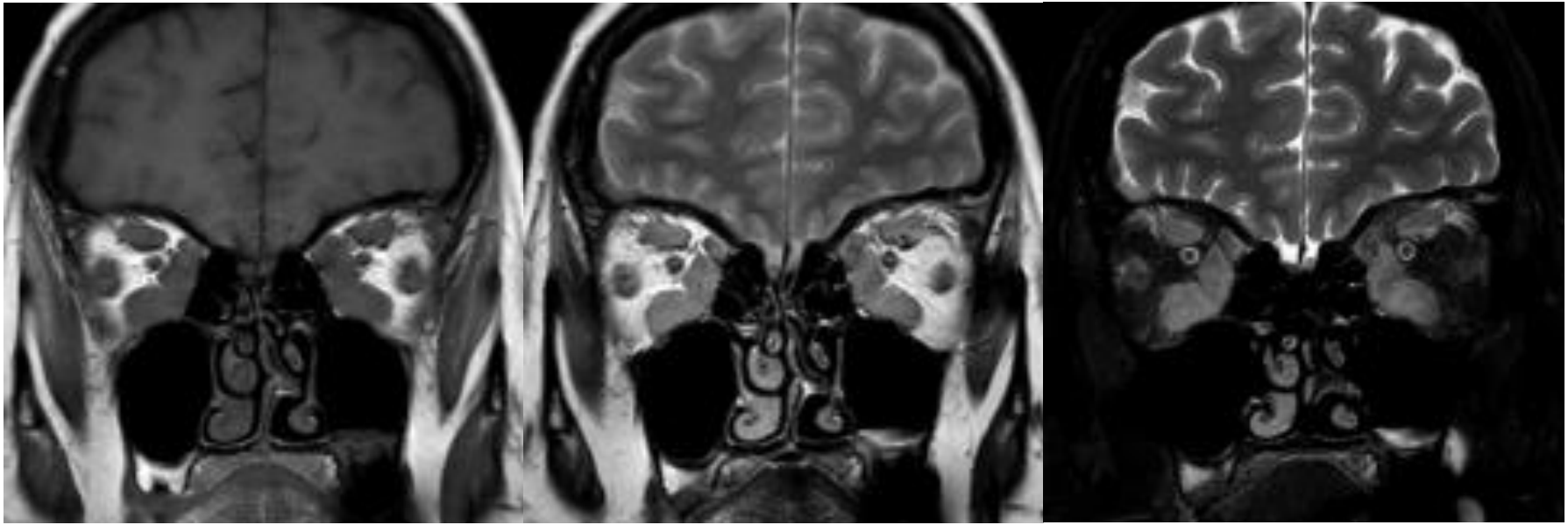
Souvent difficile : protocole de caractérisation multiparamétrique

La révolution de l'IA

alecler@for.paris

Case 1

47 yo woman, exophthalmos and chemosis

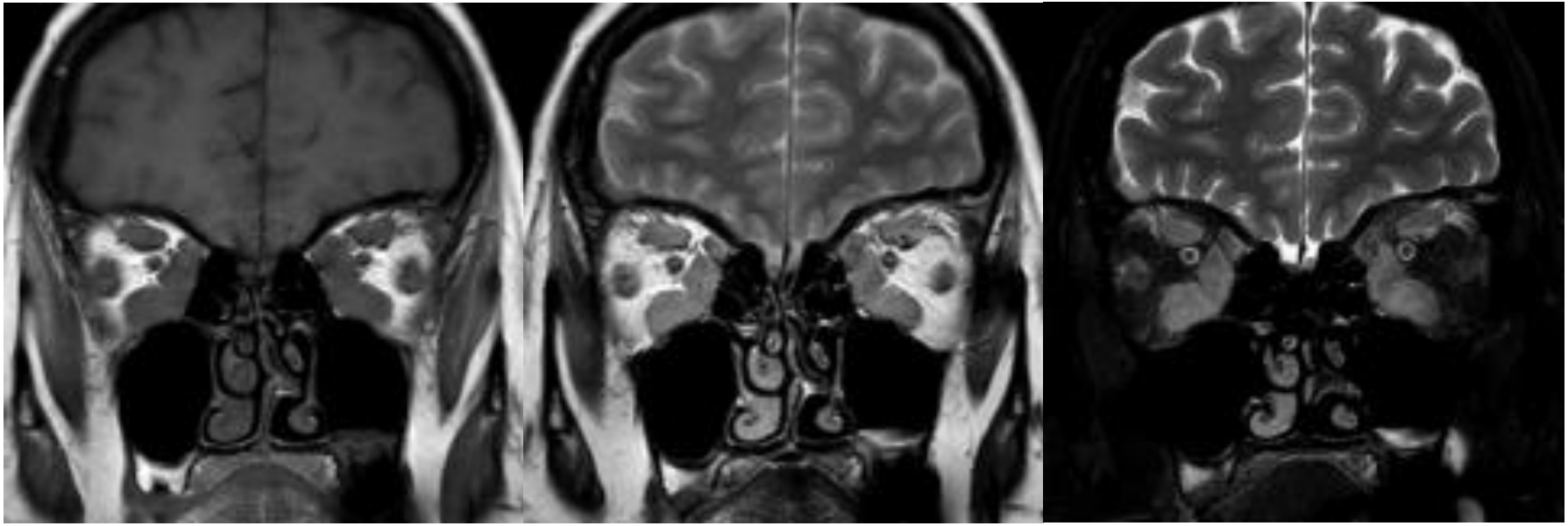


T1WI T2WI FS T2WI

Case 1

Diagnosis ?

47 yo woman, exophthalmos and chemosis



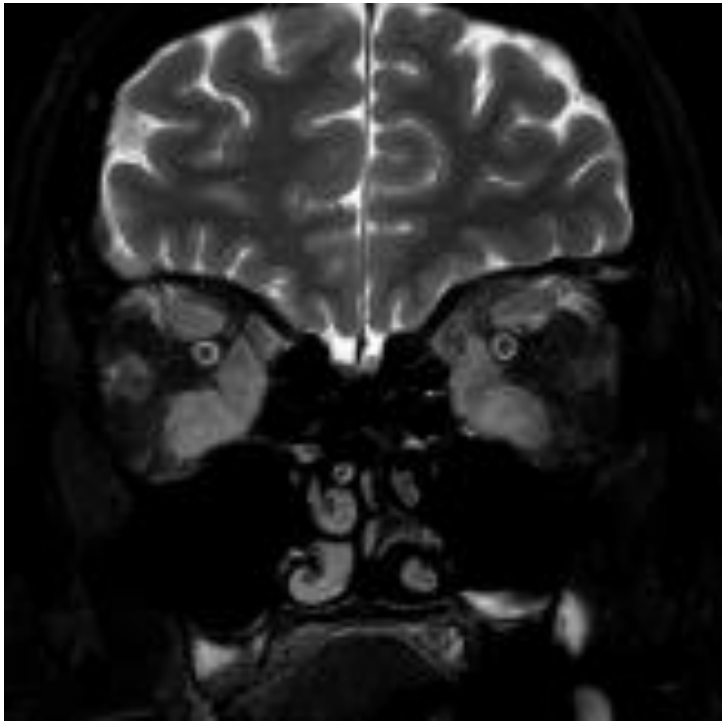
T1WI

T2WI

FS T2WI

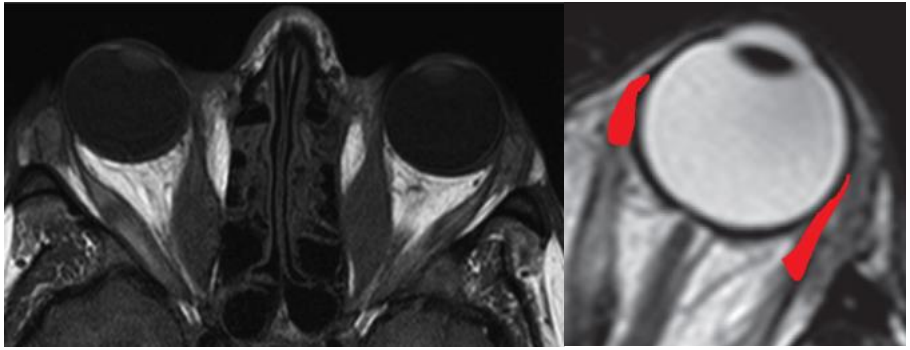
Thyroid eye disease

- Chronic, inflammatory disease targeting extraocular muscles (EOM) and orbital fat
- Affects mostly women from 40 to 60 years old
- Clinical signs: pain, redness, swelling
- Diagnosis: mainly clinical
- Complications: fibrosis, diplopia, keratitis, **optic neuropathy**
- MRI helpful for precise evaluation of inflammation and detecting complications

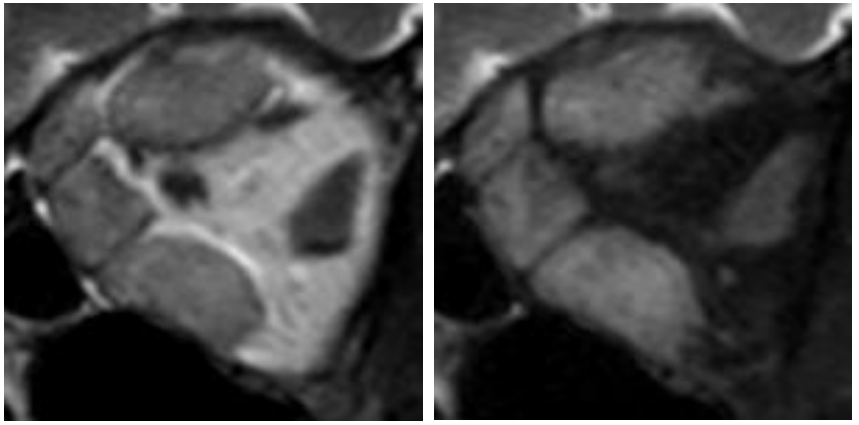


I’m slow

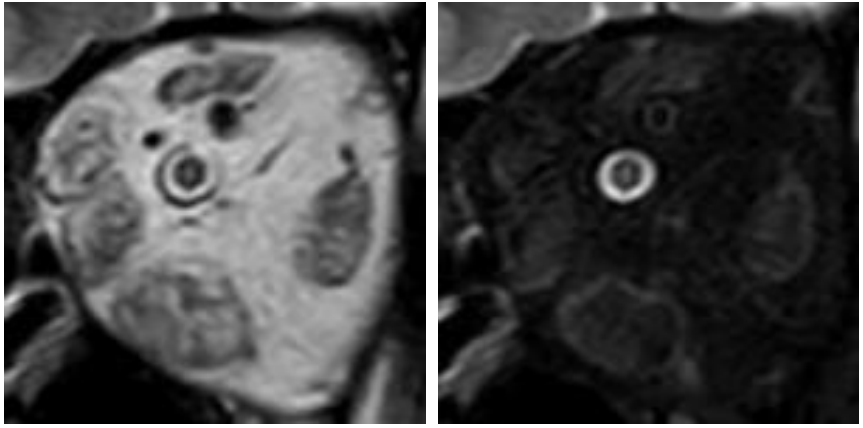
Thyroid eye disease



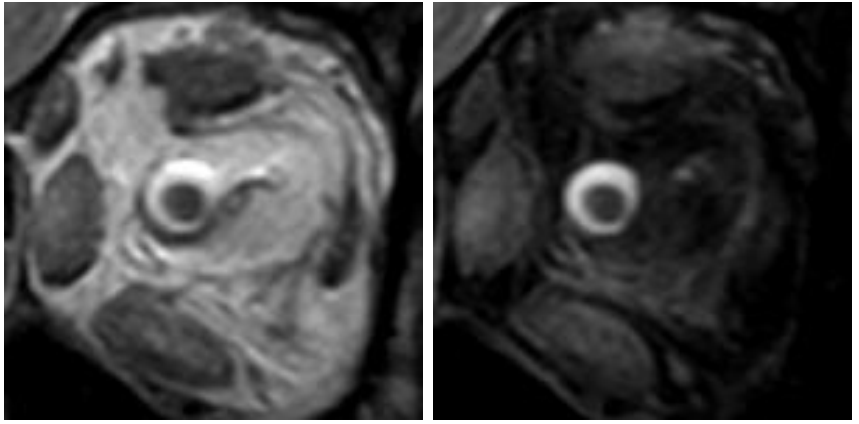
Tendon not affected



Inflammatory EOM



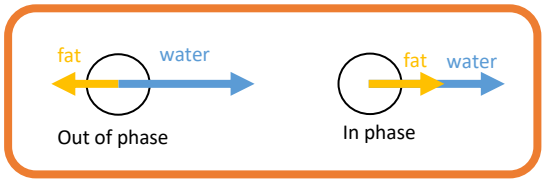
Fatty degeneration



Orbital fat inflammation

DIXON technique

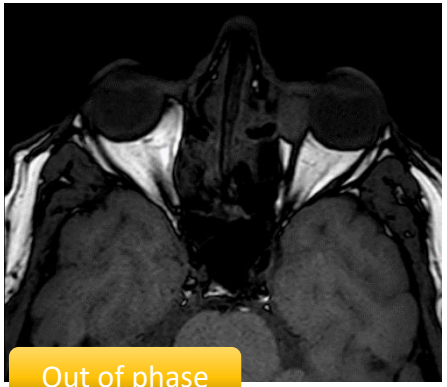
based on chemical-shift

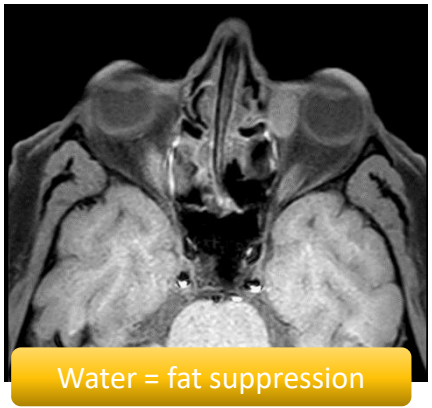


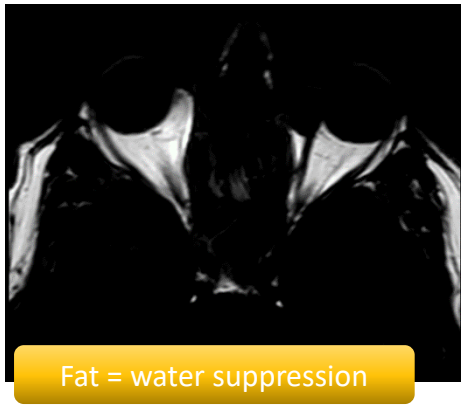
Less artifacts

Uniform fat suppression

Ideal for the orbit







Dixon, Radiology 1984

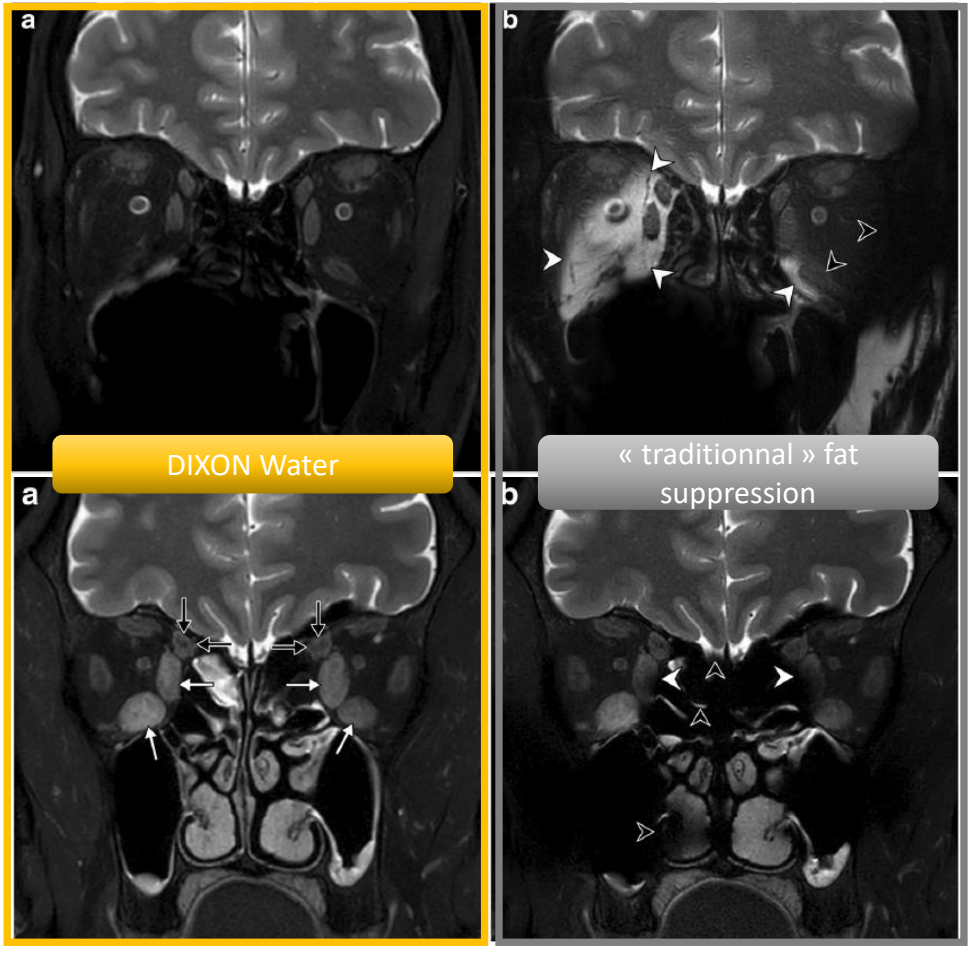
DIXON technique

DIXON

Thyroid-eye disease

Faster protocol

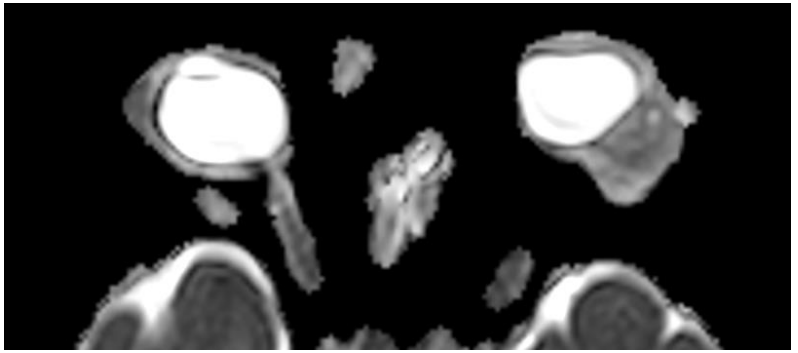
Better evaluation of inflammation

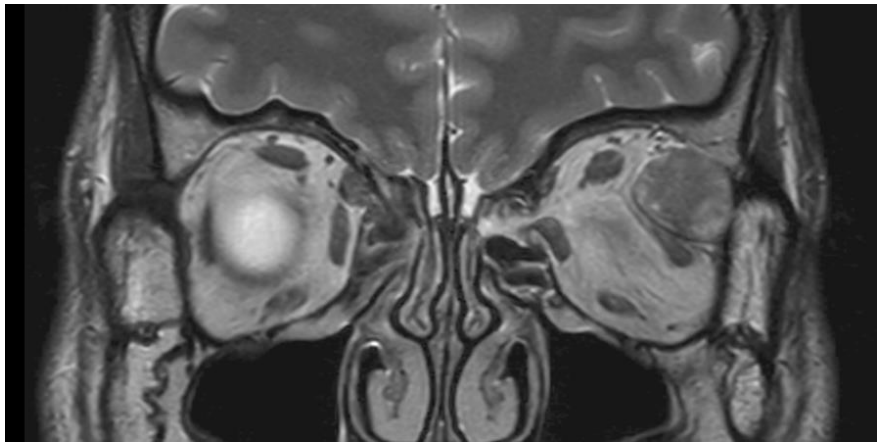


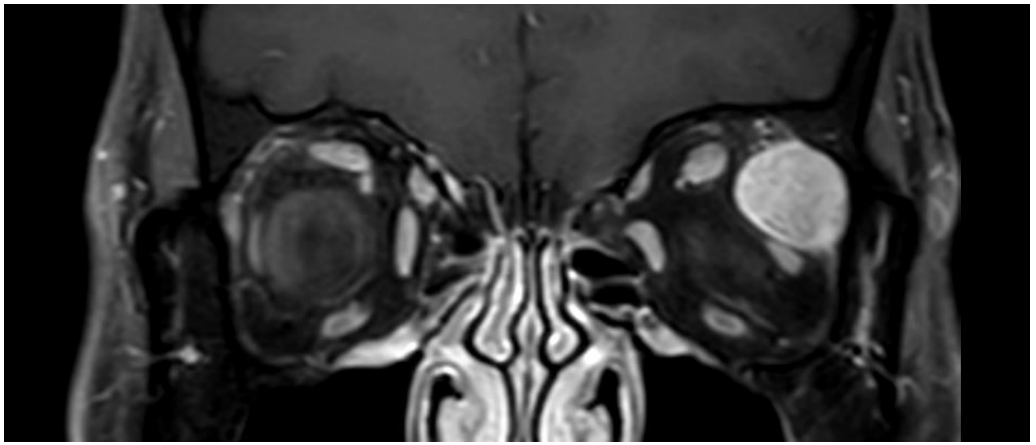
Ollitraut, Lecler et al European Radiology 2021

Case 5

74 yo man, lump of the left eye

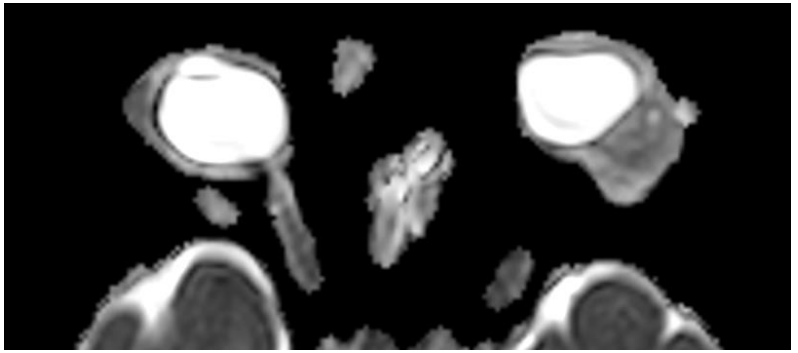


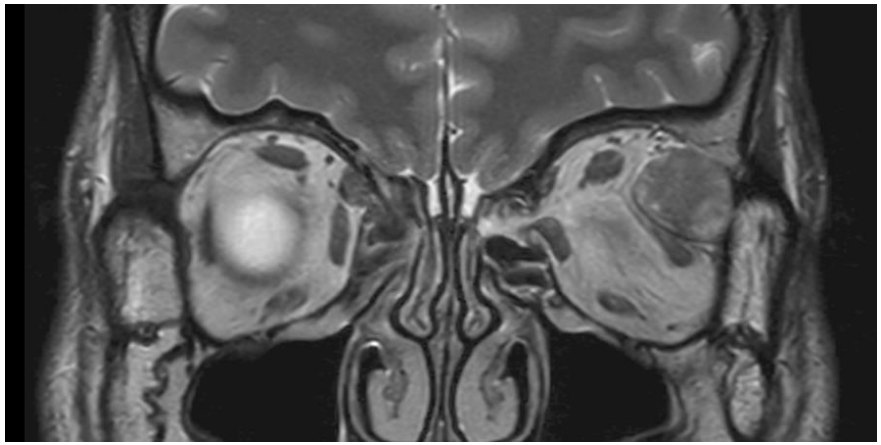


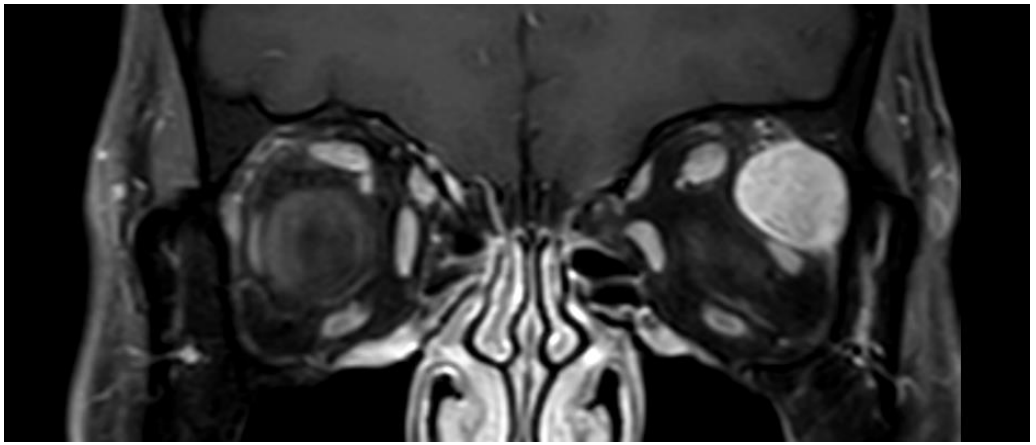


Case 5

74 yo man, lump of the left eye







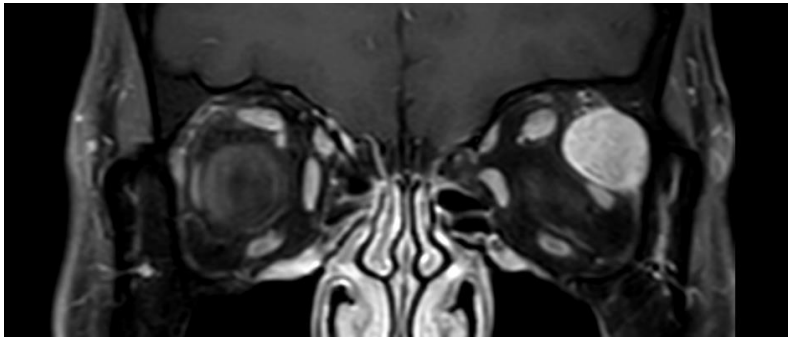
Diagnosis ?

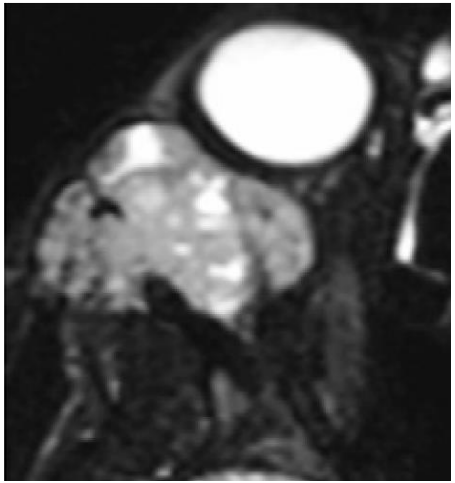
Lacrymal gland carcinoma

Aggressive tumor

Bone destruction

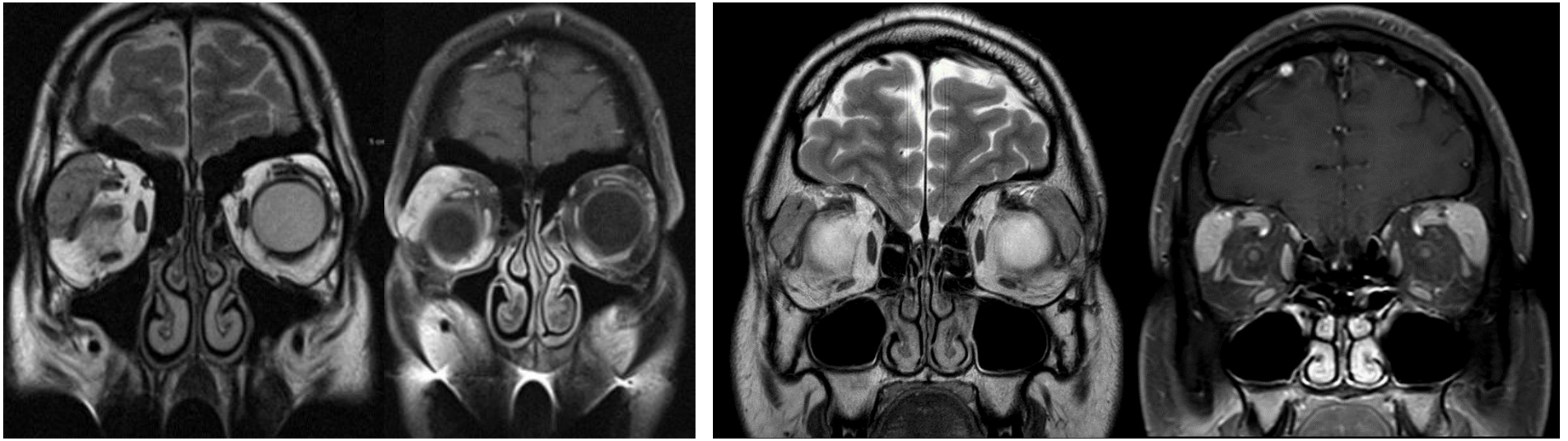
A block resection of the tumor must be performed to prevent recurrence or malignant transformation.





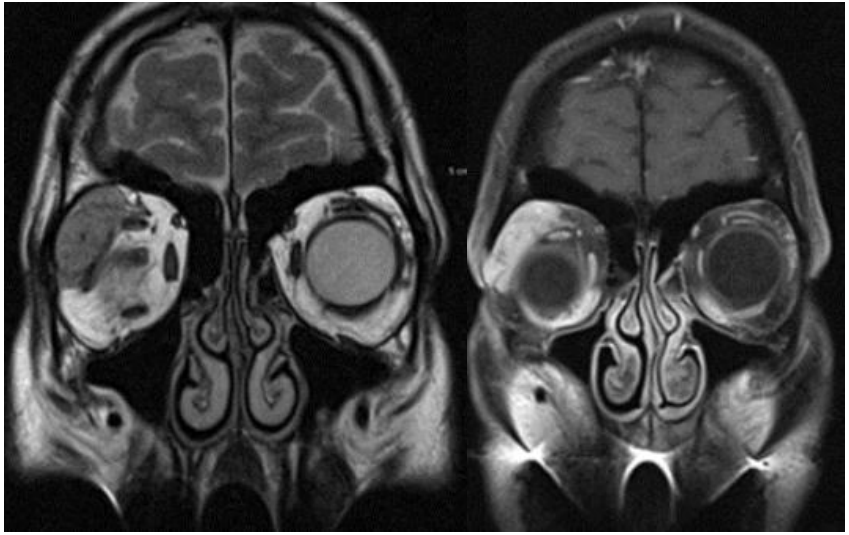
Case 6

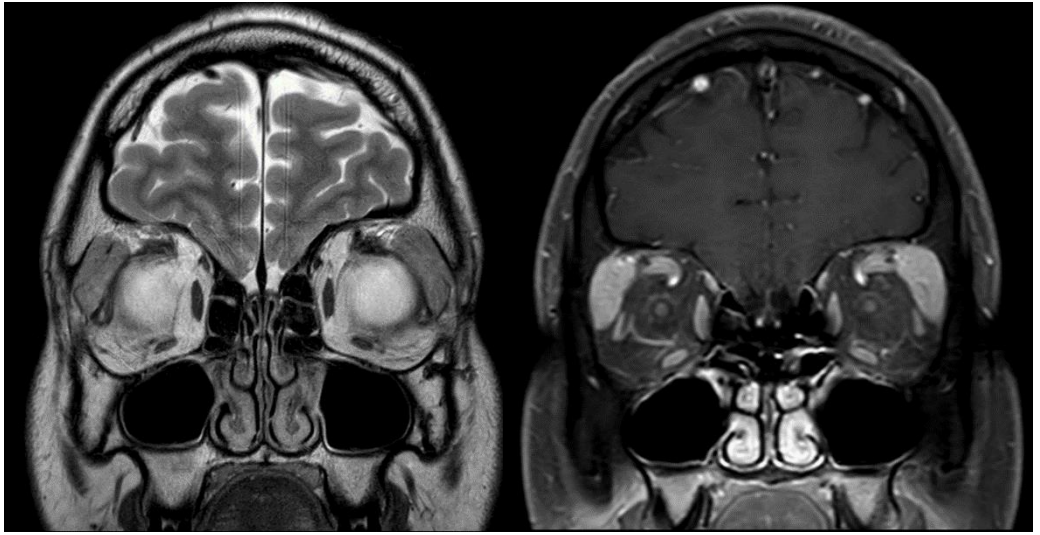
77 yo man, dry eye syndrome / His 44 yo daughter with DES too



Case 6

77 yo man, dry eye syndrome / His 44 yo daughter with DES too

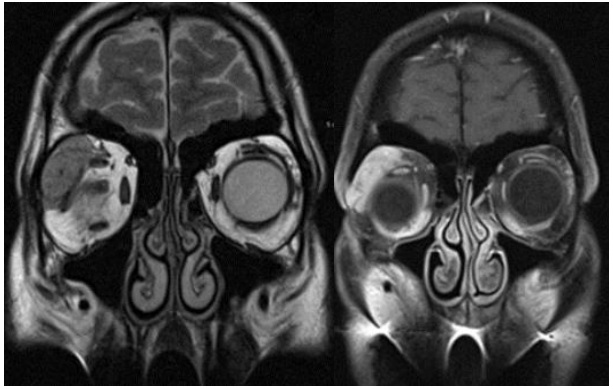


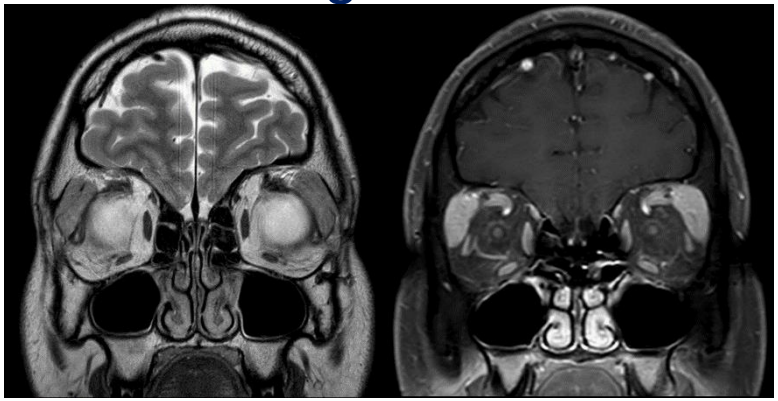


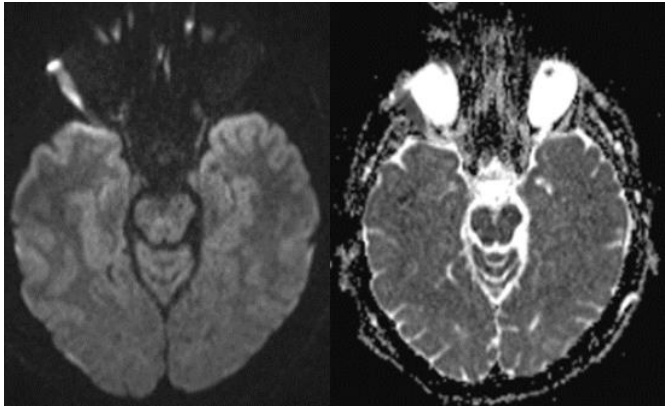
What is missing ? (again !)

Case 6

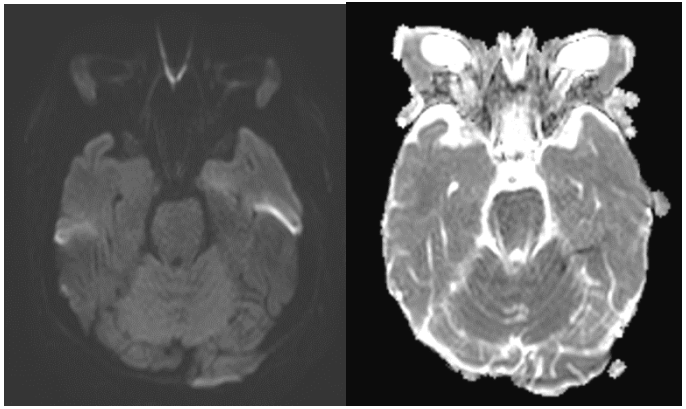
77 yo man, dry eye syndrome / His daughter







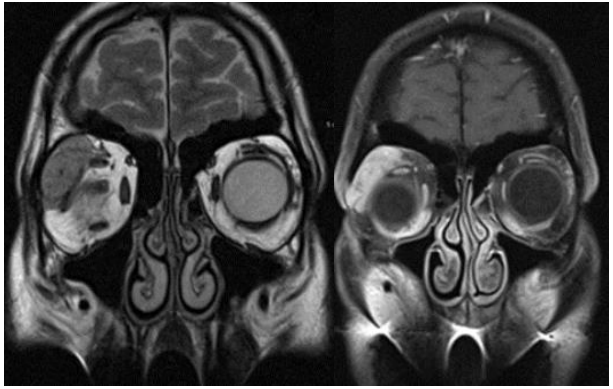
DWI

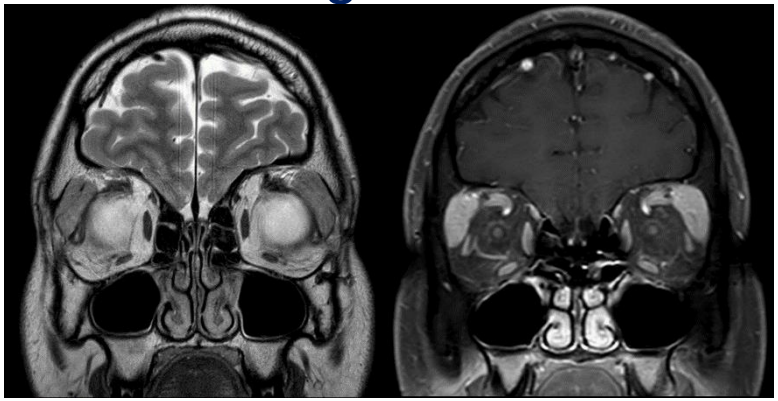


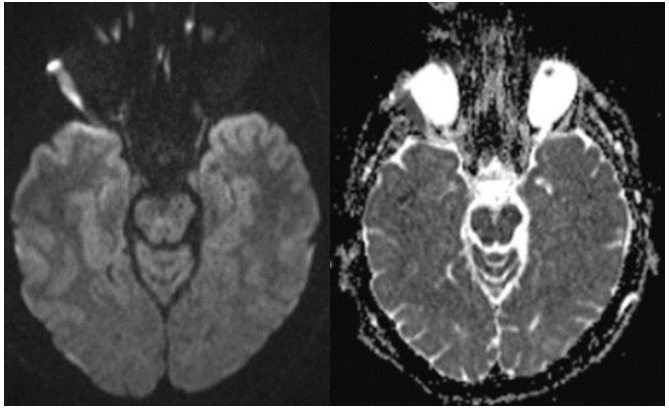
Case 6

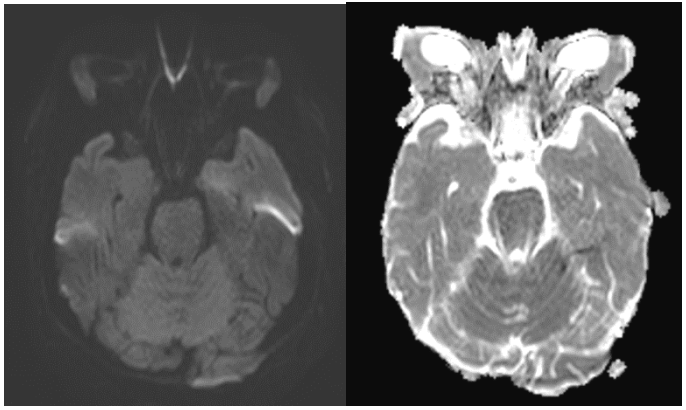
Diagnosis ?

77 yo man, dry eye syndrome / His daughter



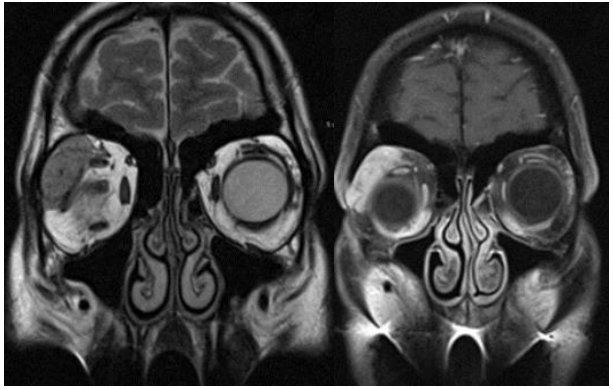


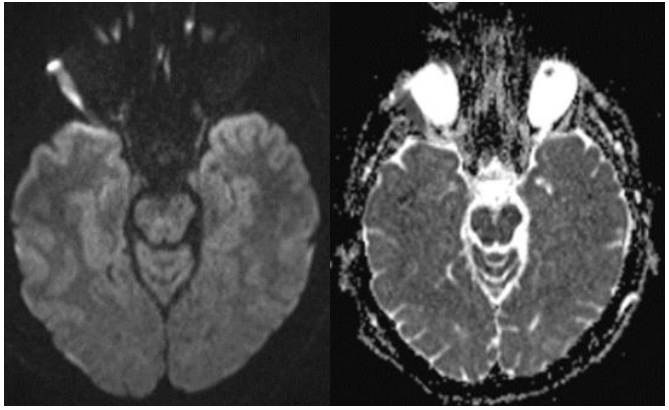




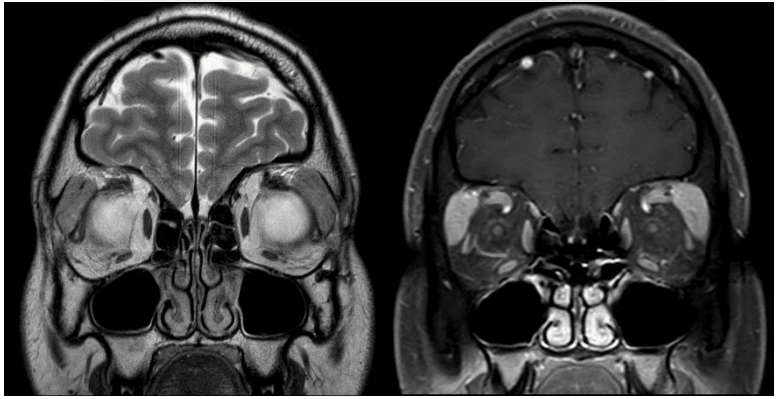
Case 6

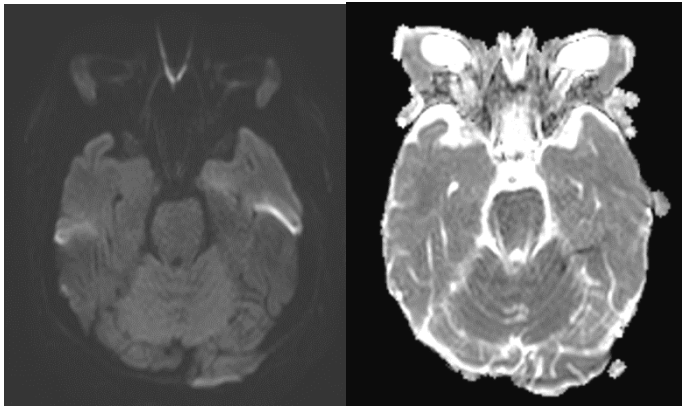
Lacrymal gland lymphoma





Dacryoadenitis





Case 8

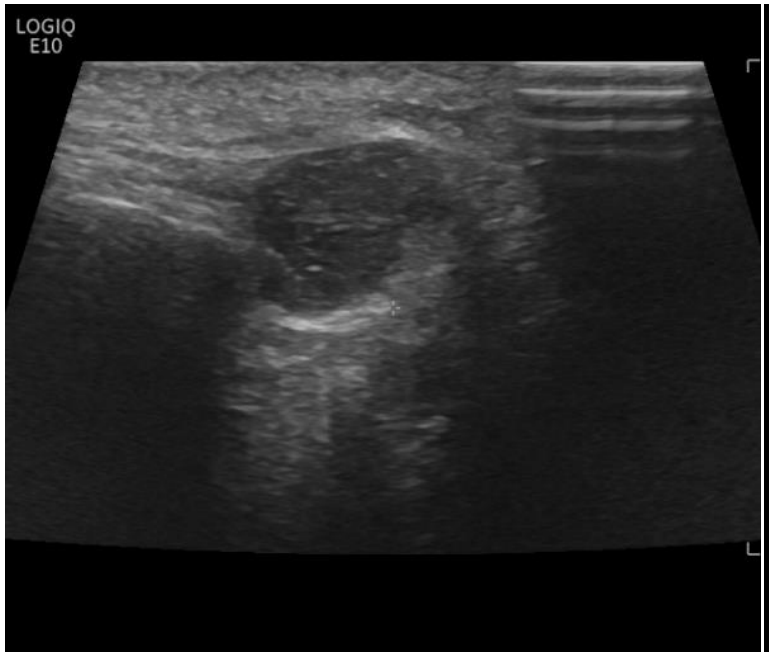
25 yo woman, positional exophthalmos

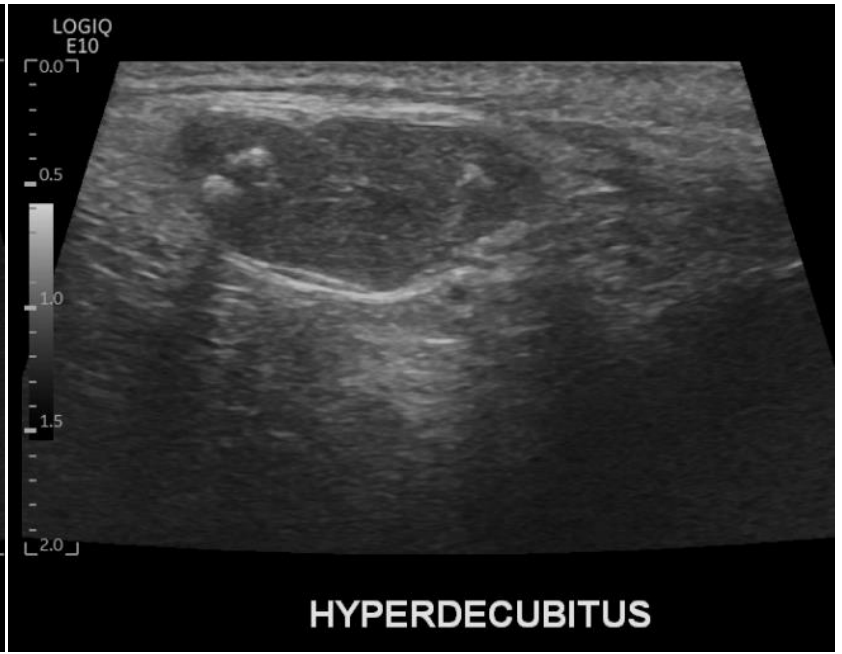
What imaging examination should be performed first? And How ?

Case 8

25 yo woman, positional exophthalmos

Ultrasound with hyperdecubitus manoeuver

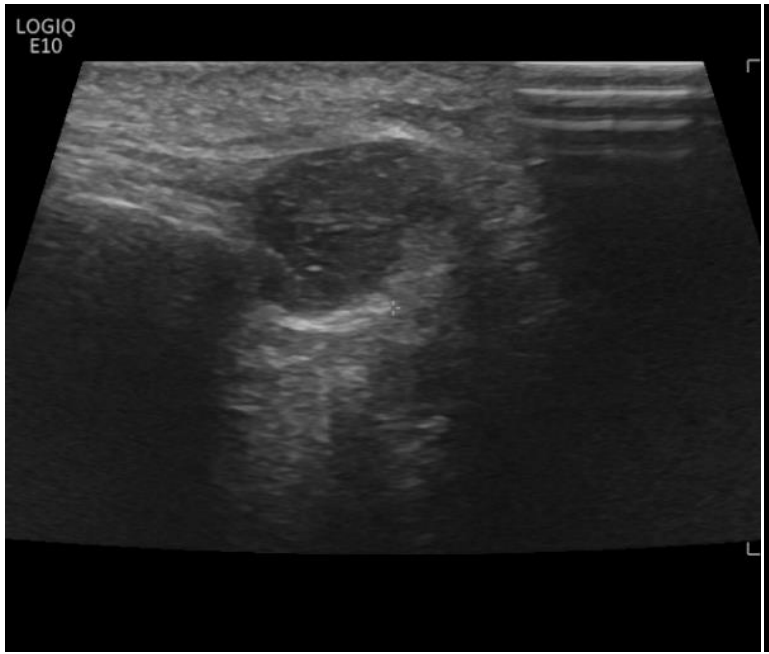


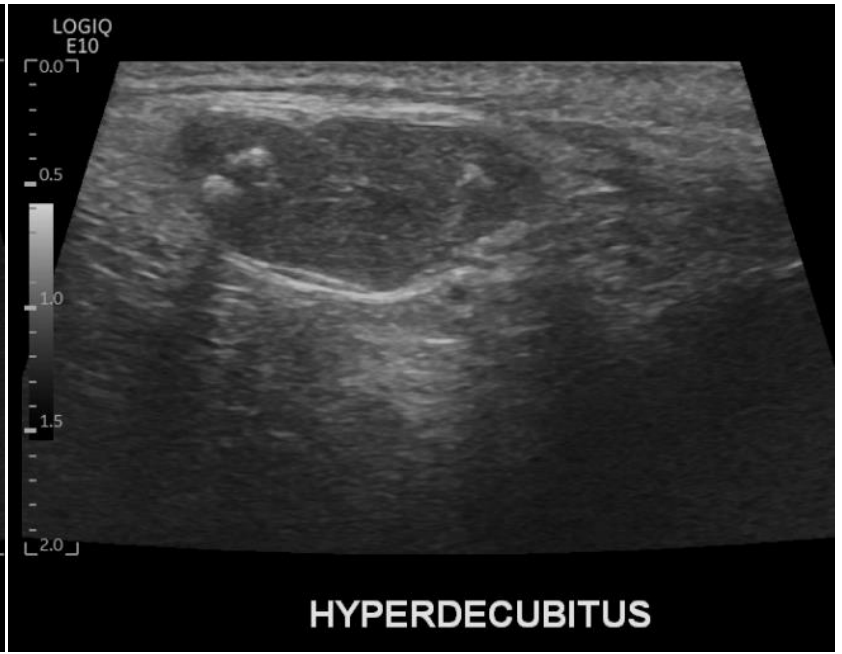


Case 8

25 yo woman, positional exophthalmos

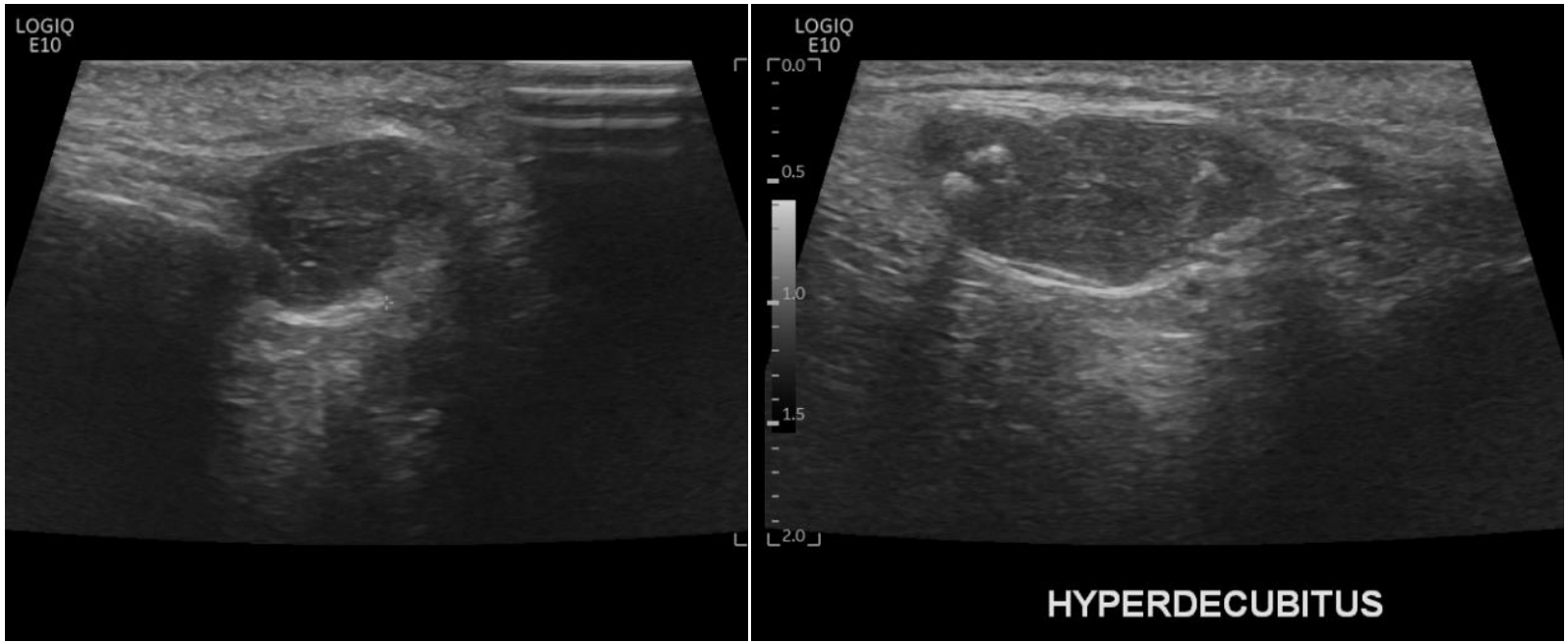
Diagnosis ?





Orbital varix

Increase in size during dynamic maneuvers:
hyperdecubitus, procubitus, Valsalva.



Orbital varix

Increase in size during dynamic maneuvers:
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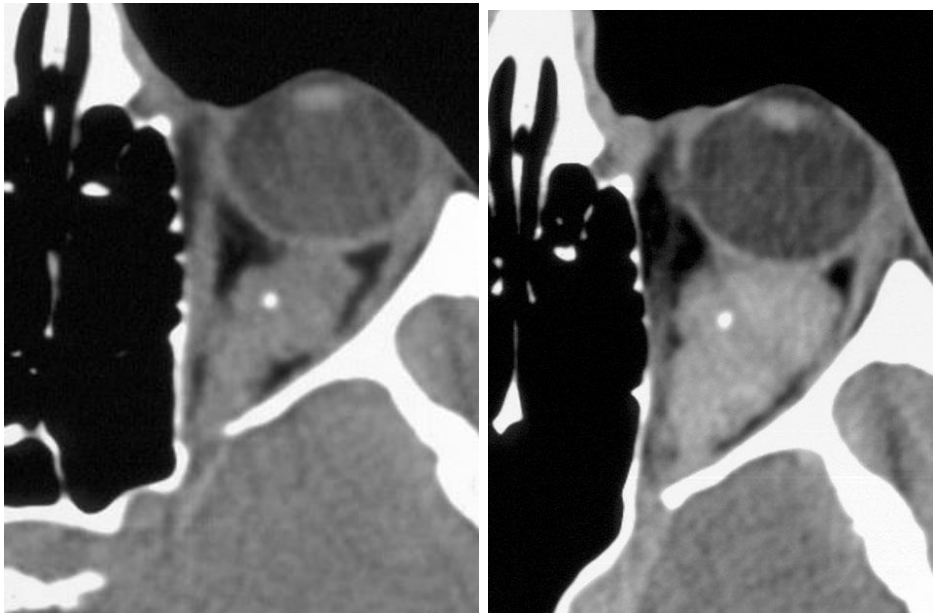

Orbital varix

Increase in size during dynamic maneuvers:
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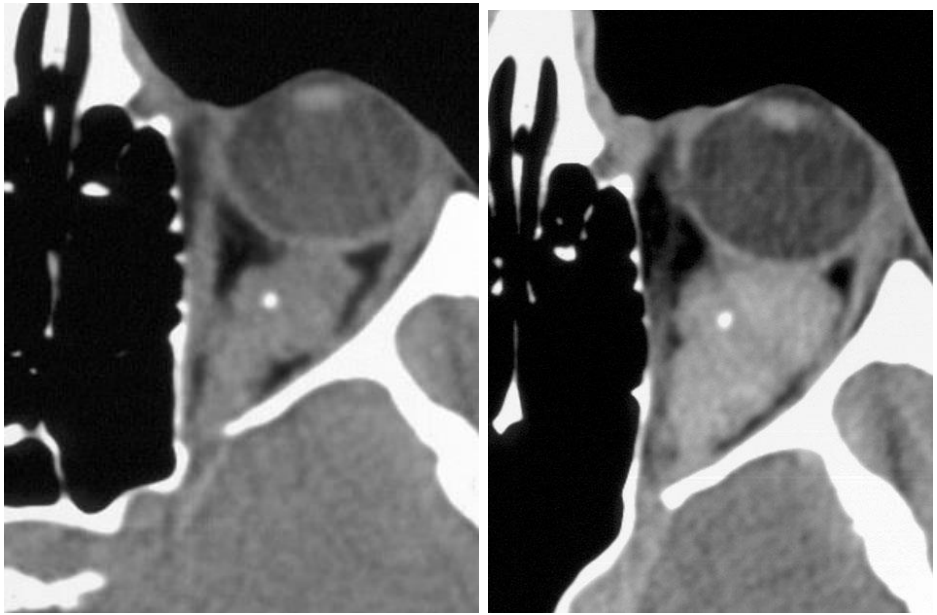
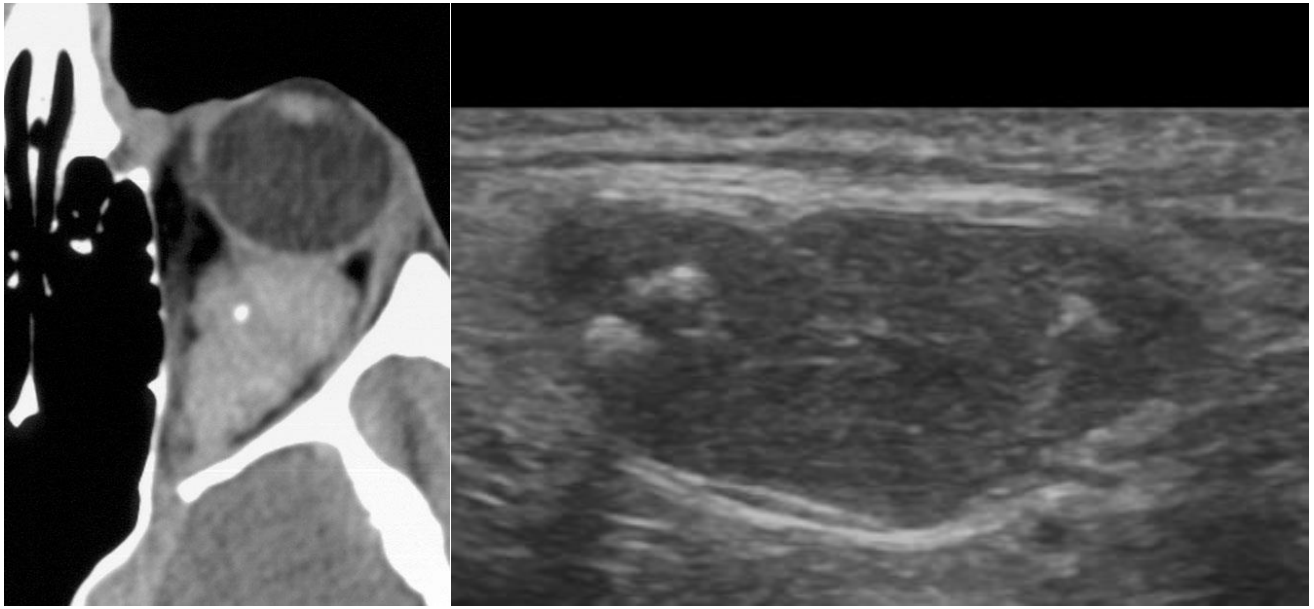


Do we really need the CT scan to show the phlebolithes ?

Orbital varix

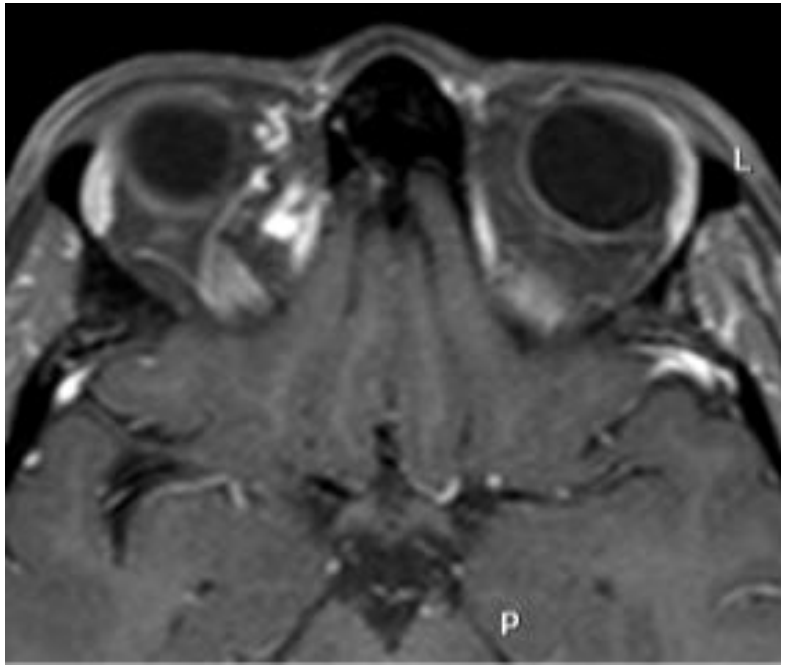
Increase in size during dynamic maneuvers:
hyperdecubitus, procubitus, Valsalva.

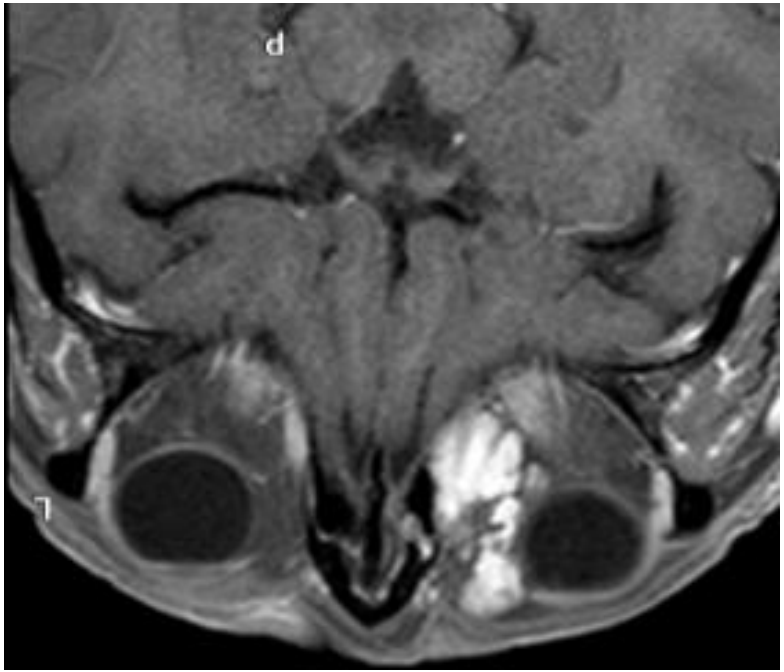


No !
Avoid CT
when imaging
orbital lesions

Orbital varix

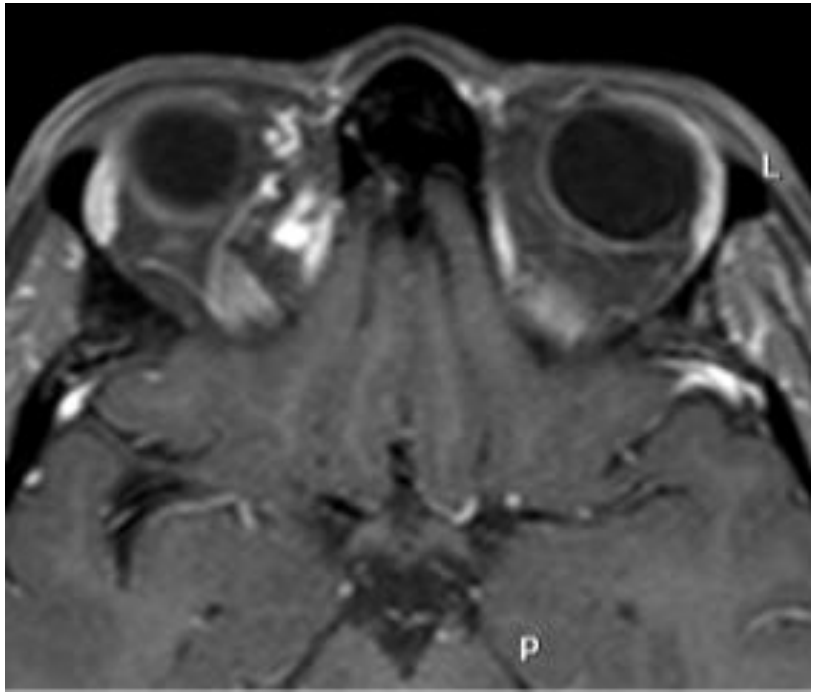
MRI
procubitus

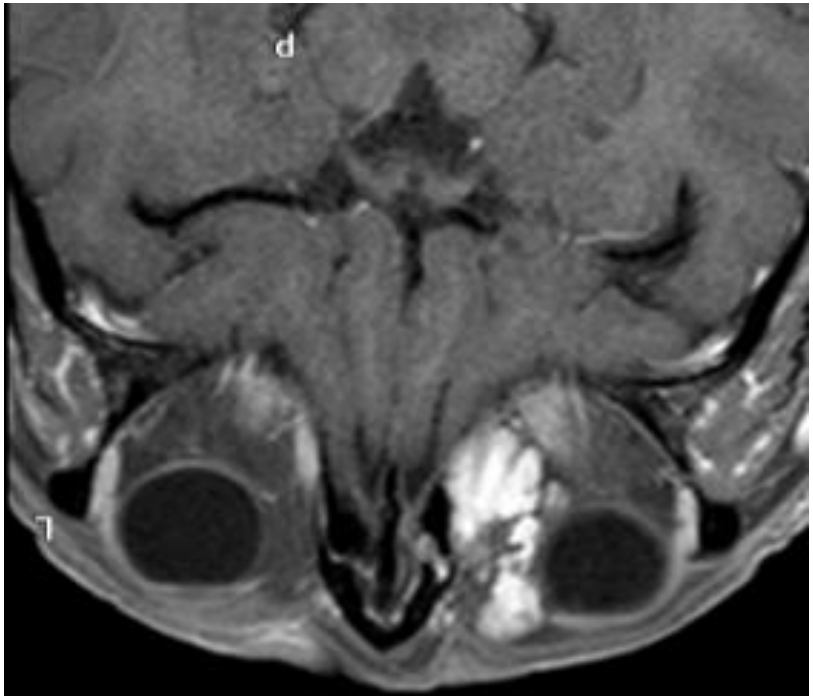




Orbital varix

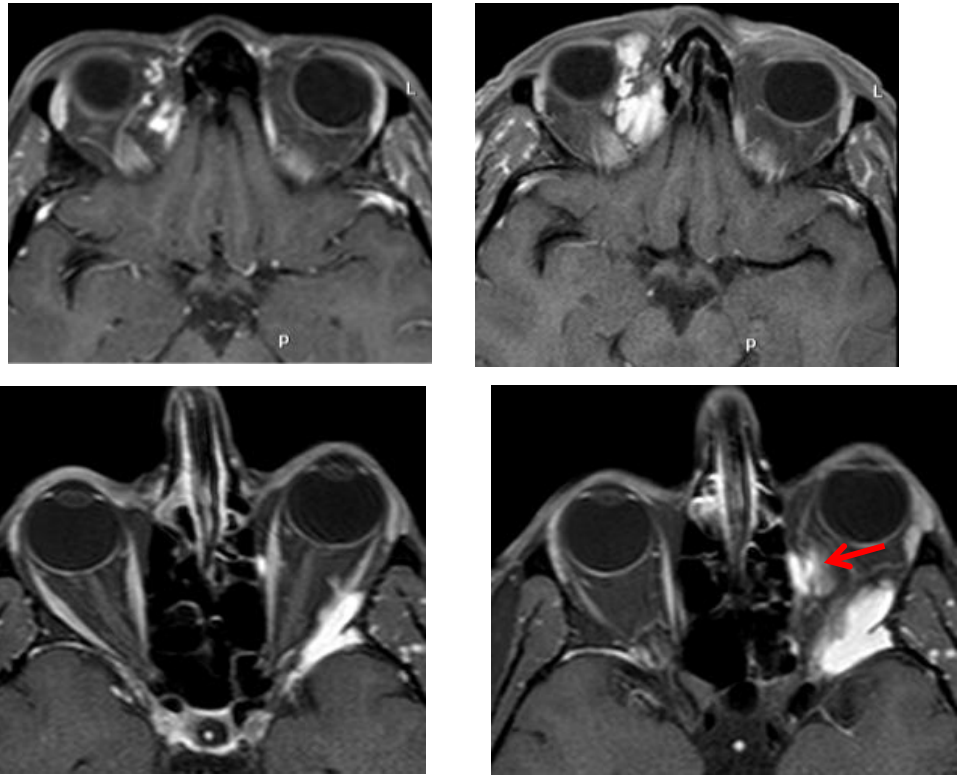
MRI
procubitus



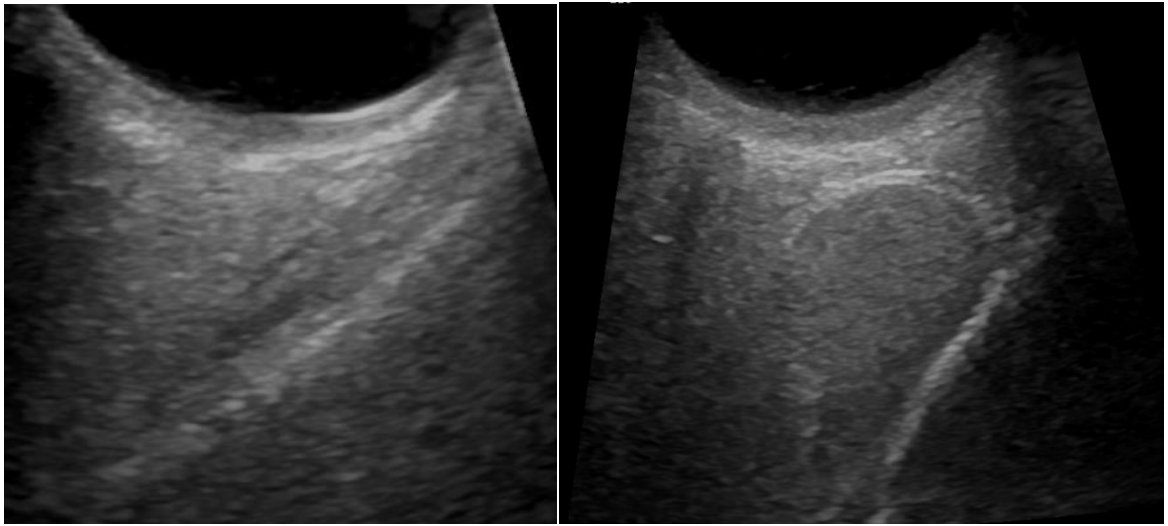


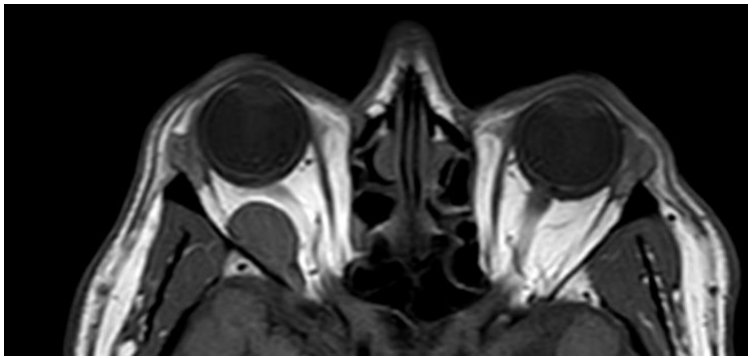
Orbital varix

MRI procubitus

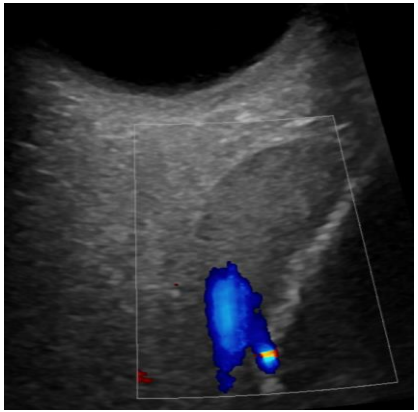


Orbital varix





Sometimes completely invisible without dynamic maneuvers.



Case 9

1 month old boy, reddish mass of the eyelid.

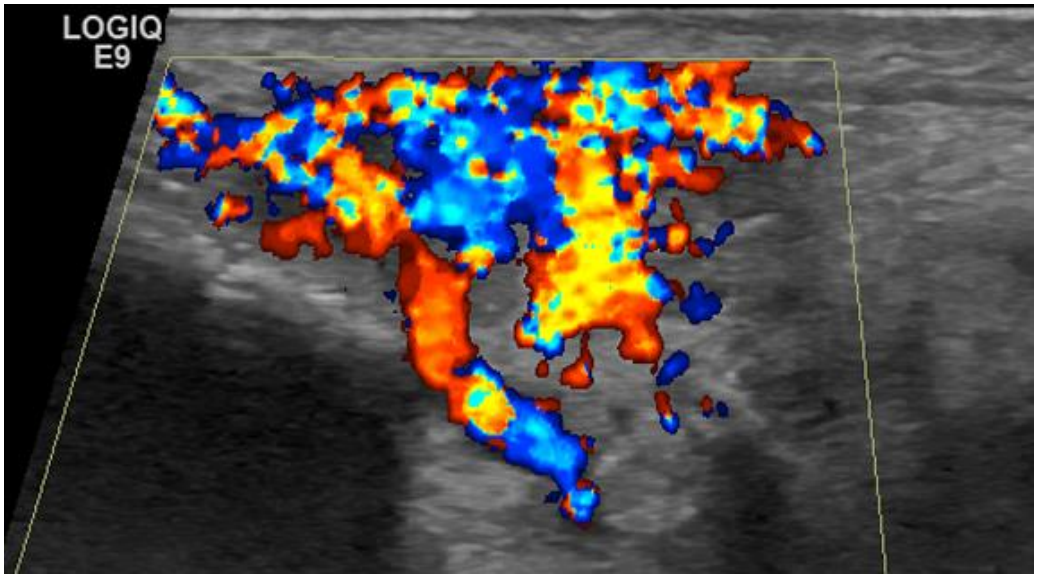
What imaging examination should be performed?

Case 9

1 month old boy, reddish mass of the eyelid.

Ultrasound first !

Especially in children



Case 9

1 month old boy, reddish mass of the eyelid.

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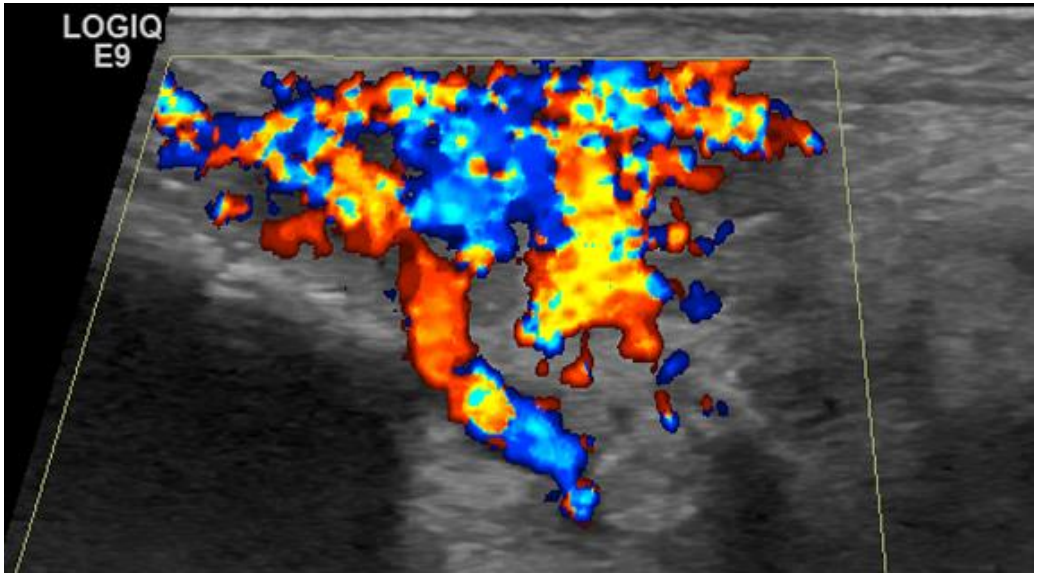
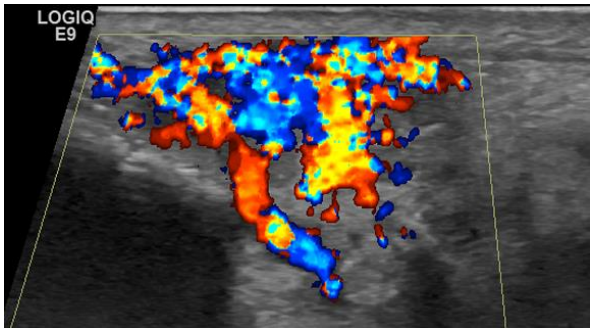


Diagnosis ?

Infantile hemangioma

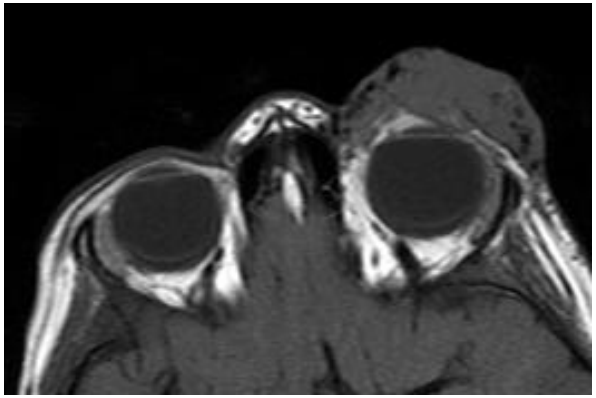
Most common benign tumors in children (10% of children <1 year old), Girls > boys
Intense proliferation
Stabilization
Regression

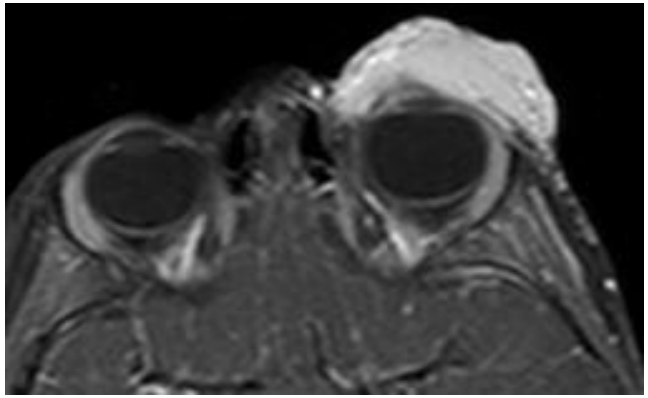


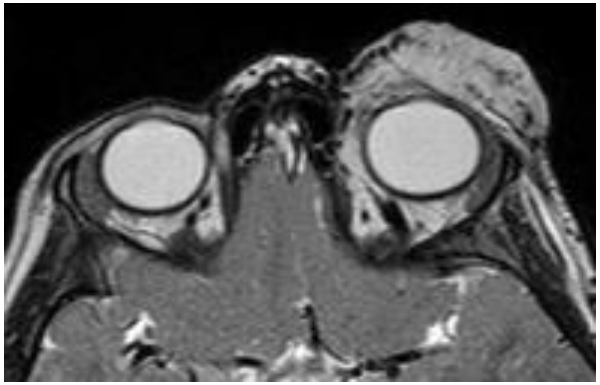
Single or multiple lesions, located in the face, ENT (airway obstruction...).
Systemic associations (Sturge-Weber...).
Extensive forms leading to functional impairments (strabismus...) or aesthetic concerns (ptosis...).

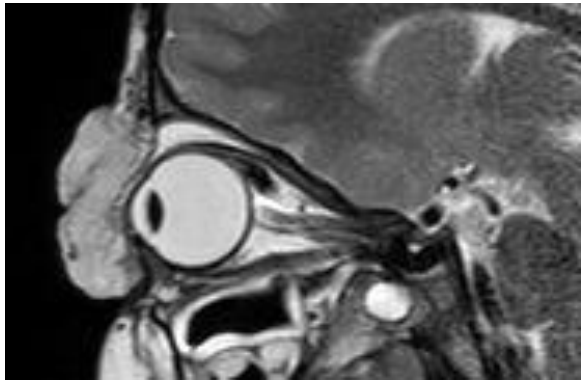
Beta-blockers very efficient
Surgical interventions or radiotherapy may also be considered.

Infantile hemangioma









High T2-WI signal = vascular lesion

Case 10

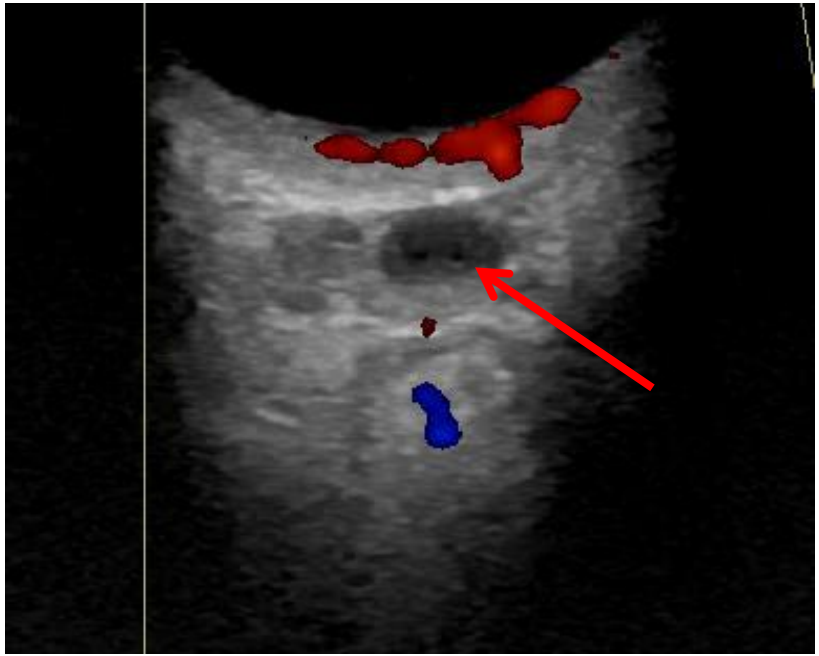
7 yo boy, sudden exophthalmos

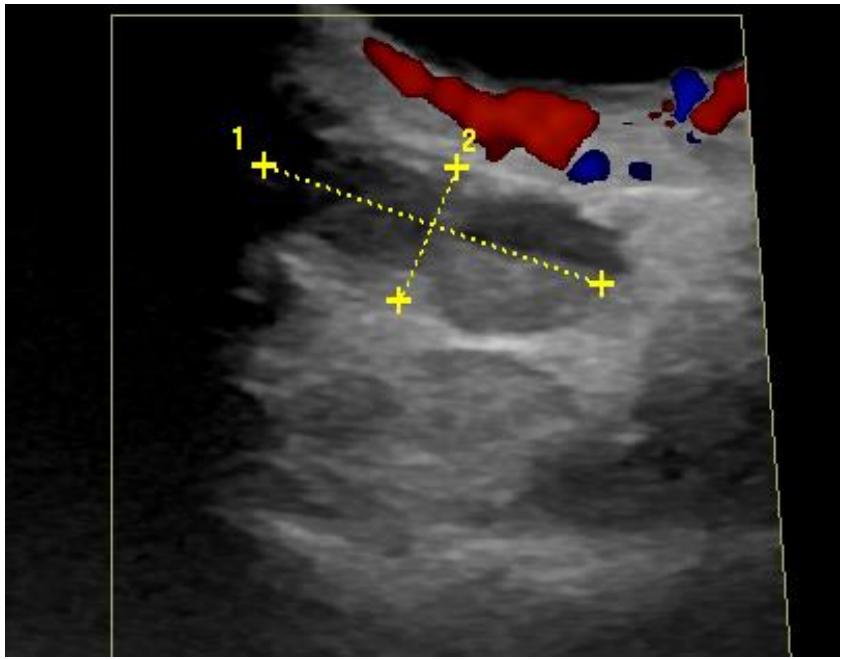
What imaging examination should be performed?

Case 10

7 yo boy, sudden exophthalmos

Ultrasound, as usual !

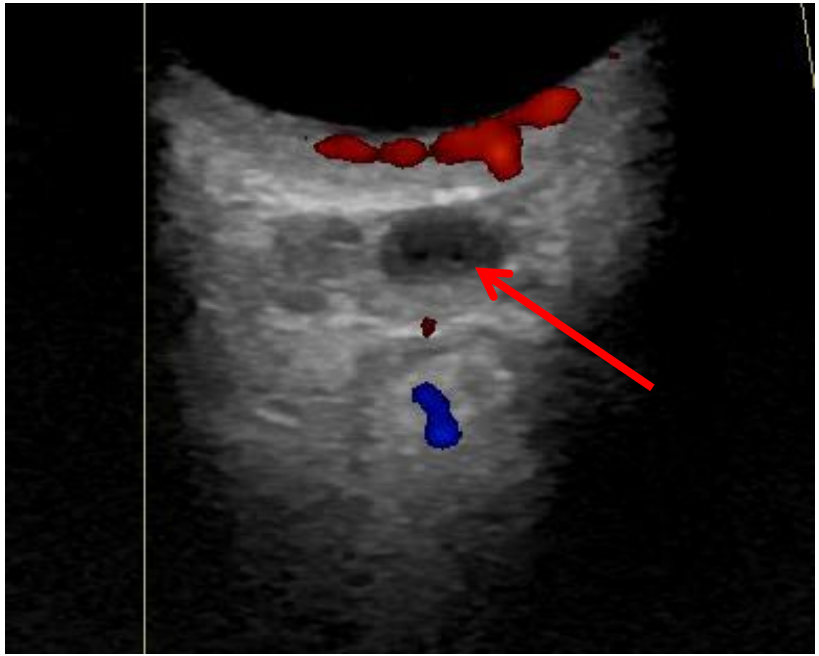




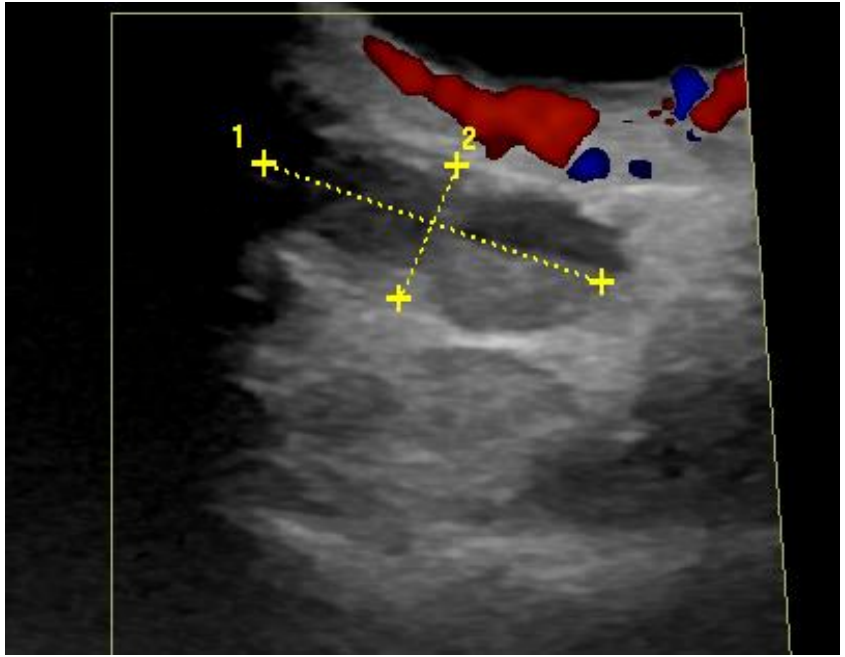
Case 10

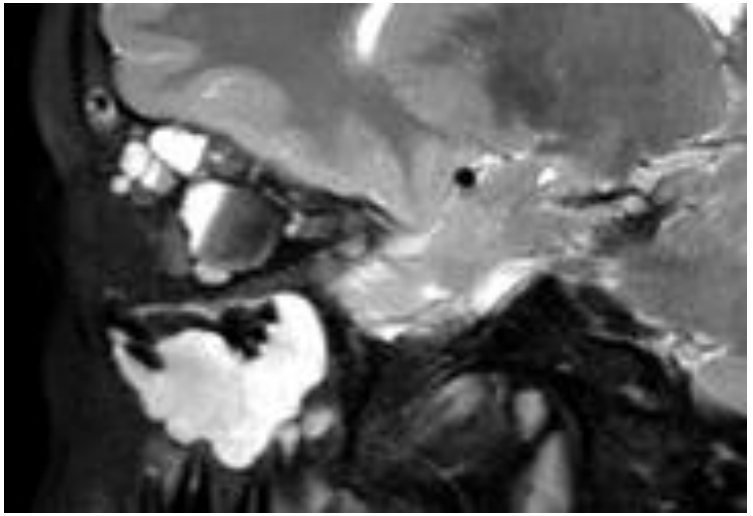
7 yo boy, sudden exophthalmos

Ultrasound, as usual !

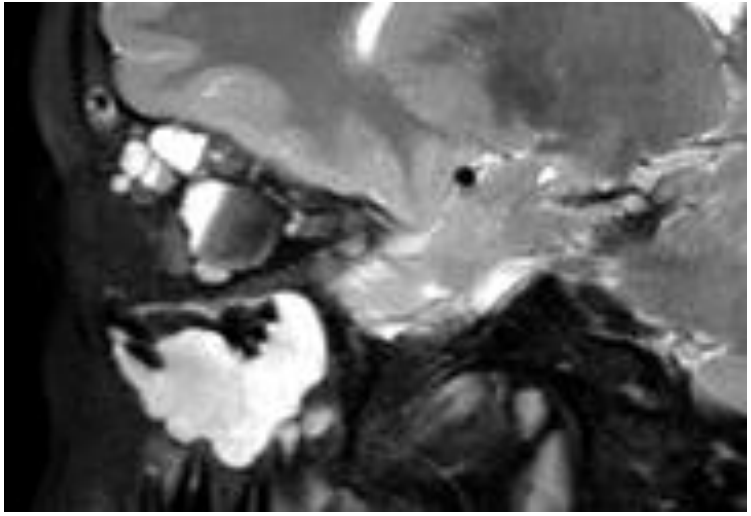


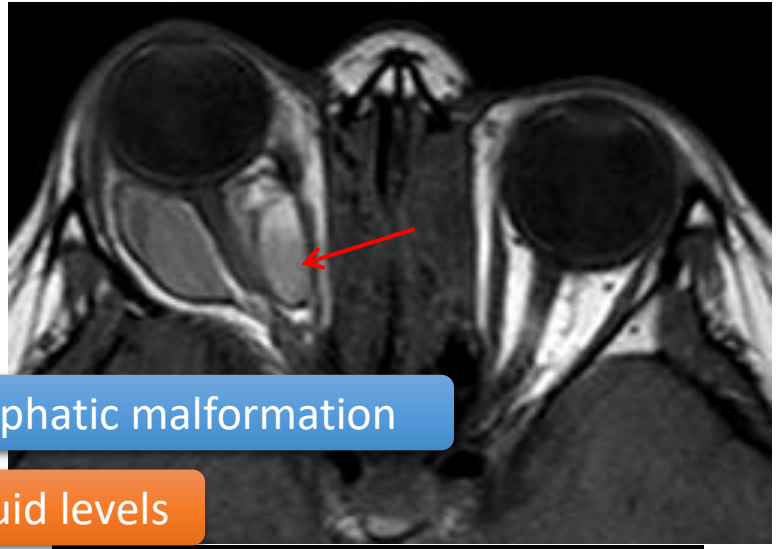
But disappointing here





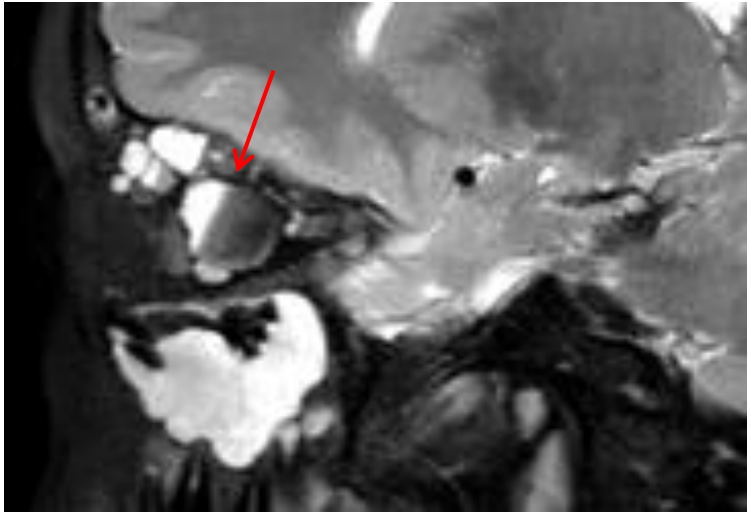
Diagnosis ?





Venolymphatic malformation

Liquid liquid levels

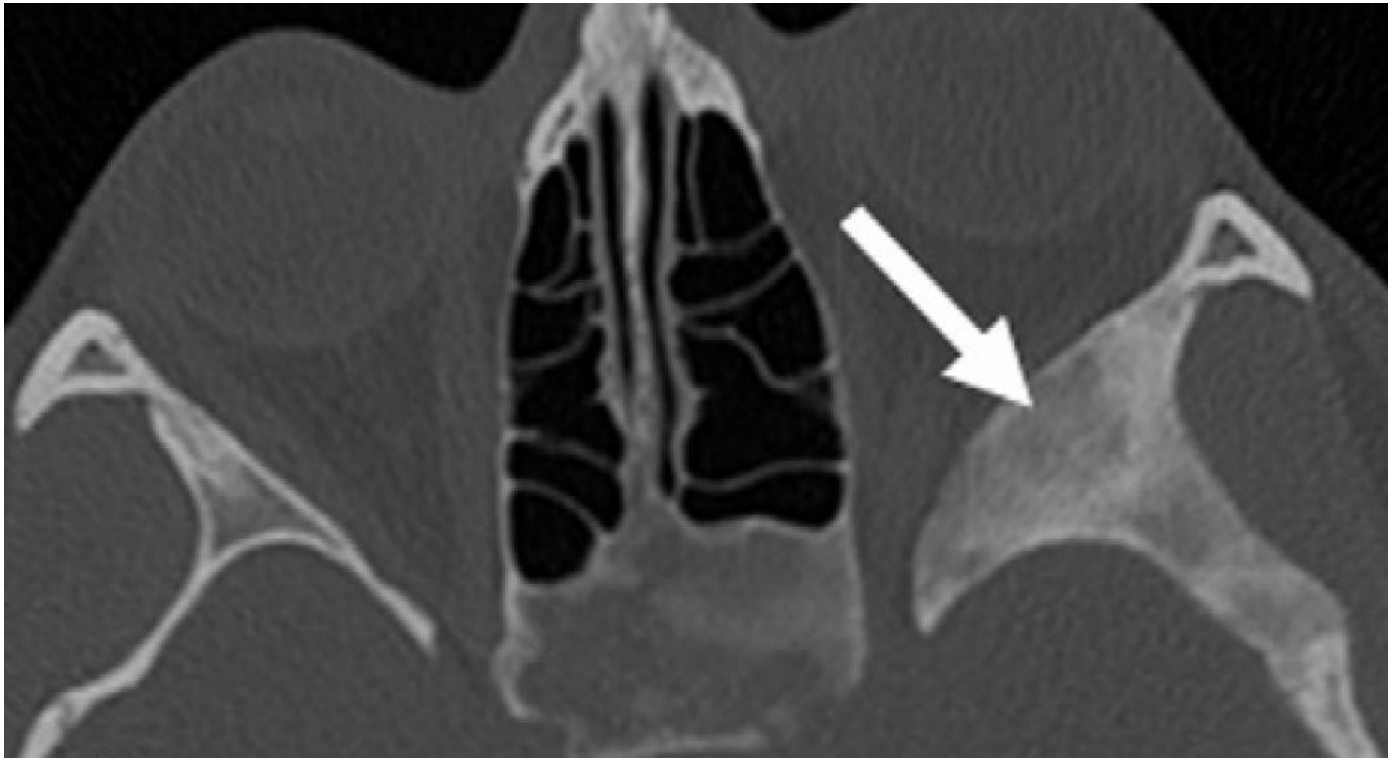


Venolymphatic malformation

Ramifications of abnormal lymphatics
1% of orbital tumors, 12% of tumors
Present from birth
Severe vascular hemorrhagic episodes
Diagnosis before 10 years of age
Complications around 13 years of age
Cerebral vascular abnormalities (arteriovenous malformations, arterial venous fistulas, cavernous malformations)

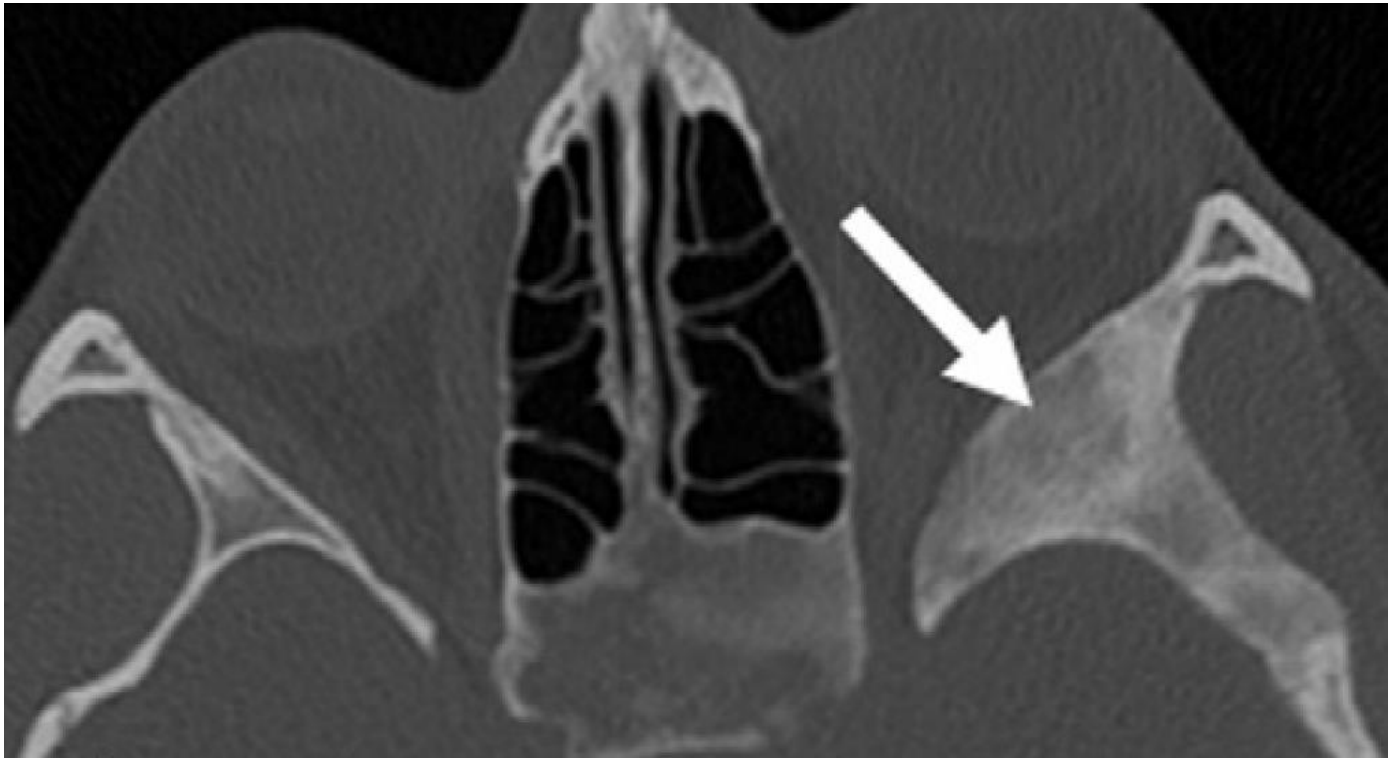
Plurimorphism (superficial or deep)
Sudden exophthalmos: reactive lymphoid hyperplasia (ENT episode), hemorrhage
Emergency surgical management is required.

Case 12



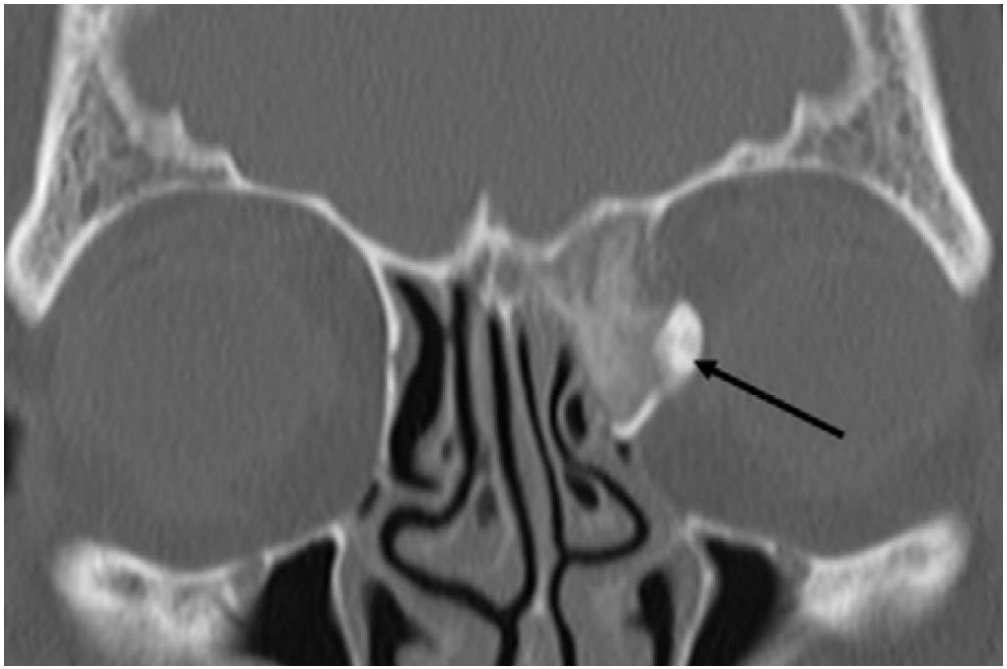
Diagnosis ?

Case 12



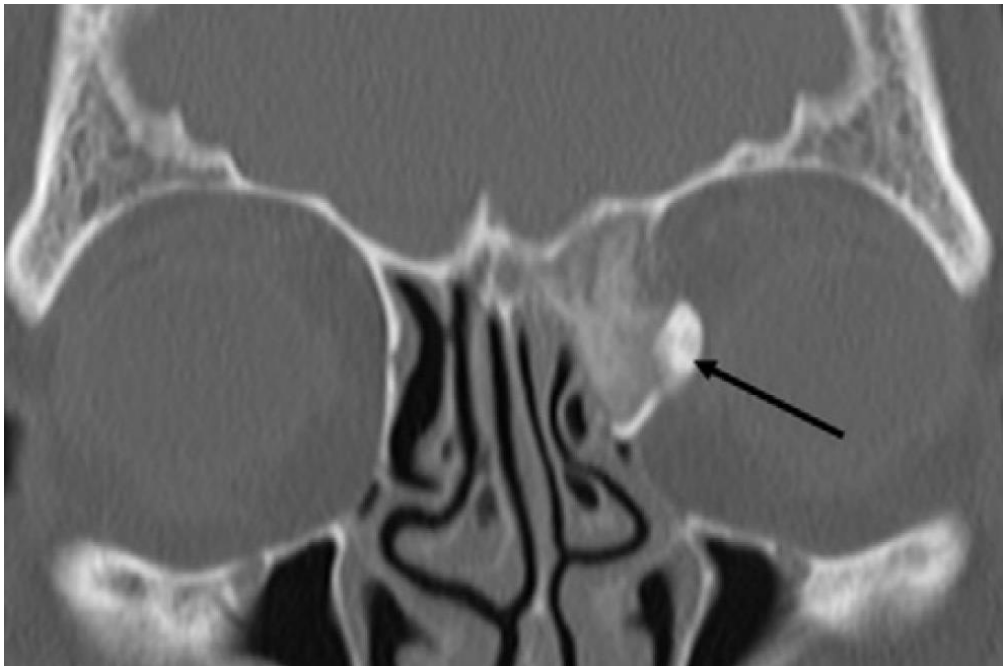
Fibrous dysplasia

Case 13



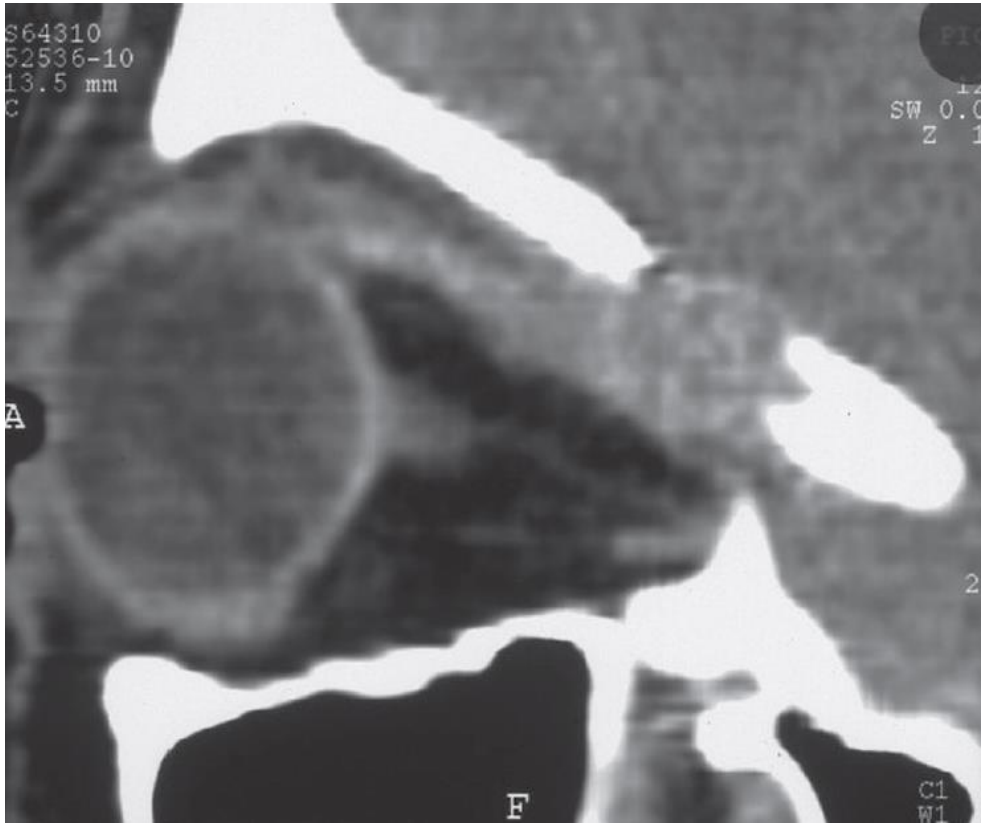
Diagnosis ?

Case 13



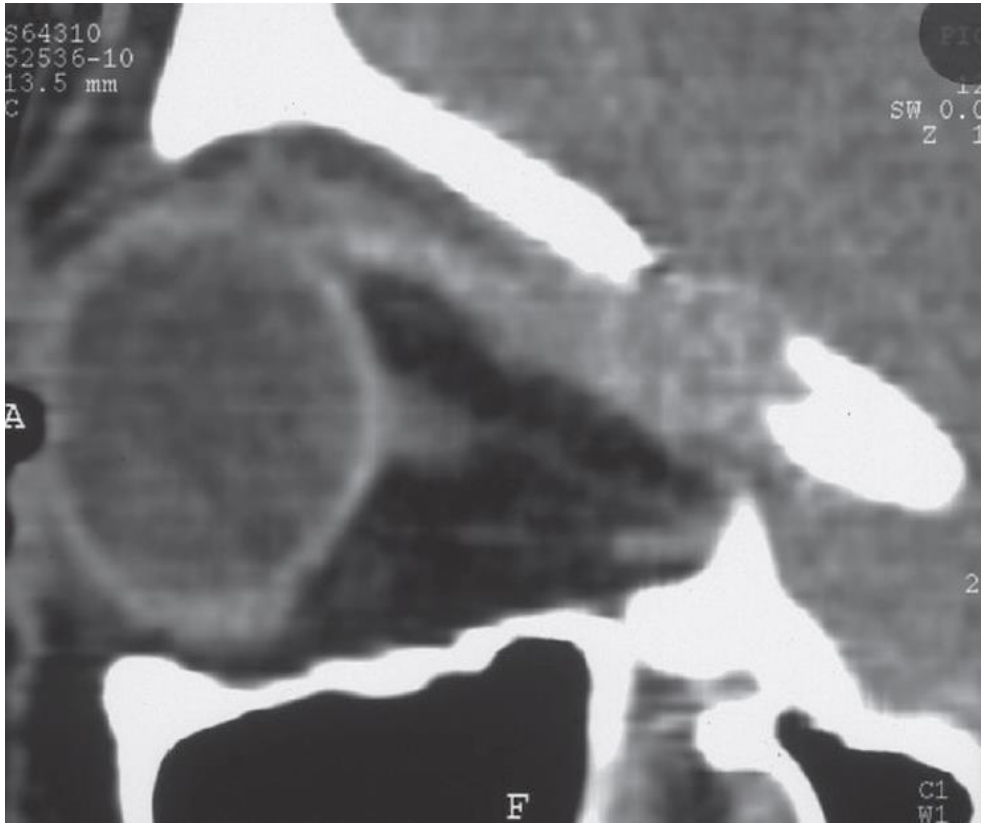
Osteoma

Case 12 (7 yo girl)

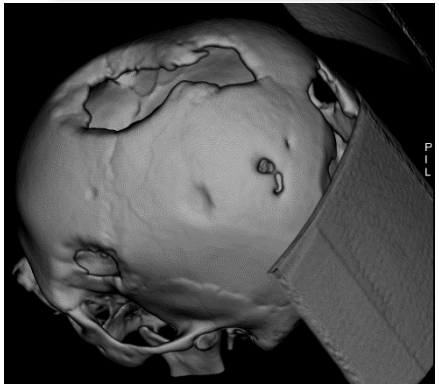


Diagnosis ?

Case 12 (7 yo girl)



Histiocytosis



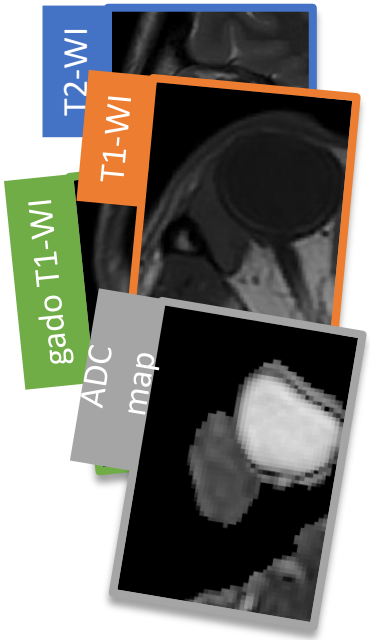
The IA revolution: radiomics

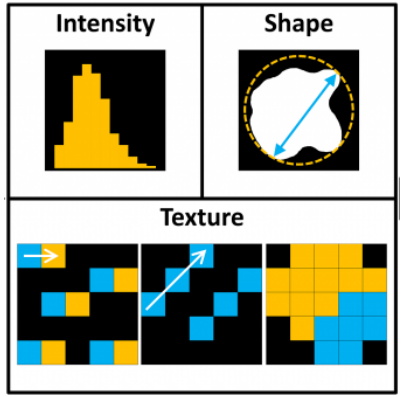
Data-driven
Research field

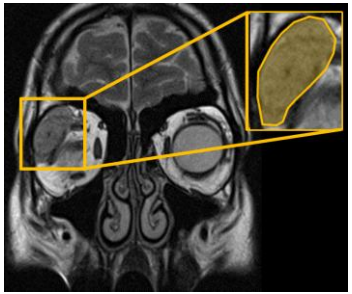
High number
of features

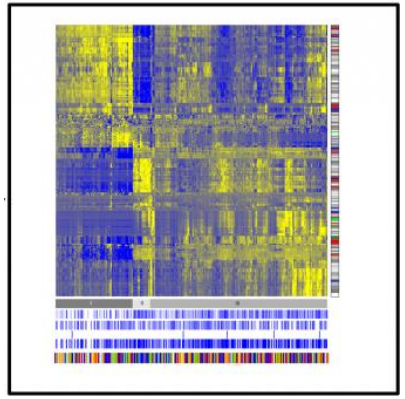
Correlation to
diagnosis / prognosis

Imaging Biomarkers









Reproducible

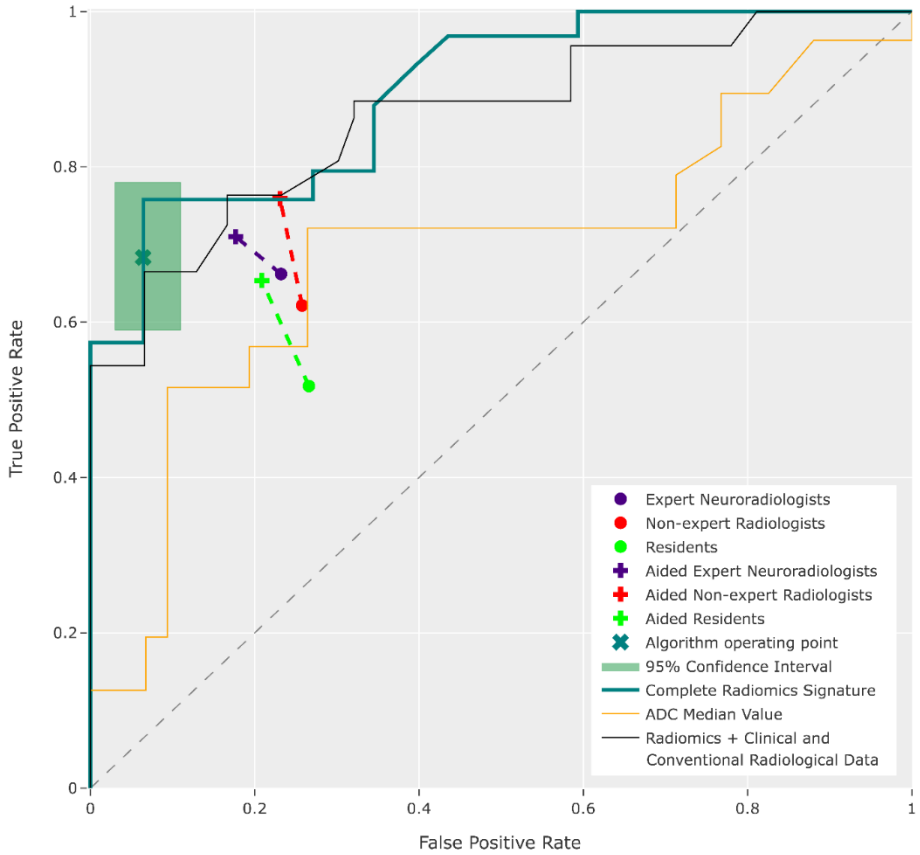
Non-redundant

Informative

Features

Radiomics Signature

The IA revolution: radiomics



Radiomics signature > ADC Median Value (p=0.02)

AUC 0.87 (95%CI [0.83-0.90])

Radiomics signature > Expert Neuroradiologists (p<0.01)

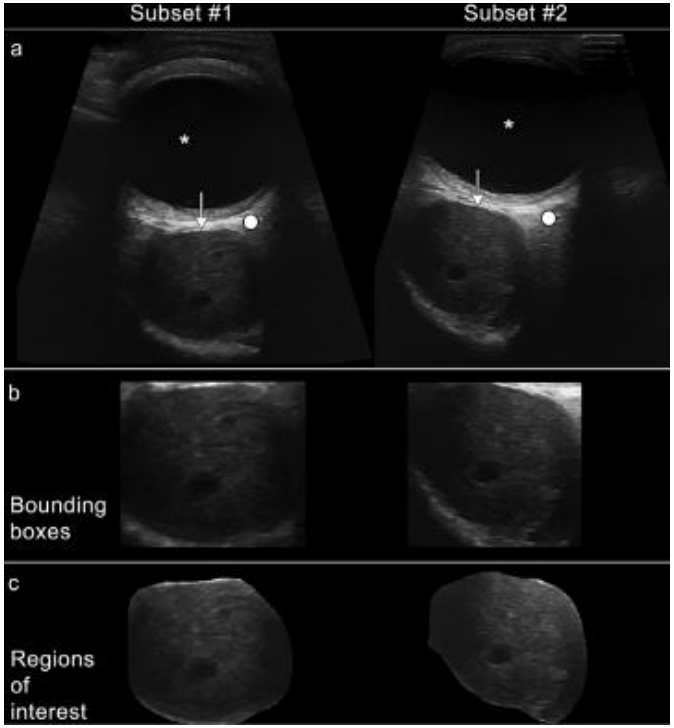
Radiomics signature + Human > Human
For Residents (p = 0.002)
For General Radiologists (p = 0.02)
+/- for Neuroradiologists (p = 0.06)

No increase in FP : no more biopsies.

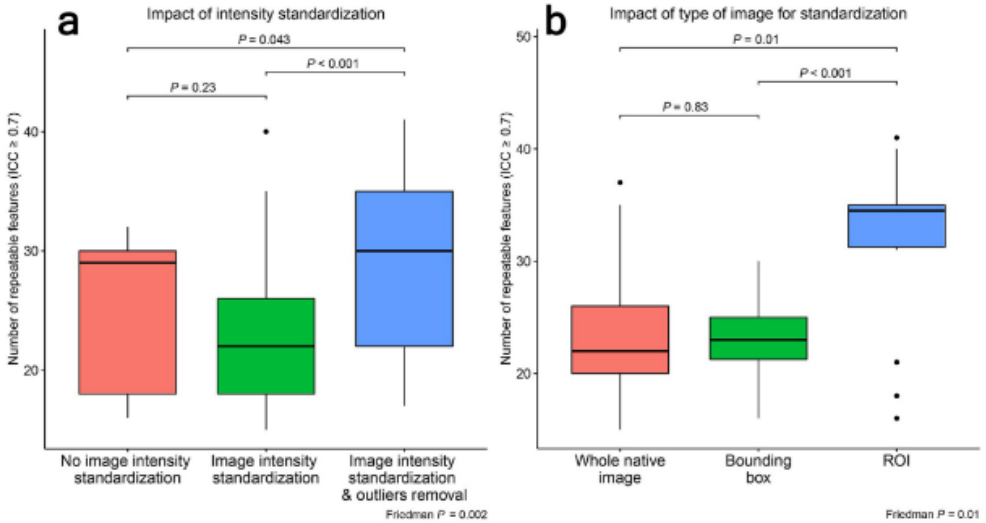
Duron, Lecler et al Investigative Radiology 2021

The IA revolution: machine learning

It works with ultrasound images too !



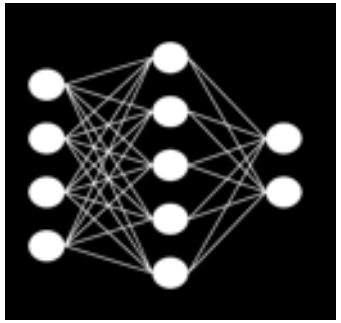
Acquisition variability = ↘ radiomics feature repeatability



Duron, Lecler et al Diagnostic and Interventional Imaging 2021

The IA revolution: machine learning

RadioEye: Machine Learning for Image-Retrieval and Interpretation



Ask colleagues and search online

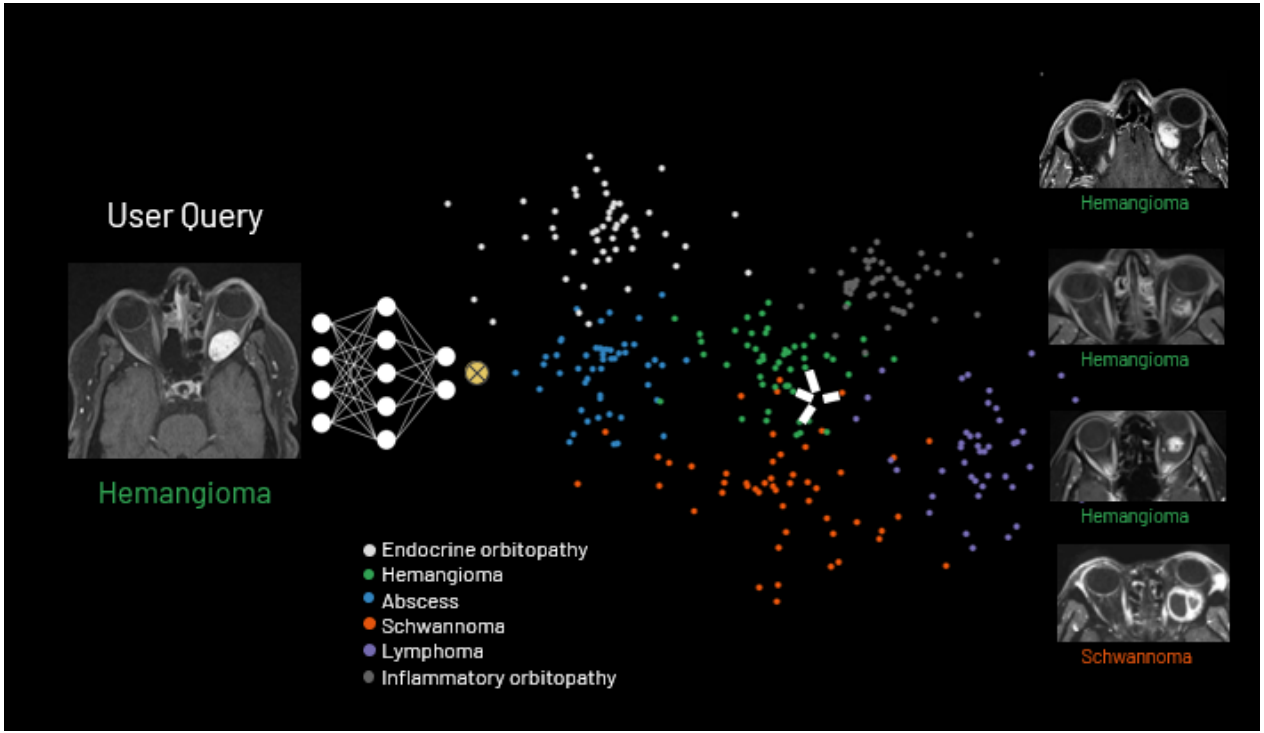
Establish a reference database

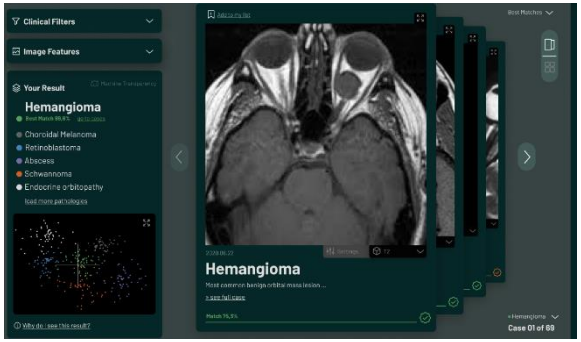
Build a ML model for image-retrieval

Courtesy Erb-Eigner K, Department of Radiology, Charité-Universitätsmedizin Berlin, Germany

The IA revolution: machine learning

RadioEye: Machine Learning for Image-Retrieval and Interpretation





katharina.erb@charite.de

Courtesy Erb-Eigner K, Department of Radiology, Charité-Universitätsmedizin Berlin, Germany

Conclusion

Typical cases

Often difficult ! Need for multiparametric imaging

The revolution of IA !

alecler@for.paris