



Roma, 9-12 novembre 2017

AACE ITALIAN CHAPTER - COURSE 2



ITALIAN CHAPTER



ENDOGENOUS HYPERCORTISOLISM CUSHING FROM A TO Z

WHAT CAN WE GET FROM RADIOLOGY ?

Adriano M. Priola

Rome - Italy, November 9, 2017



DEPARTMENT OF RADIOLOGY

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Conflitti di interesse

Ai sensi dell'art. 3.3 sul conflitto di interessi, pag 17 del Regolamento Applicativo Stato-Regioni del 5/11/2009, dichiaro che negli ultimi 2 anni ho avuto rapporti diretti di finanziamento con i seguenti soggetti portatori di interessi commerciali in campo sanitario:

- Nessun rapporto di finanziamento
- Nessun conflitto di interessi



INTRODUCTION



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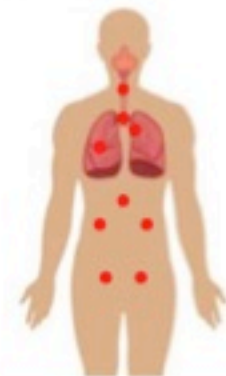
ROLE OF DIAGNOSTIC IMAGING IN ENDOGENOUS HYPERCORTISOLISM

ACTH-DEPENDENT 80%

CUSHING DISEASE



MAGNETIC RESONANCE
(COMPUTED TOMOGRAPHY)



COMPUTED TOMOGRAPHY

ECTOPIC ACTH
SECRETING TUMOUR

ACTH-INDEPENDENT 20%

ADRENAL GLANDS



COMPUTED TOMOGRAPHY
(MAGNETIC RESONANCE)
(ULTRASONOGRAPHY)



■ ACTH-DEPENDENT CUSHING SYNDROME

80%

AUTONOMOUS PRODUCTION OF ACTH

ACTH HYPERSTIMULATION RESULTS IN ADRENAL HYPERPLASIA IN 70% OF CASES

✓ PITUITARY GLAND - ADENOHYPHYSIS

ANATOMY & NORMAL FINDINGS

- MAGNETIC RESONANCE IMAGING
- COMPUTED TOMOGRAPHY

PATHOLOGY

- PITUITARY MICROADENOMA
- PITUITARY MACROADENOMA

80-85%

DIFFERENTIAL DIAGNOSIS

✓ ECTOPIC ACTH-SECRETING TUMOUR

10-15%



■ ACTH-INDEPENDENT CUSHING SYNDROME

20%

ADRENAL GLAND IS THE SITE OF AUTONOMOUS CORTISOL PRODUCTION

✓ ADRENAL GLANDS

ANATOMY & NORMAL FINDINGS

- COMPUTED TOMOGRAPHY
- MAGNETIC RESONANCE IMAGING

PATHOLOGY

- ADRENAL ADENOMA 90%
- ADRENOCORTICAL CARCINOMA <10%
- ADRENAL HYPERPLASIA
 - PRIMARY PIGMENTED NODULAR ADRENAL DYSPLASIA (PPNAD)
 - MACRONODULAR ADRENOCORTICAL HYPERPLASIA (AIMAH)

RARE

<1%

DIFFERENTIAL DIAGNOSIS



■ ACTH-DEPENDENT CUSHING SYNDROME

80%

ACTH HYPERSTIMULATION RESULTS IN ADRENAL HYPERPLASIA IN 70% OF CASES

✓ PITUITARY GLAND - ADENOHYPHYSIS

ANATOMY & NORMAL FINDINGS

- MAGNETIC RESONANCE IMAGING
- COMPUTED TOMOGRAPHY

IMAGING MODALITY OF CHOICE
T1-W T2-W T1-W/Gadolinium
SAGITTAL & CORONAL PLANES

PATHOLOGY

- PITUITARY MICROADENOMA
- PITUITARY MACROADENOMA

80-85%

DIFFERENTIAL DIAGNOSIS

- ✓ ECTOPIC ACTH-SECRETING TUMOUR

10-15%



ACTH-DEPENDENT CUSHING SYNDROME

PITUITARY

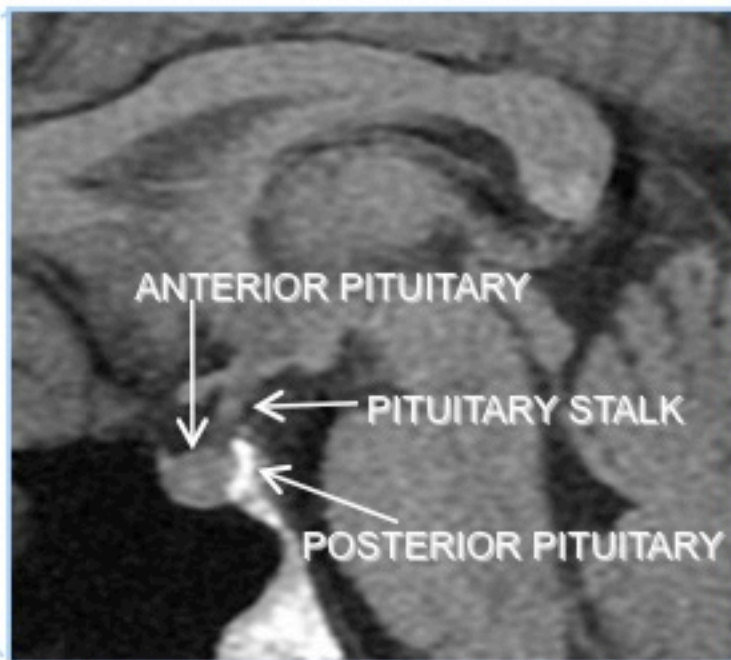


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ANATOMY AND NORMAL FINDINGS - MAGNETIC RESONANCE

HIGH QUALITY IMAGES OF HYPOTHALAMIC-PITUITARY AXIS & ADJACENT STRUCTURES
EXCELLENT CONTRAST





ACTH-DEPENDENT CUSHING SYNDROME PITUITARY



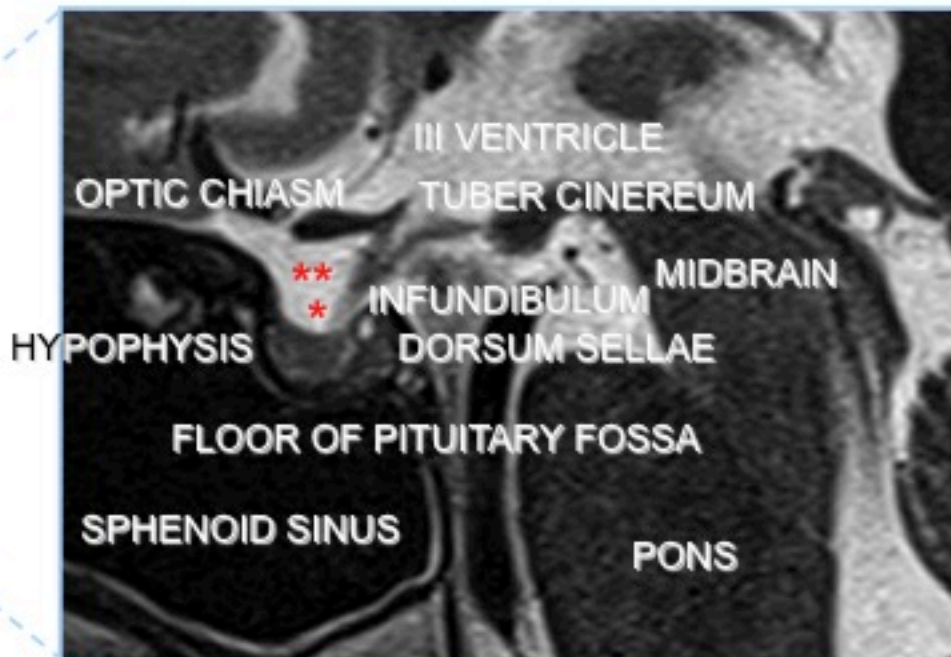
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ANATOMY AND NORMAL FINDINGS - MAGNETIC RESONANCE



T2-W SAGITTAL



* HYPOPHYSEAL & ** SUPRASellar CISTERNA



ACTH-DEPENDENT CUSHING SYNDROME

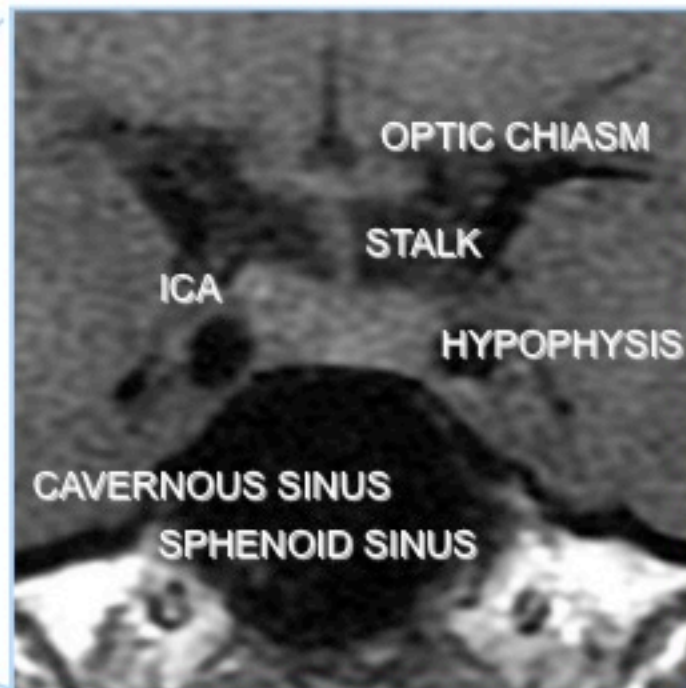
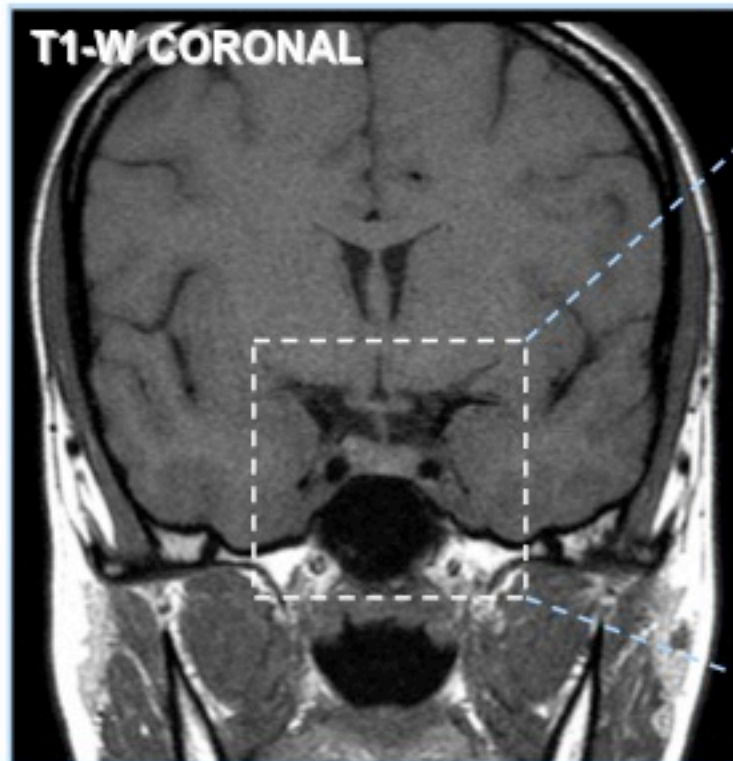
PITUITARY



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ANATOMY AND NORMAL FINDINGS - MAGNETIC RESONANCE





ACTH-DEPENDENT CUSHING SYNDROME PITUITARY



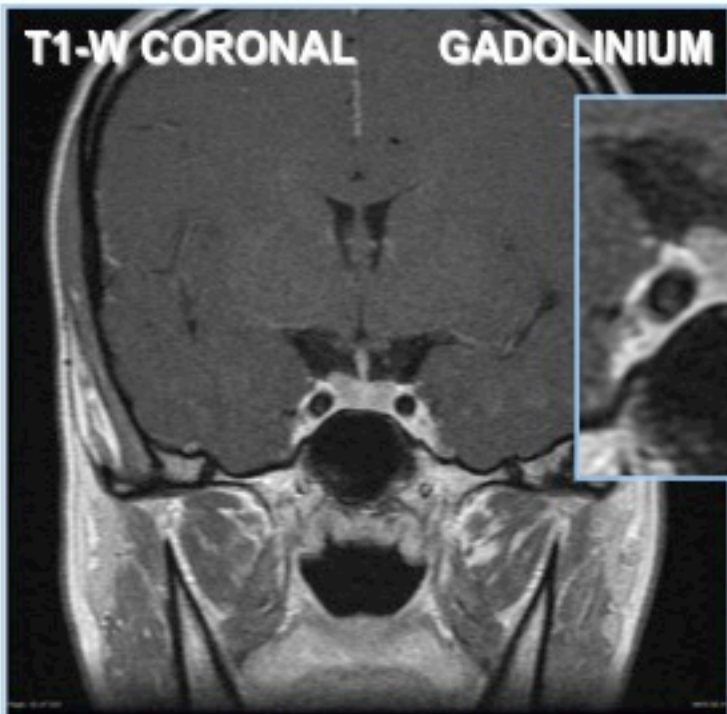
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ANATOMY AND NORMAL FINDINGS - MAGNETIC RESONANCE

INTRAVENOUS BOLUS ADMINISTRATION - GADOLINIUM, 7 ML

T1-W CORONAL GADOLINIUM



GADOLINIUM



T1-W SAGITTAL GADOLINIUM



DIFFUSE & HOMOGENEOUS CONTRAST-ENHANCEMENT



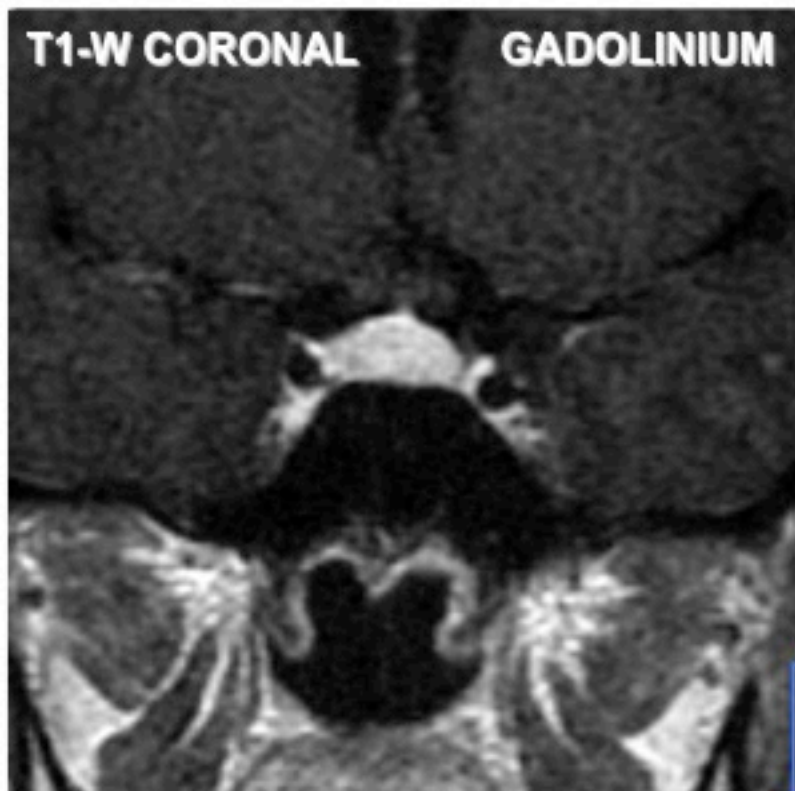
ACTH-DEPENDENT CUSHING SYNDROME PITUITARY



ANATOMY AND NORMAL FINDINGS - MAGNETIC RESONANCE

T1-W CORONAL

GADOLINIUM



DYNAMIC CONTRAST ENHANCEMENT

- ❖ RAPID SEQUENTIAL IMAGING OF HYPOPHYSIS DURING THE FIRST 60"/90" FOLLOWING INTRAVENOUS INJECTION OF GADOLINIUM
- ❖ TEMPORAL DIFFERENCES IN GADOLINIUM UPTAKE BETWEEN ADENOMA AND NORMAL GLAND
- ❖ DETECTION OF PITUITARY MICROADENOMA

PROGRESSIVE AND INTENSE CONTRAST-ENHANCEMENT
HOMOGENEOUS AND DIFFUSE AFTER 45-60"



ACTH-DEPENDENT CUSHING SYNDROME PITUITARY

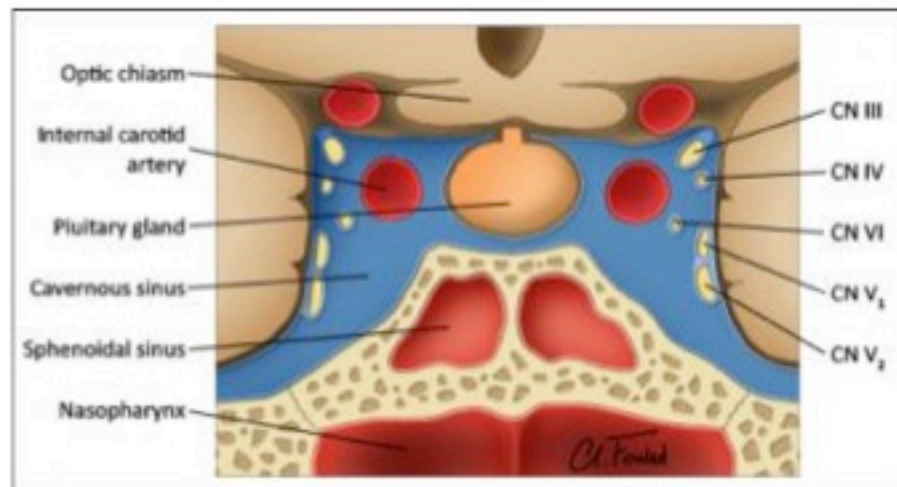


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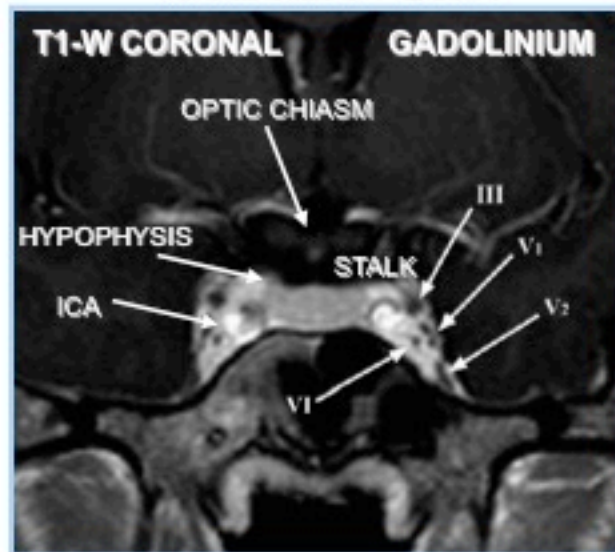
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ANATOMY AND NORMAL FINDINGS - MAGNETIC RESONANCE

ANATOMY



3TESLA - UNIT



❖ HIGHER SPATIAL RESOLUTION - FINE ANATOMICAL DETAIL



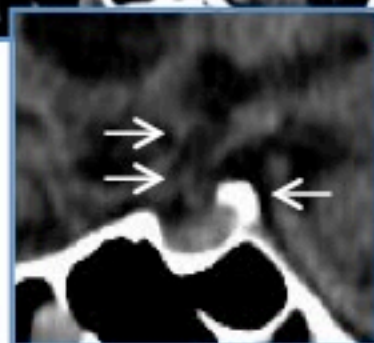
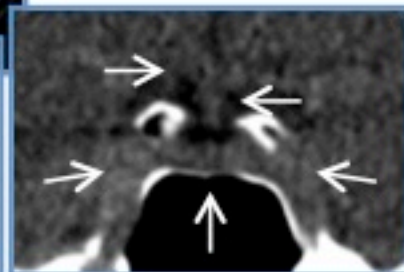
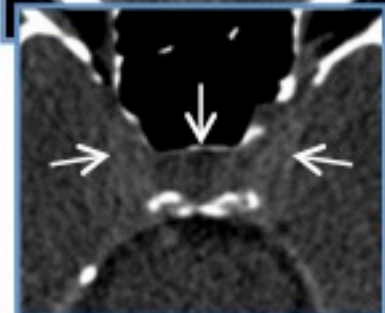
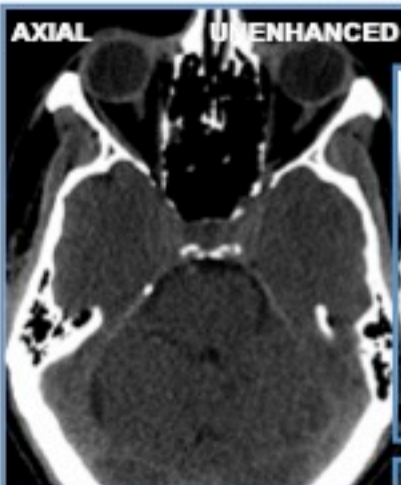
ACTH-DEPENDENT CUSHING SYNDROME PITUITARY



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ANATOMY AND NORMAL FINDINGS - COMPUTED TOMOGRAPHY



LOWER CONTRAST RESOLUTION

HOMOGENEOUS & INTENSE C-E

↑ TISSUE CONTRAST BETWEEN HYPOPHYSIS AND ADJACENT STRUCTURES OR PITUITARY LESIONS



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ACTH-DEPENDENT CUSHING SYNDROME PITUITARY



ITALIAN CHAPTER



ANATOMY AND NORMAL FINDINGS - COMPUTED TOMOGRAPHY

- ❖ **CT IS THE PRIMARY IMAGING MODALITY FOR PATIENTS WHO ARE UNABLE TO UNDERGO MRI (E.G., CLAUSTROPHOBIA, CARDIAC PACEMAKER DEVICES)**
- ❖ **ADMINISTRATION OF IODINATED CONTRAST MATERIAL IMPROVES THE TISSUE CONTRAST BETWEEN NORMAL GLAND AND PATHOLOGICAL LESIONS AND BETTER DELINEATES ANATOMY OF SELLAR REGION**
- ❖ **DESPITE THE INFERIOR SOFT TISSUE DISCRIMINATION COMPARED TO MR, CT PROVIDES BETTER IMAGING OF THE BONE AND REMAINS USEFUL FOR IDENTIFYING CALCIFICATIONS AND BONE EROSION OF THE SELLAR FLOOR**
- ❖ **CT PROVIDES PRE-OPERATIVE DATA FOR TRANSSPHENOIDAL HYPOPHYSECTOMY, INCLUDING BONY STRUCTURE OF THE ETHMOID AND SPHENOID SINUSES**



■ ACTH-DEPENDENT CUSHING SYNDROME

80%

ACTH HYPERSTIMULATION RESULTS IN ADRENAL HYPERPLASIA IN 70% OF CASES

✓ PITUITARY GLAND - ADENOHYPHYSIS

ANATOMY & NORMAL FINDINGS

- MAGNETIC RESONANCE IMAGING
- COMPUTED TOMOGRAPHY

PATHOLOGY

- PITUITARY MICROADENOMA
- PITUITARY MACROADENOMA

80-85%

DIFFERENTIAL DIAGNOSIS

✓ ECTOPIC ACTH-SECRETING TUMOUR

10-15%



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ACTH-DEPENDENT CUSHING SYNDROME

PITUITARY

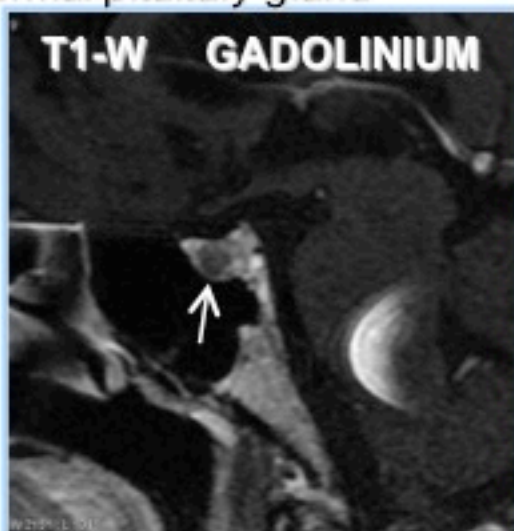
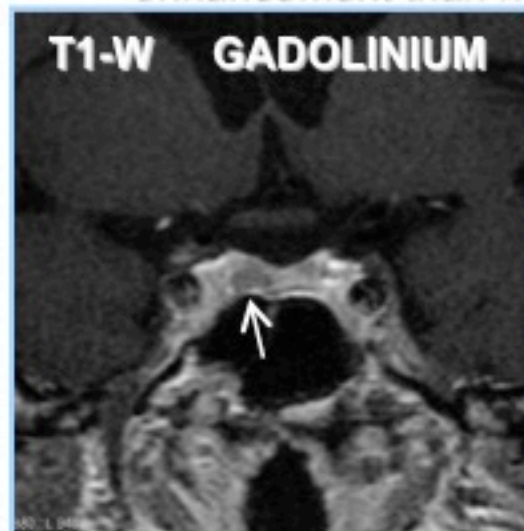
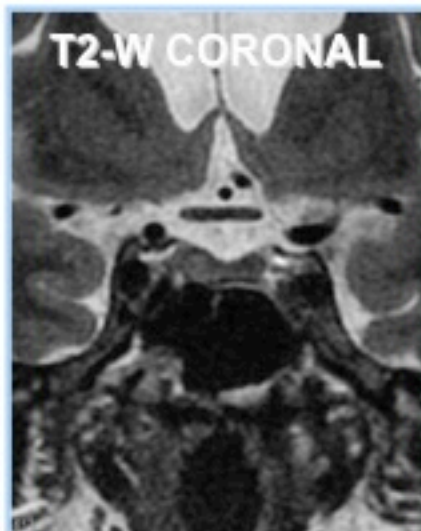
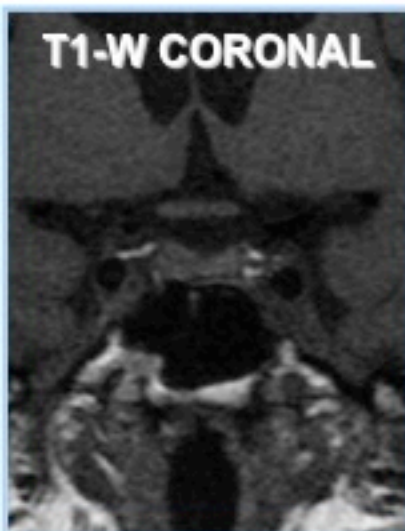


ITALIAN CHAPTER



PATHOLOGY - MICROADENOMA

- ❖ ≤ 10 mm in diameter
- ❖ isointense to normal gland on T1-W/T2-W (not visible on unenhanced MR)
- ❖ within sellar region and pituitary boundaries
- ❖ increased convexity of the superior margin of pituitary gland
- ❖ contralateral displacement of the infundibulum
- ❖ well defined lesion with less contrast enhancement than normal pituitary gland





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ACTH-DEPENDENT CUSHING SYNDROME PITUITARY



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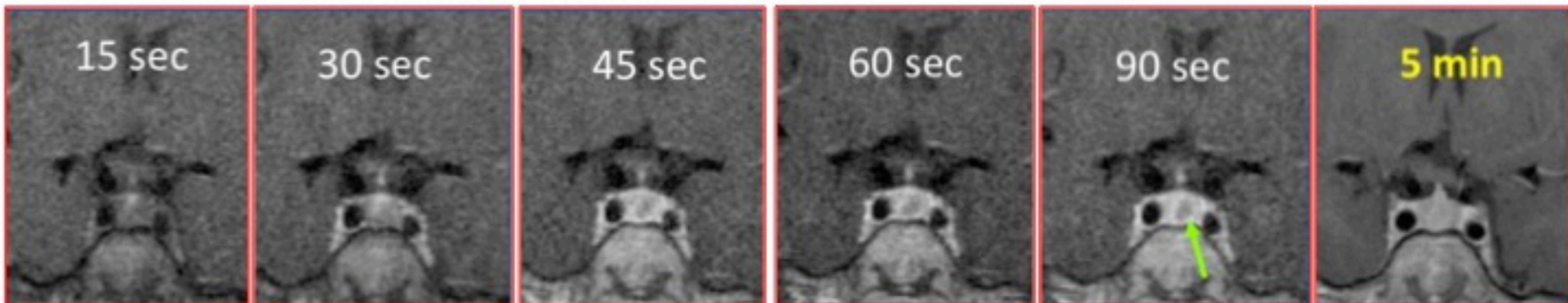


PATHOLOGY - MICROADENOMA

- ❖ **DCE-MR** IMPROVES ACCURACY IN DETECTION OF MICROADENOMAS IN PATIENTS WITH CUSHING'S DISEASE
- ❖ SENSITIVITY OF 67-95% COMPARED TO 50-60% OF CONVENTIONAL CONTRAST-ENHANCED MR
- ❖ HIGH NEGATIVE PREDICTIVE VALUE
- ❖ FALSE POSITIVE RESULTS

PEAK OF DIFFERENCE IN CONTRAST-ENHANCEMENT BETWEEN NORMAL HYPOPHYSIS AND MICROADENOMA AT 60-90"

C-E ADENOMA = C-E HYPOPHYSIS





ACTH-DEPENDENT CUSHING SYNDROME PITUITARY

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PATHOLOGY - MICROADENOMA

COLOUR MAP

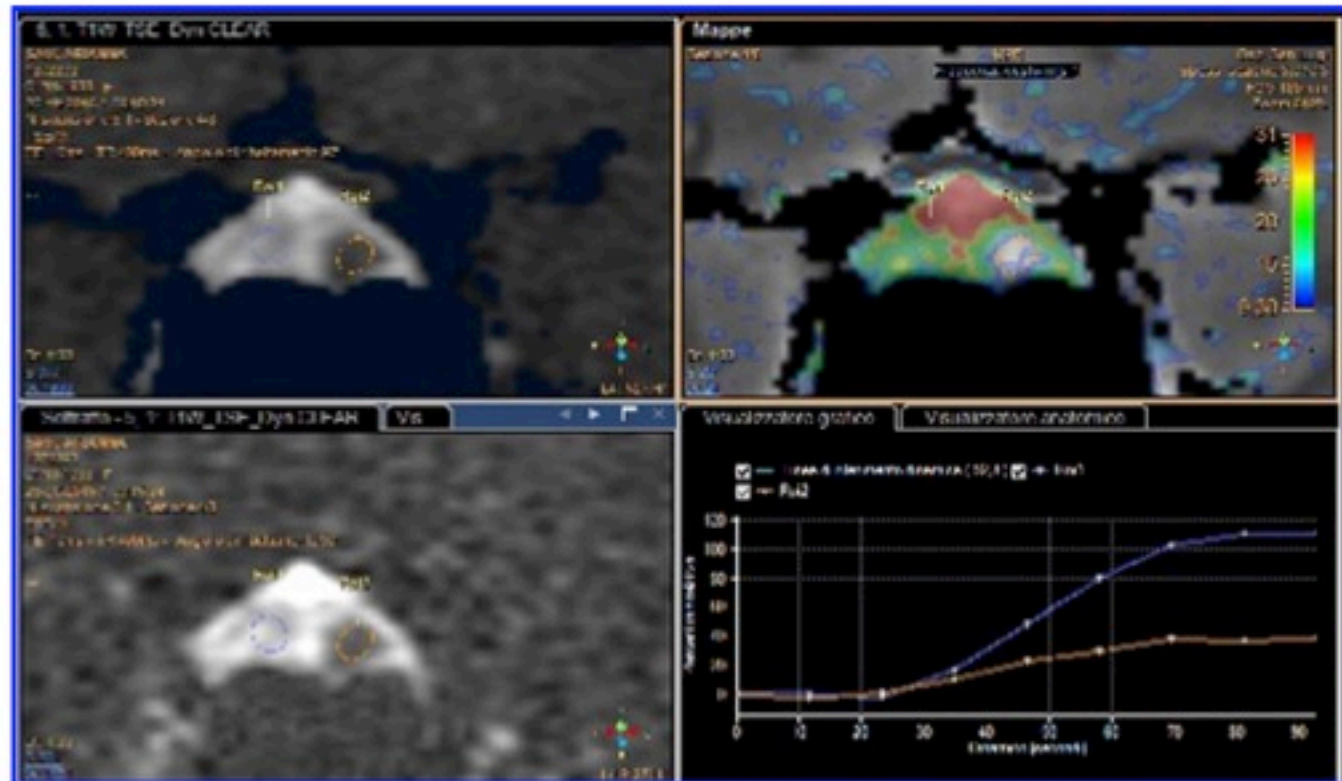
Contrast-enhancement
on a pixel-by-pixel basis

Clear discrimination of
MICROADENOMA
from

NORMAL PITUITARY GLAND

TIME-INTENSITY CURVE

LESS PROGRESSIVE C-E
OF MICROADENOMA
OVER TIME





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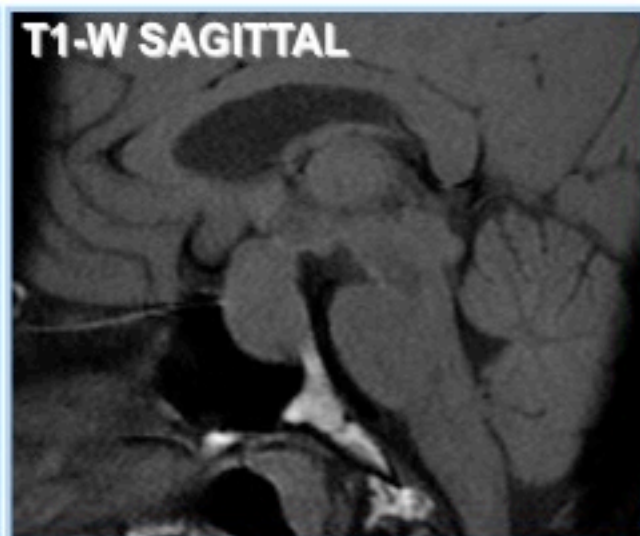
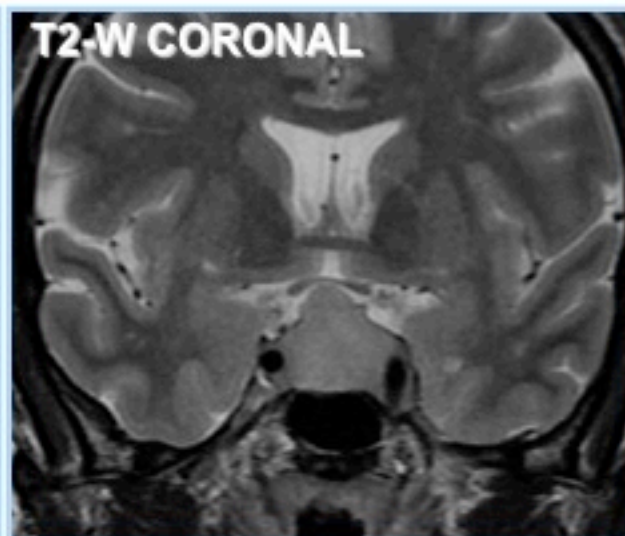
ACTH-DEPENDENT CUSHING SYNDROME

PITUITARY



PATHOLOGY - MACROADENOMA

- ❖ > 10 mm in diameter
- ❖ isointense to brain/muscle on T1-W/T2-W (grey matter)
- ❖ often grows superiorly into the suprasellar cistern
- ❖ may extend into the cavernous sinus





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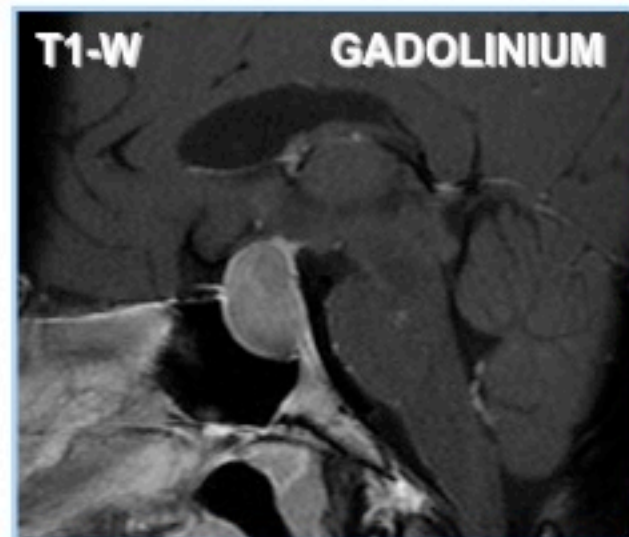
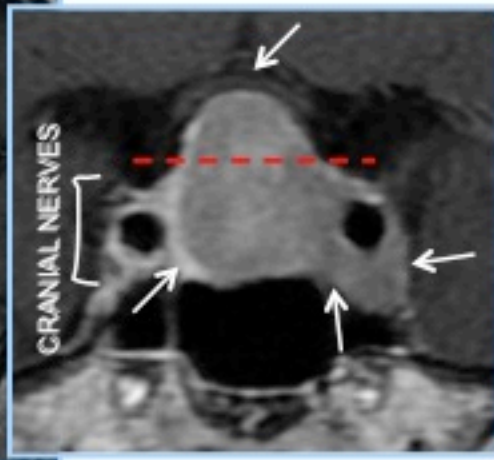
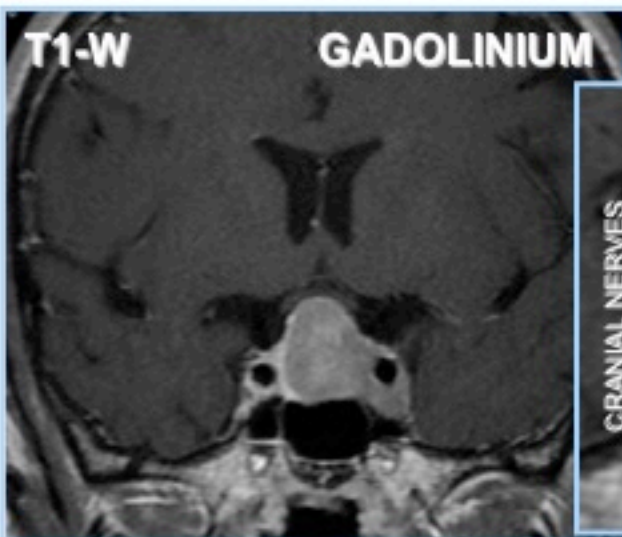
ACTH-DEPENDENT CUSHING SYNDROME

PITUITARY



PATHOLOGY - MACROADENOMA

- ❖ HETEROGENEOUS ENHANCEMENT
- ❖ SUPRASellar EXTENSION
- ❖ COMPRESSION OF THE OPTIC CHIASM
- ❖ INVASION INTO THE LEFT CAVERNOUS SINUS





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ACTH-DEPENDENT CUSHING SYNDROME

PITUITARY

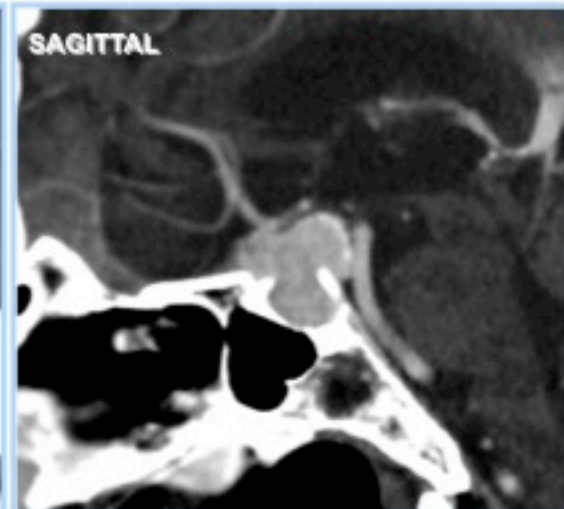


PATHOLOGY - MACROADENOMA

- ❖ CT HAS HIGH SENSITIVITY
- ❖ LESS ACCURATE THAN MR IN EVALUATING RELATIONSHIP WITH NEARBY ANATOMICAL STRUCTURES

SUPRASELLAR EXTENSION
LEFT DISPLACEMENT OF INFUNDIBULUM

ENLARGED LEFT CAVERNOUS SINUS





■ ACTH-DEPENDENT CUSHING SYNDROME

80%

ACTH HYPERSTIMULATION RESULTS IN ADRENAL HYPERPLASIA IN 70% OF CASES

✓ PITUITARY GLAND - ADENOHYPHYSIS

ANATOMY & NORMAL FINDINGS

- MAGNETIC RESONANCE IMAGING
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80-85%

DIFFERENTIAL DIAGNOSIS

✓ ECTOPIC ACTH-SECRETING TUMOUR

10-15%



■ ECTOPIC ACTH-SECRETING TUMOURS

- EXCESS SECRETION OF ACTH BY A BENIGN OR, MORE OFTEN, MALIGNANT NON-PITUITARY TUMOUR
- RESPONSIBLE FOR 7 TO 15% OF ALL CASES OF CUSHING SYNDROME

LUNG CANCER

- BRONCHIAL CARCINOID
 - SMALL CELL LUNG CANCER
- } 50% OF ALL CASES

SMALL CELL CANCER OF THE THYMUS

MEDULLARY CARCINOMA OF THE THYROID

PANCREATIC NEUROENDOCRINE TUMOUR

PHEOCHROMOCYTOMA

BENIGN OVARIAN TUMOURS

ULTRASONOGRAPHY

COMPUTED TOMOGRAPHY

IMAGING MODALITY OF CHOICE



ACTH-DEPENDENT CUSHING SYNDROME

ECTOPIC ACTH-SECRETING TUMOURS



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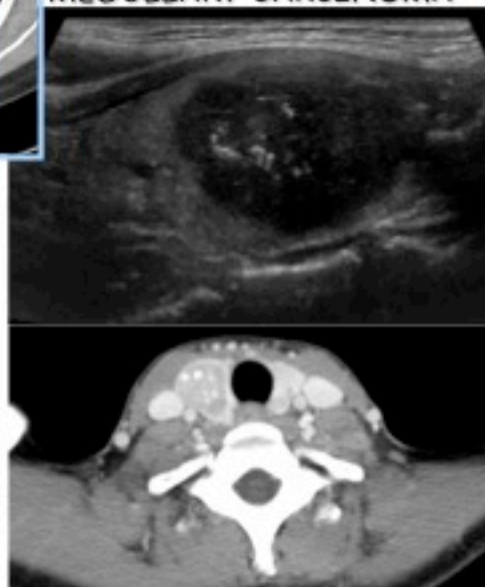
**BRONCHIAL
CARCINOID**



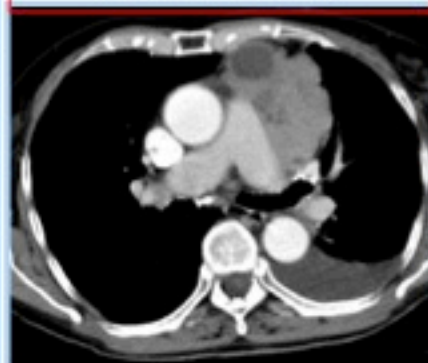
SCLC



**THYROID
MEDULLARY CARCINOMA**



SCC THYMUS



**PANCREAS
NEUROENDOCRINE TUMOR**





■ ACTH-DEPENDENT CUSHING SYNDROME

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ACTH-DEPENDENT CUSHING SYNDROME

ADRENAL



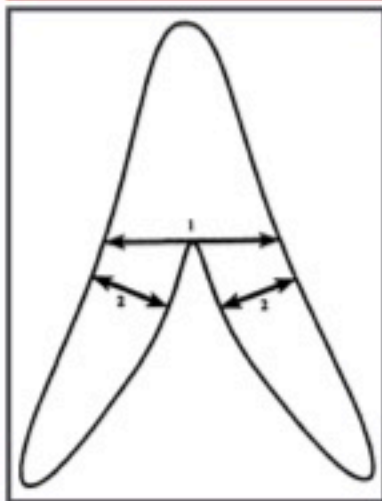
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ADRENAL HYPERPLASIA

NORMAL ADRENAL GLANDS
SIZE - NORMAL RANGE

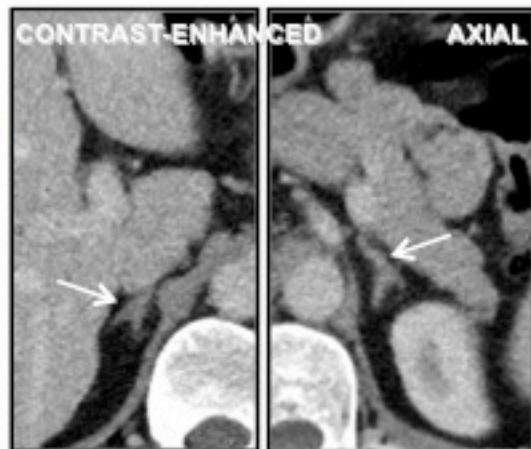
MEASUREMENTS
ADRENAL GLAND



	RIGHT ADRENAL GLAND millimeters	LEFT ADRENAL GLAND millimeters
BODY	6.1	7.9
MEDIAL LIMB	2.8	3.3
LATERAL LIMB	2.8	3.0

Vincent JM - Clin Radiol - 1994

LEFT ADRENAL GLAND SLIGHTLY **LARGER** IN SIZE





ACTH-DEPENDENT CUSHING SYNDROME

ADRENAL



ADRENAL HYPERPLASIA

NODULAR HYPERPLASIA

- ❖ ADRENAL SIZE **HIGHER** IN
 - ACTH-DEPENDENT CUSHING SYNDROME VS HEALTHY SUBJECTS
 - ECTOPIC ACTH SECRETION VS CUSHING DISEASE
- ❖ NORMAL-SIZED GLAND IN 30% OF CASES



DIFFUSE ENLARGEMENT



TABLE 3 Size of Adrenal Component and Enlargement on CT in Patients with ACTH-Dependent Cushing's Syndrome

Patient Group	Median Width of Adrenal Component (mm)					
	Right Side			Left Side		
	Body	Lateral Limb	Medial Limb	Body	Lateral Limb	Medial Limb
Cushing's disease (<i>n</i> = 40)	8.8	4.5	4.5	10.0	5.3	5.2
Ectopic ACTH secretion (<i>n</i> = 10)	11.4	5.8	6.1	12.4	6.5	6.3
<i>p</i> (Mann-Whitney test)	.09	.02	.01	.04	.03	.05



ACTH-INDEPENDENT CUSHING SYNDROME

20%

ADRENAL GLAND IS THE SITE OF AUTONOMOUS CORTISOL PRODUCTION

✓ ADRENAL GLANDS

ALWAYS INVOLVED

ANATOMY & NORMAL FINDINGS

- COMPUTED TOMOGRAPHY
- MAGNETIC RESONANCE IMAGING

IMAGING MODALITY OF CHOICE
MORPHOLOGICAL ASSESSMENT

ADDED VALUE IN DIFFERENTIAL DIAGNOSIS
OF ADRENAL LESIONS INDETERMINED ON CT

PATHOLOGY

- ADRENAL ADENOMA
- ADRENOCORTICAL CARCINOMA
- ADRENAL HYPERPLASIA
 - PRIMARY PIGMENTED NODULAR ADRENAL DYSPLASIA (PPNAD)
 - MACRONODULAR ADRENOCORTICAL HYPERPLASIA (AIMAH)

RARE

DIFFERENTIAL DIAGNOSIS



ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL



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ANATOMY AND NORMAL FINDINGS - COMPUTED TOMOGRAPHY

PERIRENAL SPACE
WITHIN PERIRENAL FASCIA

RIGHT



V-shaped
50%

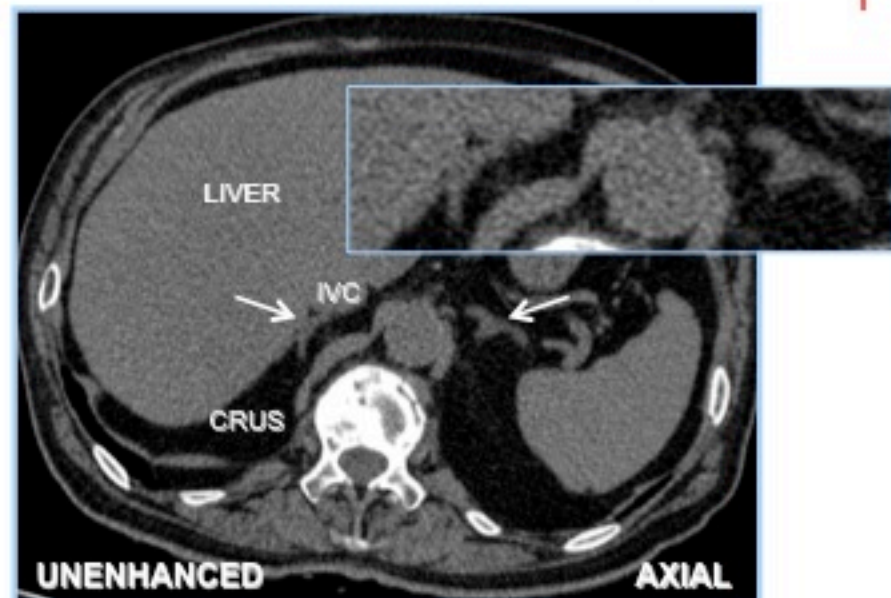


Y-shaped
32%



Triangular
9%

LEFT





■ ACTH-INDEPENDENT CUSHING SYNDROME

20%

ADRENAL GLAND IS THE SITE OF AUTONOMOUS CORTISOL PRODUCTION

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ANATOMY & NORMAL FINDINGS

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PATHOLOGY

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 - MACRONODULAR ADRENOCORTICAL HYPERPLASIA (AIMAH)

RARE

<1%

DIFFERENTIAL DIAGNOSIS



ACTH-INDEPENDENT CUSHING SYNDROME ADRENAL



UNENHANCED CT

ATTENUATION OF ADRENAL NODULE/MASS
MEAN DENSITOMETRIC VALUE

HOUNSFIELD UNITS

DIFFERENTIAL DIAGNOSIS

HIGHLY NEGATIVE VALUES
(-100/-50)

MYELOLIPOMA

NEGATIVE VALUES / + 10

LIPID-RICH ADENOMA

+10 / + 20

GREY ZONE

+ 20

SOLID LESION

INDETERMINED LESION

MYELOLIPOMA
LIPID-POOR ADENOMA
CYST
CARCINOMA
METASTASIS
LYMPHOMA
PHEOCROMOCYTOMA





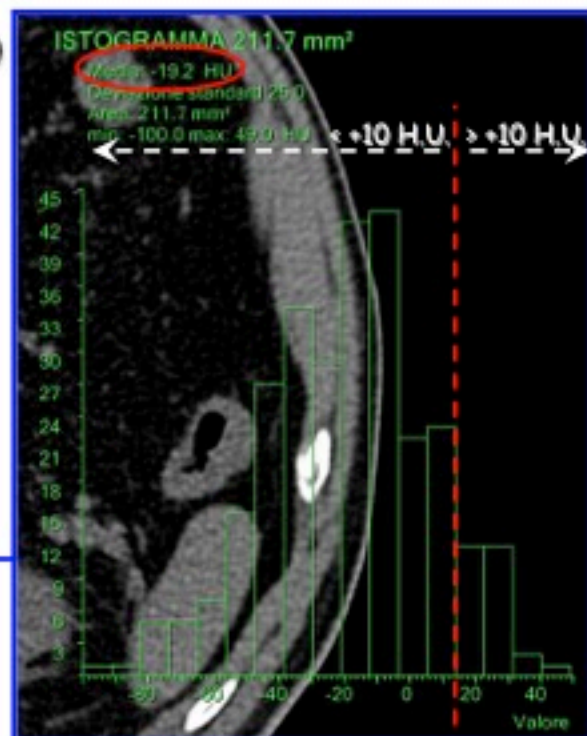
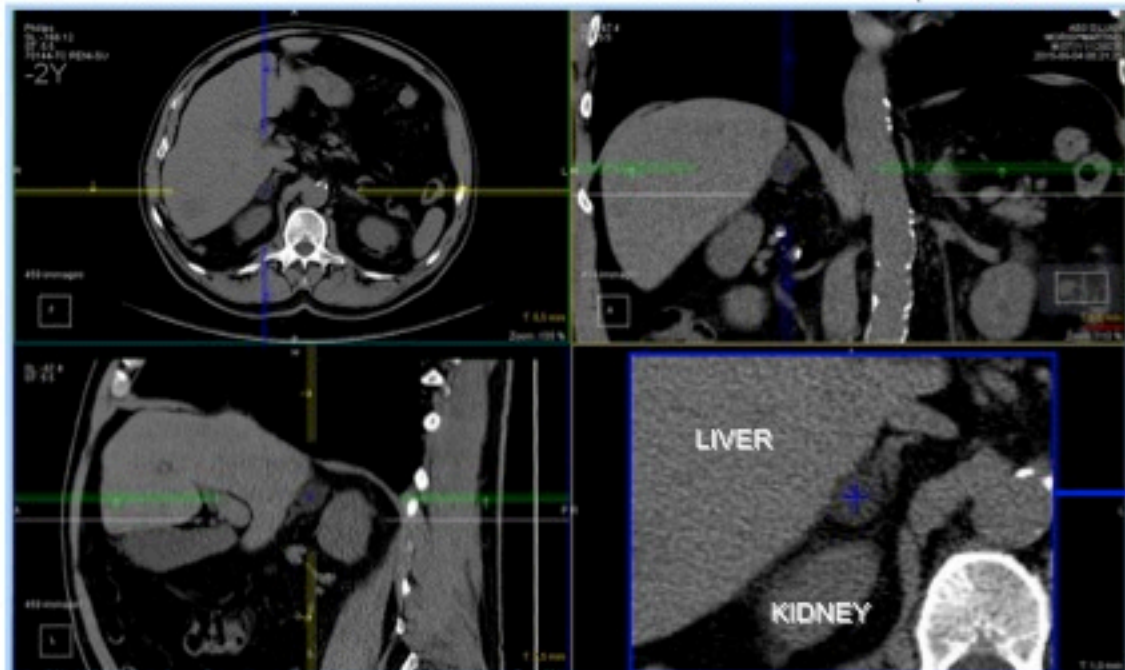
ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL

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PATHOLOGY - LIPID RICH ADENOMA

- 70-80% OF ADRENAL ADENOMAS - 4 CM
- HIGH INTRACELLULAR FAT RESULTS IN LOW ATTENUATION VALUES
- UNENHANCED CT: SENSITIVITY 70% - SPECIFICITY 98% (**THRESHOLD +10 H.U.**)





ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL

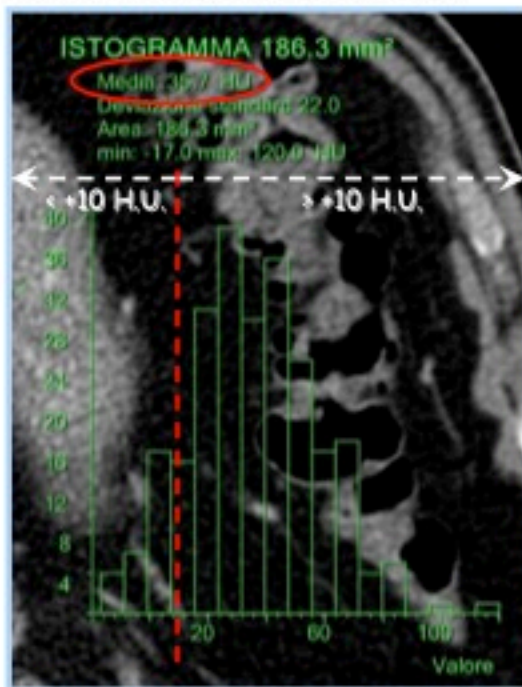
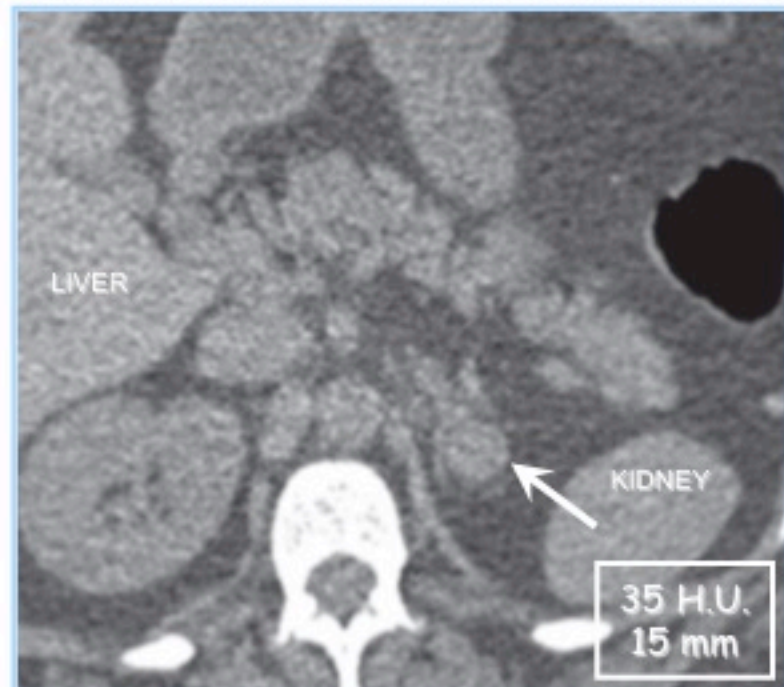


ITALIAN CHAPTER

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PATHOLOGY - LIPID POOR ADENOMA

- ❖ 20-30% OF ADRENAL ADENOMAS - SIMILAR ATTENUATION TO LIVER AND KIDNEY
LOW AMOUNT OF INTRACELLULAR FAT
- ❖ UNENHANCED CT: INDETERMINATE – NEED FURTHER IMAGING INVESTIGATION





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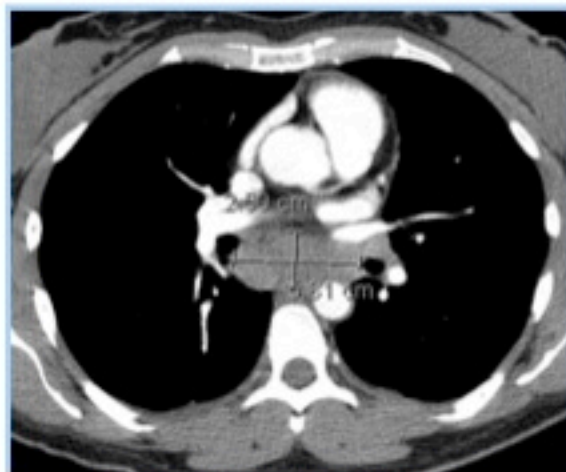
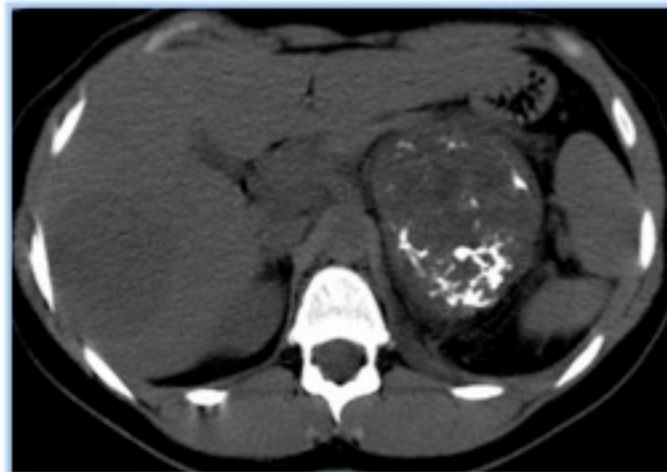
ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL



PATHOLOGY - ADRENOCORTICAL CARCINOMA

- ❖ LARGE, FUNCTIONING TUMOURS USUALLY 5 CM AT PRESENTATION (NON-FUNCTIONING, 10 CM OR MORE)
- ❖ SOLID, USUALLY CONTAINING HEMORRHAGIC, CYSTIC AND CALCIFIC AREAS
- ❖ MOSTLY UNILATERAL, BUT BILATERAL IN UP TO 10% OF CASES
- ❖ AT PRESENTATION, METASTASIS (LUNG, LIVER, LYMPH NODES, BONE) IN 20% OF CASES
- ❖ IN FUNCTIONING TUMOURS, CUSHING SYNDROME IS THE MOST FREQUENT



LARGE IN SIZE - INHOMOGENEOUS IN ATTENUATION (CALCIFICATIONS, NECROSIS) - LYMPH NODE MTS



ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL



ITALIAN CHAPTER

Roma, 9-12 novembre 2017

PATHOLOGY - PRIMARY PIGMENTED NODULAR ADRENAL DYSPLASIA

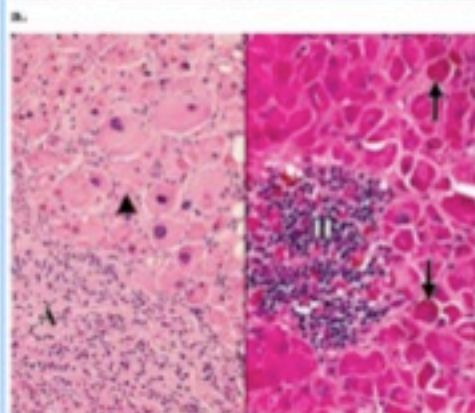
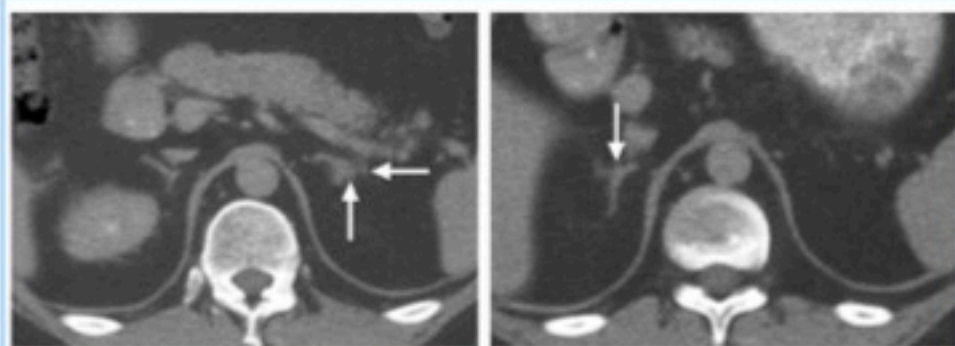


Figure 9. PPNAD in a 28-year-old man. (a, b) Delayed contrast-enhanced CT scans show small nodules in the left (a) and right (b) adrenal glands (arrows). The remaining portions of the glands do not appear hyperplastic. (c) Photomicrograph (original magnification, $\times 200$; H-E stain) (left) shows nodules of enlarged and hyperchromatic cells (hyperplastic adrenocortical cells) (arrowhead) alternating with normal adrenocortical parenchyma (A). Photomicrograph (original magnification, $\times 200$; H-E stain) (right) reveals deeply eosinophilic cells with an abundance of lipofuscin pigment (arrows) and a focal cluster of hyperchromatic cells with dark blue staining (B). The latter are hematopoietic cells and are commonly seen incidentally in normal adrenal tissue. These findings indicate the presence of PPNAD, also known as micronodular hyperplasia.

- ❖ RARE
 - < 1% OF ACTH-INDEPENDENT CUSHING SYNDROME
- ❖ BILATERAL
- ❖ GLAND NOT ENLARGED OVERALL
- ❖ SMALL DISCRETE NODULES
 - BETWEEN 2 AND 5 MM IN SIZE



ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL



PATHOLOGY - MACRONODULAR ADRENOCORTICAL HYPERPLASIA



- ❖ RARE
 - < 1% OF ACTH-INDEPENDENT CUSHING SYNDROME
- ❖ BILATERAL
- ❖ GLAND MASSIVELY ENLARGED
- ❖ ADRENAL LIMB WIDTH AND NODULE SIZE UP TO 30 MM
- ❖ LOW ATTENUATION IN 50% OF CASES
 - HIGH AMOUNT OF INTRACELLULAR FAT
- ❖ OLDER PATIENTS WITH OFTEN MILD CUSHING SYNDROME



■ ACTH-INDEPENDENT CUSHING SYNDROME

20%

ADRENAL GLAND IS THE SITE OF AUTONOMOUS CORTISOL PRODUCTION

✓ ADRENAL GLANDS

ANATOMY & NORMAL FINDINGS

- COMPUTED TOMOGRAPHY
- MAGNETIC RESONANCE IMAGING

PATHOLOGY

- ADRENAL ADENOMA
- ADRENOCORTICAL CARCINOMA
- ADRENAL HYPERPLASIA
 - PRIMARY PIGMENTED NODULAR ADRENAL DYSPLASIA (PPNAD)
 - MACRONODULAR ADRENOCORTICAL HYPERPLASIA (AIMAH)

RARE

DIFFERENTIAL DIAGNOSIS

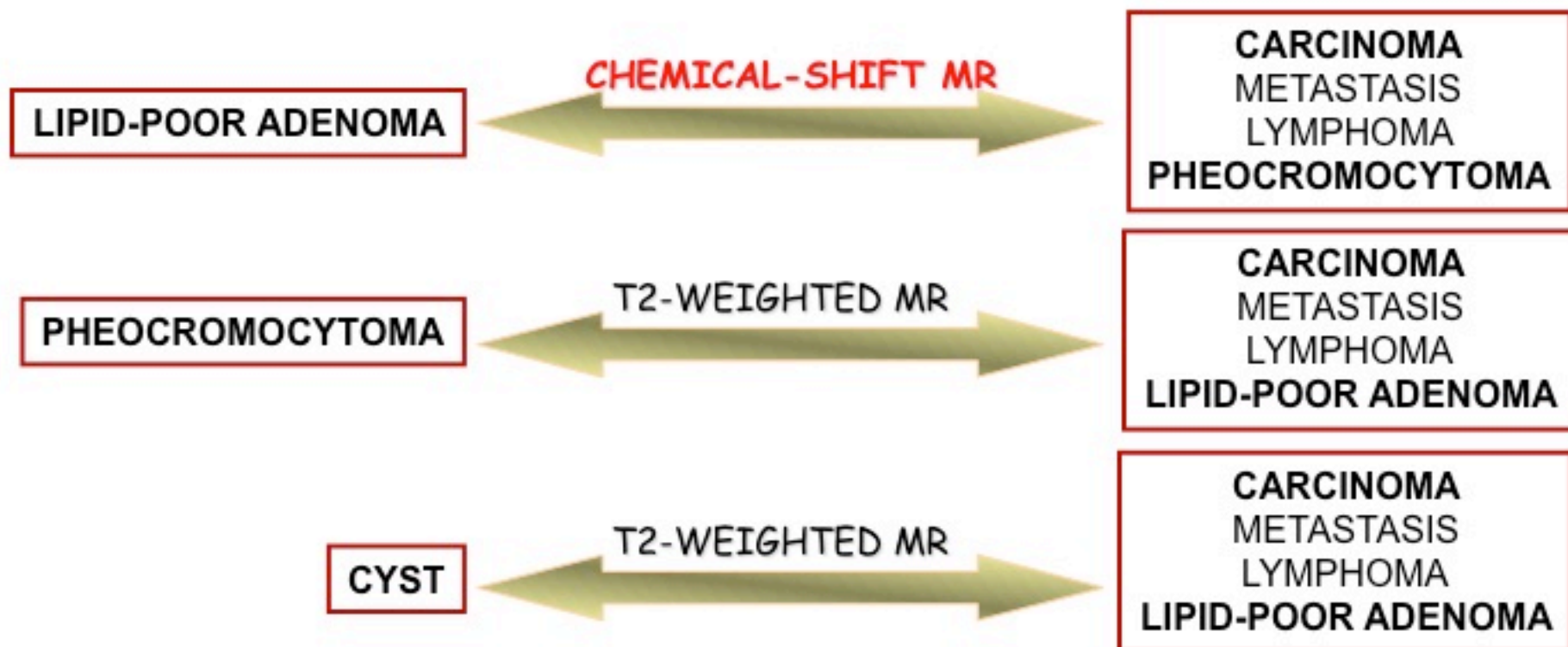
MAGNETIC RESONANCE



ACTH-INDEPENDENT CUSHING SYNDROME ADRENAL



DIFFERENTIAL DIAGNOSIS MAGNETIC RESONANCE IMAGING





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ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL



ITALIAN CHAPTER



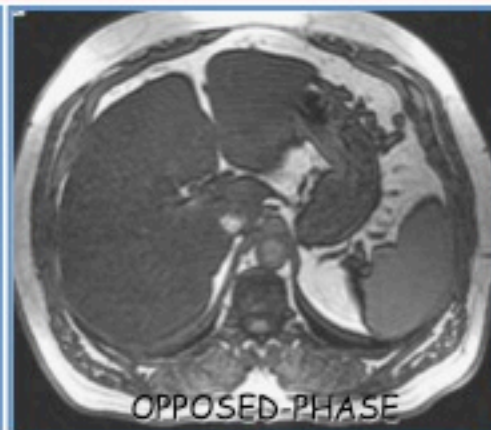
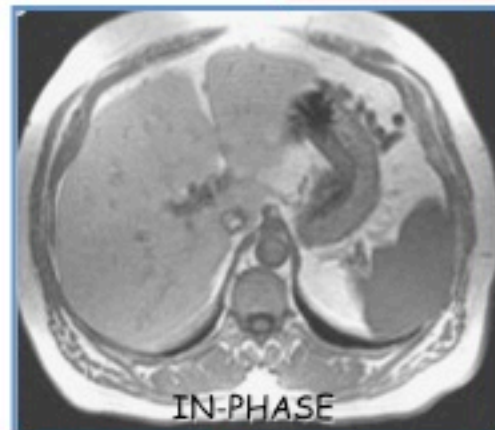
DIFFERENTIAL DIAGNOSIS

CHEMICAL-SHIFT MAGNETIC RESONANCE

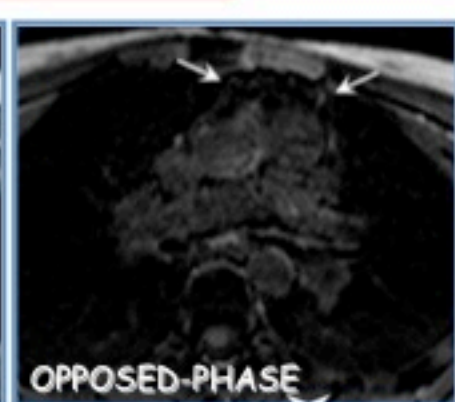
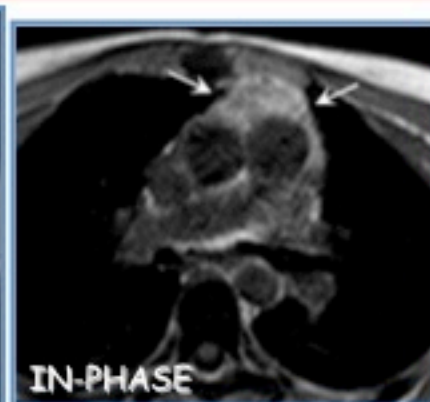
- ACCURATE TOOL FOR DETECTING MICROSCOPIC FAT IN TISSUE

INTRAVOXEL MIXTURE OF FAT AND WATER IN TISSUES, INDISTINCT AT CT

HOMOGENEOUSLY DECREASED SIGNAL INTENSITY ON OPPOSED-PHASE IMAGES RELATIVE TO IN-PHASE IMAGES



DIFFUSE HEPATIC STEATOSIS



NORMAL THYMUS - THYMIC HYPERPLASIA



ACTH-INDEPENDENT CUSHING SYNDROME ADRENAL

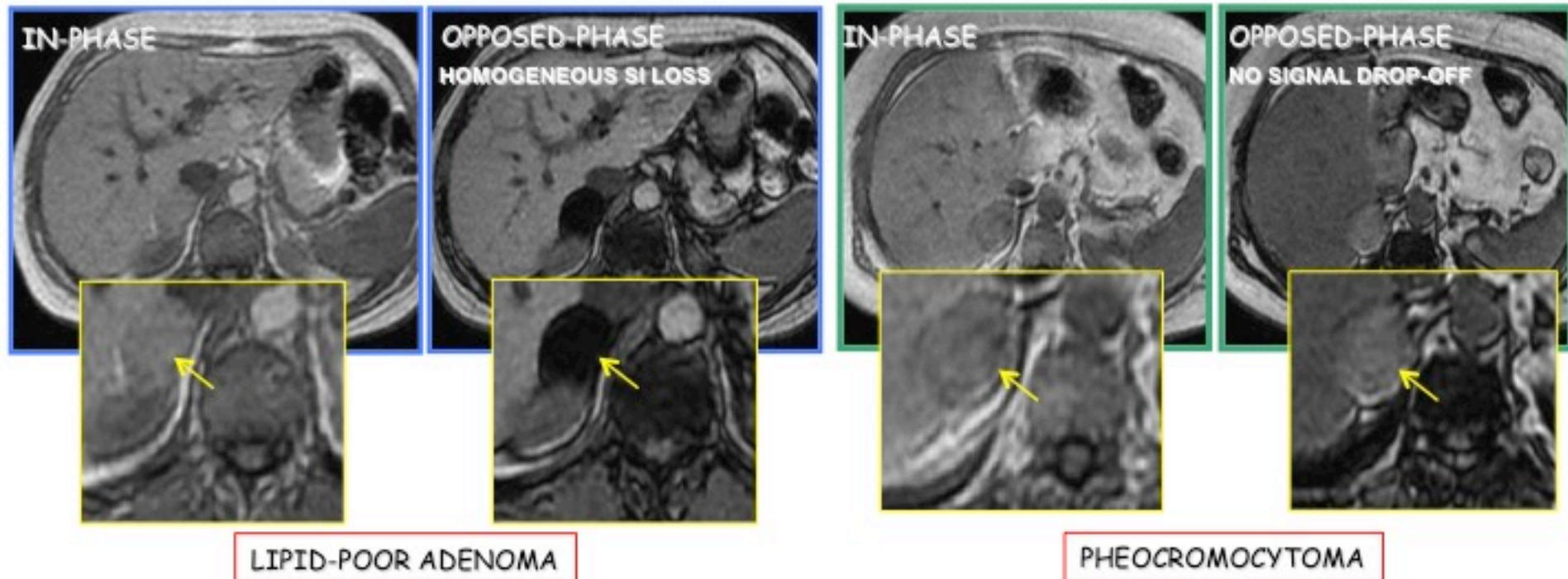


ITALIAN CHAPTER

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DIFFERENTIAL DIAGNOSIS - CHEMICAL SHIFT MR LIPID-POOR ADENOMAS VS OTHER SOLID ADRENAL LESIONS

INTRACELLULAR FAT DETECTED IN 70-80% OF LIPID-POOR ADENOMAS INDETERMINED ON CT





CONCLUSIONS I



- ❖ **IMAGING** PLAYS AN IMPORTANT ROLE IN IDENTIFYING THE UNDERLYING DISEASE IN ENDOGENOUS HYPERCORTISOLISM
- ❖ **PITUITARY AND ADRENALS** ARE THE ORGANS OF FIRST EVALUATION IN CUSHING SYNDROME
- ❖ **MR** IS THE IMAGING MODALITY OF CHOICE IN THE ASSESSMENT OF ADENOHYPHYSIS IN ACTH-DEPENDENT CUSHING SYNDROME



CONCLUSIONS II



- ❖ **CT (UNENHANCED) IS THE FIRST IMAGING MODALITY IN THE EVALUATION OF ADRENAL GLANDS IN ACTH-INDEPENDENT CUSHING SYNDROME**

- ❖ **FOR ADRENALS, CHEMICAL-SHIFT MR IS HELPFUL IN DIFFERENTIAL DIAGNOSIS BETWEEN LIPID-POOR ADRENAL ADENOMA AND ADRENOCORTICAL CARCINOMA**

- ❖ **WHOLE BODY CT CAN HELP IN FINDING THE ECTOPIC SOURCE OF ACTH PRODUCTION IN ECTOPIC ACTH-SECRETING TUMOURS**



■ ACTH-DEPENDENT CUSHING SYNDROME

80%

ACTH HYPERSTIMULATION RESULTS IN ADRENAL HYPERPLASIA IN 70% OF CASES

✓ PITUITARY GLAND - ADENOHYPHYSIS

ANATOMY & NORMAL FINDINGS

- MAGNETIC RESONANCE IMAGING
- COMPUTED TOMOGRAPHY

PATHOLOGY

- PITUITARY MICROADENOMA
- PITUITARY MACROADENOMA

80-85%

DIFFERENTIAL DIAGNOSIS

✓ ECTOPIC ACTH-SECRETING TUMOUR

10-15%



ACTH-DEPENDENT CUSHING SYNDROME PITUITARY



DIFFERENTIAL DIAGNOSIS

- ❖ RATHKE'S CLEFT CYST
 - ❖ PITUITARY METASTASIS
 - ❖ PITUITARY CARCINOMA
 - ❖ MENINGIOMA
 - ❖ CRANIOPHARYNGIOMA
 - ❖ LYMPHOCYTIC HYPOPHYSITIS
 - ❖ SACCULAR CEREBRAL ANEURYSMS
-
- ✓ RARE CONDITIONS COMPARED TO PITUITARY ADENOMAS (10-15% OF ALL INTRACRANIAL TUMOURS)
 - ✓ INCIDENTAL FINDINGS
 - ✓ APPEARANCE ON MR, LABORATORY DATA AND HISTORY OF PATIENT HELP IN DIFFERENTIAL DIAGNOSIS



ACTH-DEPENDENT CUSHING SYNDROME

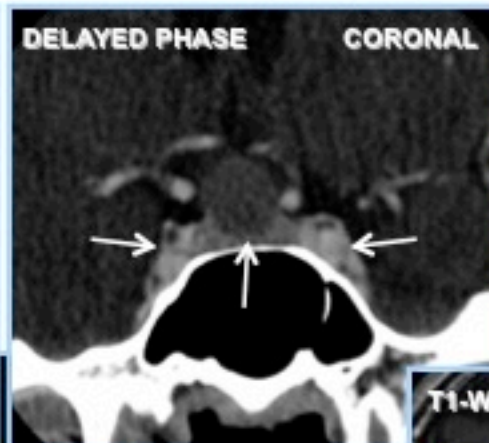
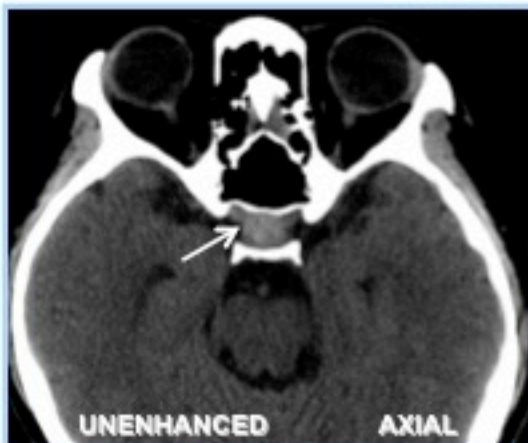
PITUITARY



ITALIAN CHAPTER

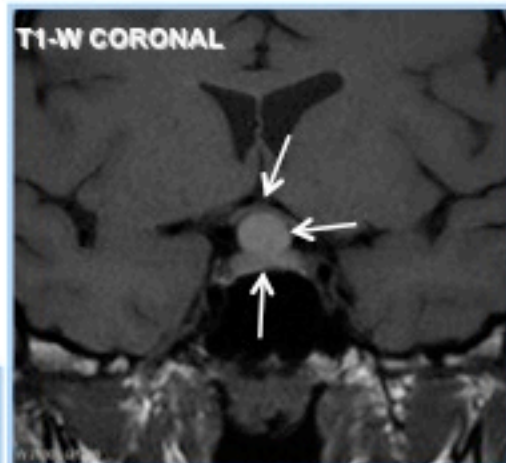
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DIFFERENTIAL DIAGNOSIS - RATKHE'S CLEFT CYST

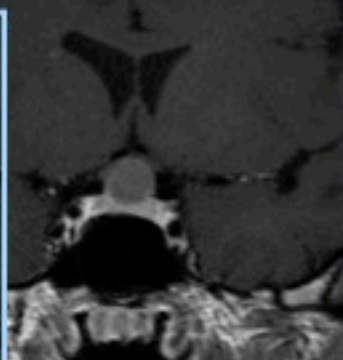
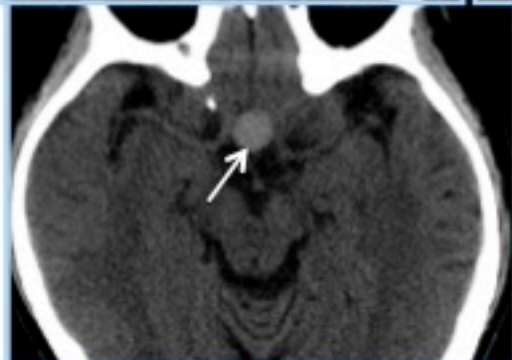


CT
 ROUNDED
 HYPERDENSE
 HOMOGENEOUS
 NO C-E

MR
 HIGH SI T1- T2-W
 NO C-E



T1-W CORONAL GADOLINIUM



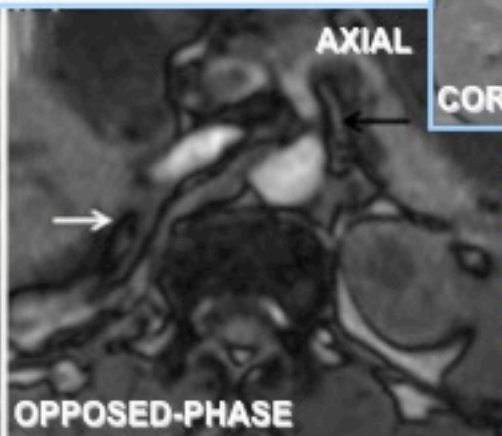
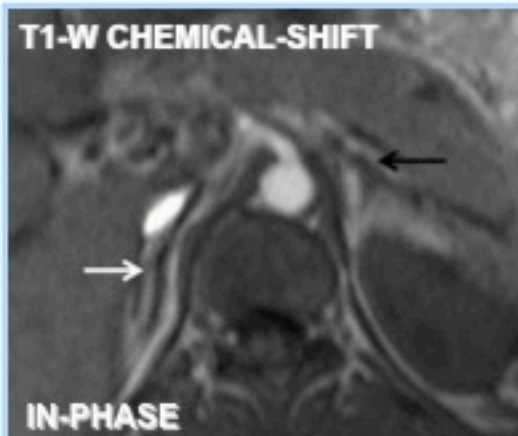
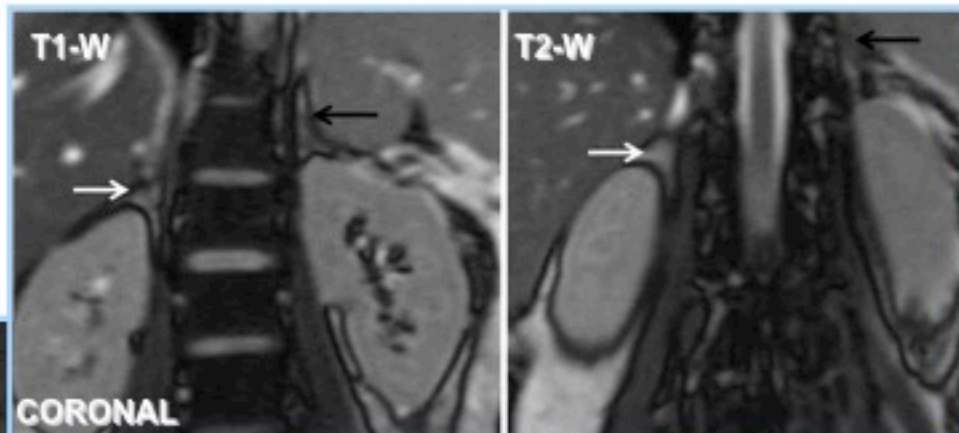
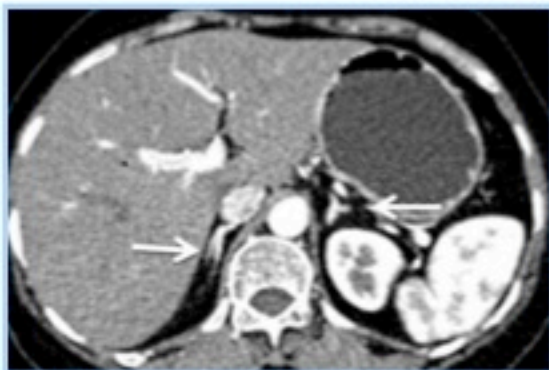


ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL

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ANATOMY AND NORMAL FINDINGS - MAGNETIC RESONANCE



- ❖ LOWER (T1-W) AND EQUAL (T2-W) SIGNAL INTENSITY COMPARED TO LIVER, SPLEIN AND PANCREAS
- ❖ INFERIOR SPATIAL RESOLUTION COMPARED TO CT
LESS FINE DETAIL



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ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL



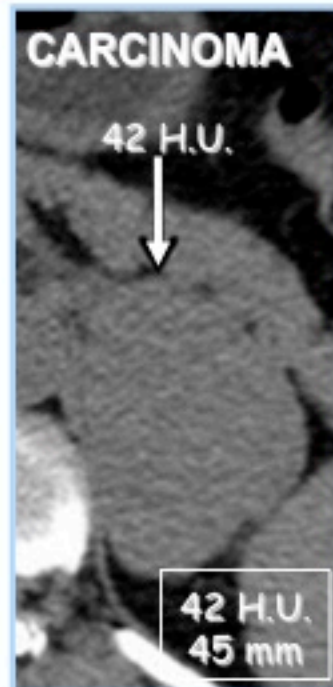
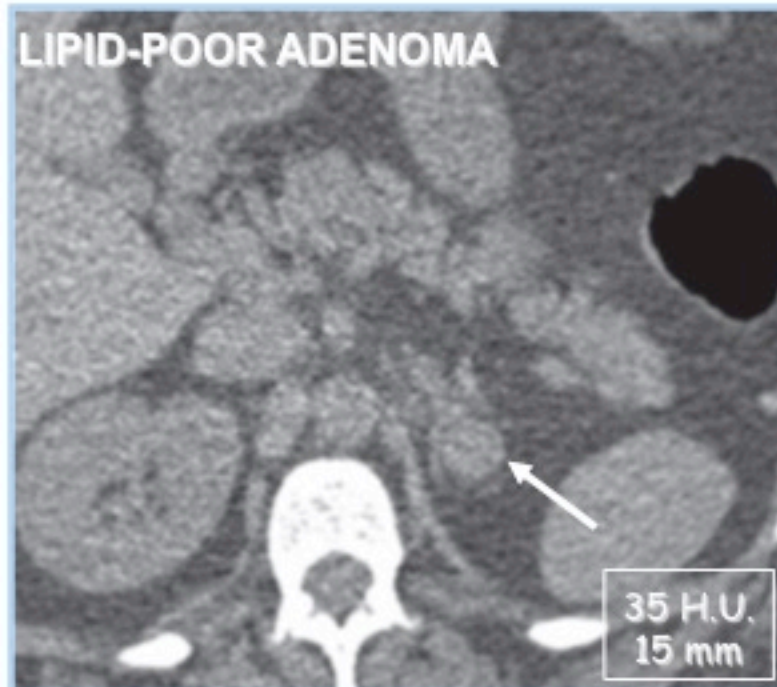
ITALIAN CHAPTER



UNENHANCED CT

- ❖ 20-30% OF ADRENAL ADENOMAS > 20 H.U.
LOW AMOUNT OF INTRACELLULAR FAT

ATTENUATION OF ADRENAL NODULE/MASS
INDETERMINATE LESIONS





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ACTH-INDEPENDENT CUSHING SYNDROME

ADRENAL

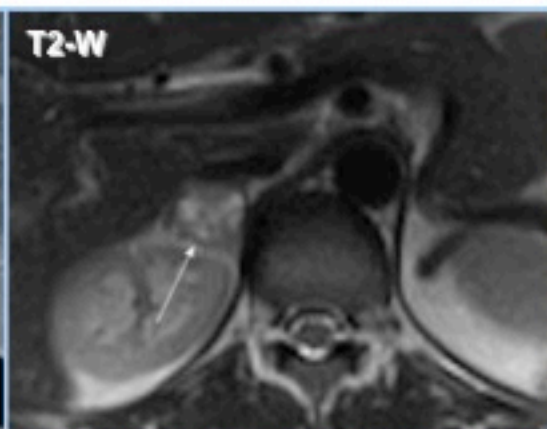
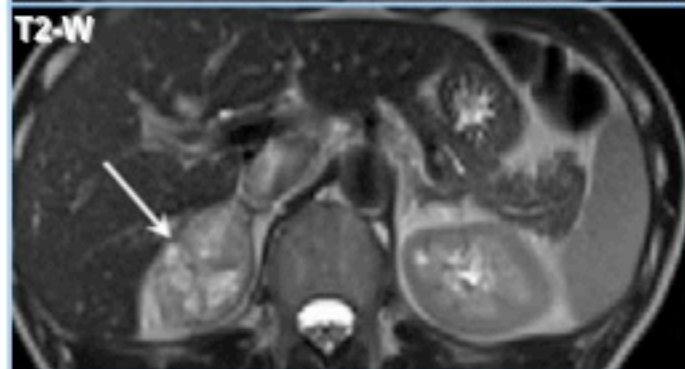
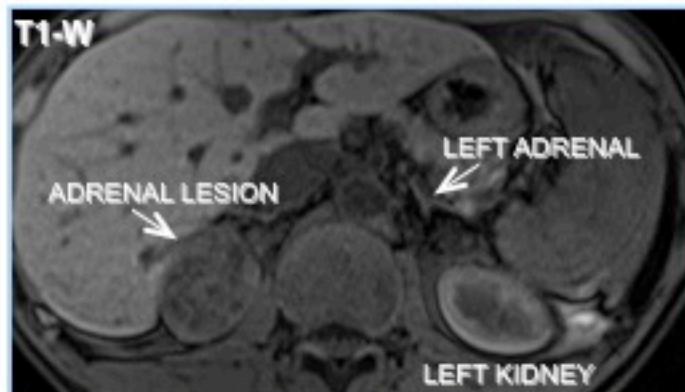


ITALIAN CHAPTER



DIFFERENTIAL DIAGNOSIS

PHEOCROMOCYTOMA VS OTHER SOLID ADRENAL LESIONS



- ❖ INCREASED SIGNAL INTENSITY ON T2-W WITH AREAS OF MARKED HYPERINTENSITY DISPERSED WITHIN THE NODULE OR MASS



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ACTH-INDEPENDENT CUSHING SYNDROME

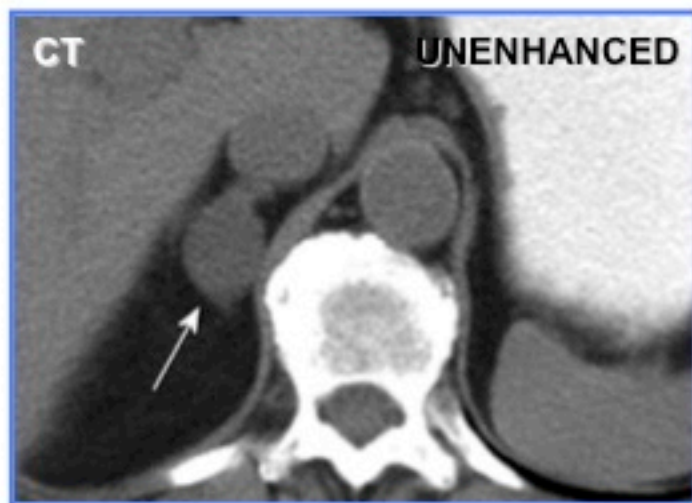
ADRENAL



DIFFERENTIAL DIAGNOSIS

ADRENAL CYST VS SOLID ADRENAL LESIONS

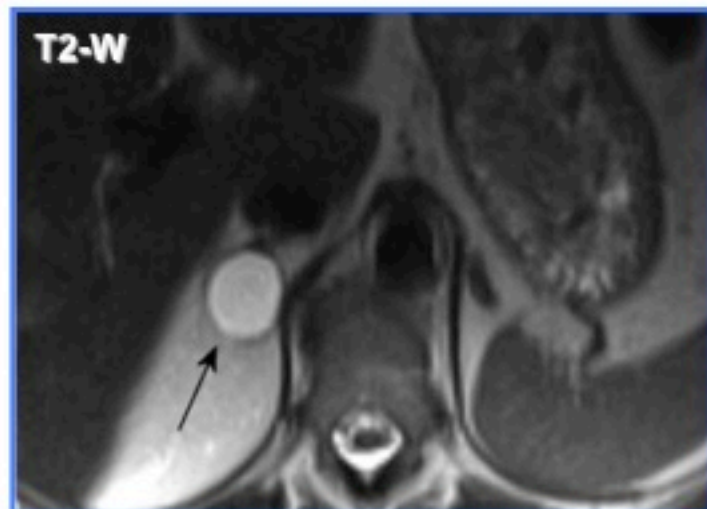
INCIDENTAL FINDING AT CROSS-SECTIONAL IMAGING



INDETERMINED NODULE

DENSITOMETRIC VALUE +12 H.U.

ADENOMA - CYST ?



LIGHTBULB SIGN

HOMOGENEOUS HIGH SIGNAL INTENSITY

TYPICAL OF FLUIDS

DIAGNOSTICA PER IMMAGINI

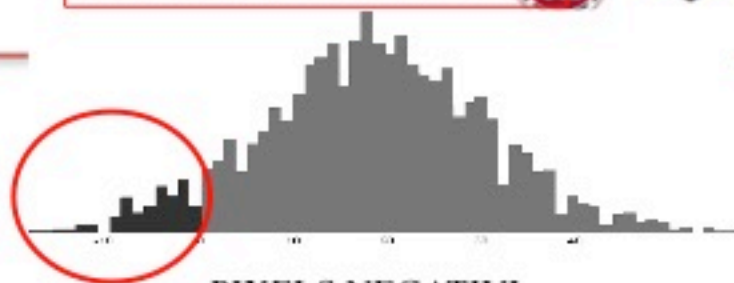
SURRENI - RUOLO DELL'IMAGING

Roma, 9-12 novembre 2011

TOMOGRAFIA COMPUTERIZZATA
IMAGING BASALE A STRATO SOTTILE

ADENOMA

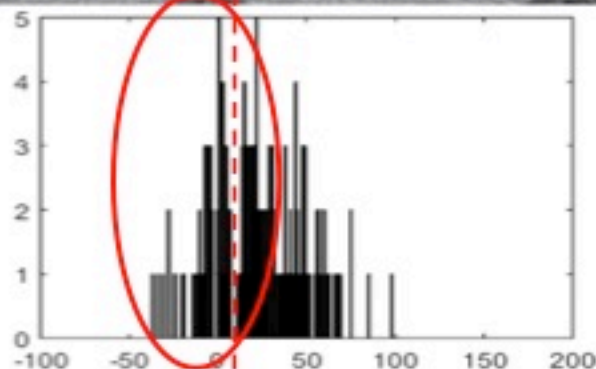
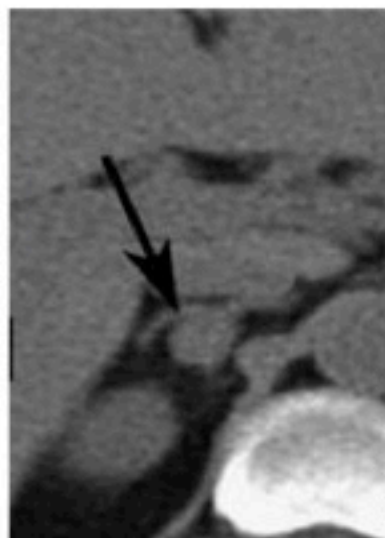
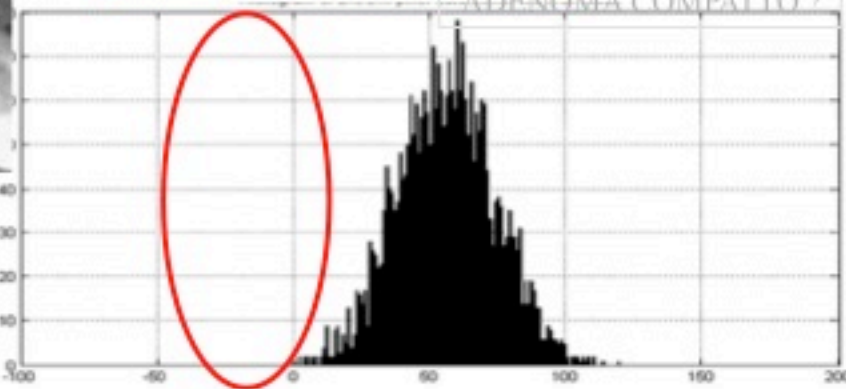
DENSITOMETRICA
ANALISI AD ISTOGRAMMI



PIXELS NEGATIVI
MAGGIORE 10%

MTS SURRENE DX
ADENOCARCINOMA POLMONARE

ADENOMA COMPATTO ?





ESAME CON MEZZO DI CONTRASTO ORGANO-IODATO ENDOVENOSO

POSSIBILITA' DI CARATTERIZZAZIONE ATTRAVERSO VALUTAZIONE

- IMPREGNAZIONE CONTRASTOGRAFICA
 - OMOGENEA - DISOMOGENEA
- ESAME MULTIFASICO

→ Relative percentage washout at 15 min =

$$\frac{70\text{-s attenuation} - 15\text{-min attenuation}}{70\text{-s attenuation}} \times 100$$

→ Absolute percentage washout at 15 min =

$$\frac{70\text{-s attenuation} - 15\text{-min attenuation} \times 100}{70\text{-s attenuation} - \text{unenhanced attenuation}}$$

- TARDIVA (10-15 min) ADENOMA COMPATTO

10 MIN - 15 MIN
≥ 40%

10 MIN ≥ 50%
15 MIN ≥ 60%

RAPIDO WASH-IN / RAPIDO WASH-OUT

DIAGNOSTICA PER IMMAGINI

SURRENI - RUOLO DELL'IMAGING

Roma, 9-12 novembre 2011 **TOMOGRAFIA COMPUTERIZZATA**

IMAGING CON M.D.C. E.V.

ESAME MULTIFASICO
WASH-IN / WASH-OUT



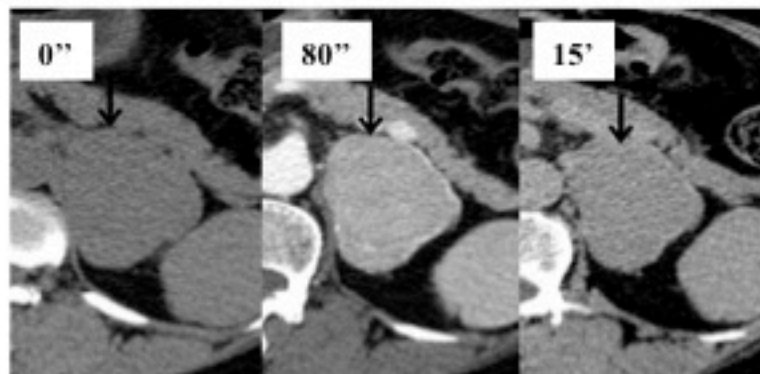
ALTA SPECIFICITA' > 80%

ITALIAN CHAPTER

CARATTERIZZAZIONE ADENOMA COMPATTO AD ESAME BASALE
RAPIDO WASH-IN / RAPIDO WASH-OUT



RPW 61%
APW 78%



DIMENSIONI
RPW 55%
APW 66%

DIAGNOSTICA PER IMMAGINI

SURRENI - RUOLO DELL'IMAGING

Roma, 9-12 novembre 2011

TOMOGRAFIA COMPUTERIZZATA

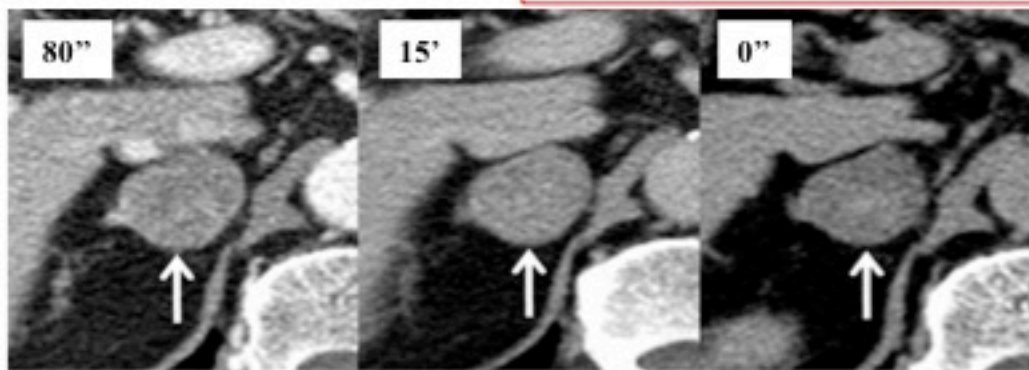
IMAGING CON M.D.C. E.V.

ESAME MULTIFASICO
WASH-IN / WASH-OUT



ITALIAN CHAPTER
ALTA SPECIFICITA' > 80%

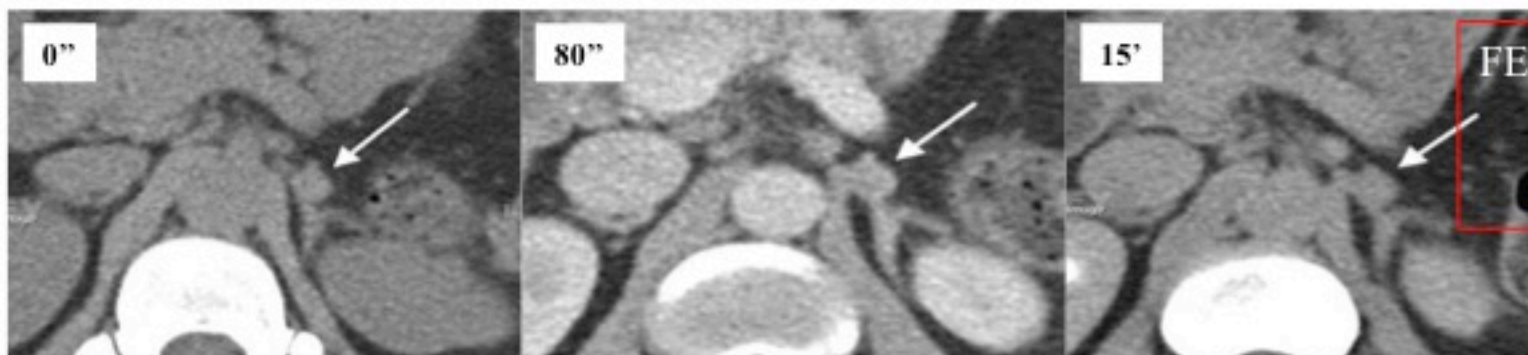
CARATTERIZZAZIONE DI ADENOMA COMPATTO
RAPIDO WASH-IN / LENTO WASH-OUT (NON ADENOMA)



MTS ADENOCARCINOMA POLMONARE

RPW 32%

APW 44%



FEOCROMOCITOMA

DIMENSIONI

RPW 33%

APW 48%