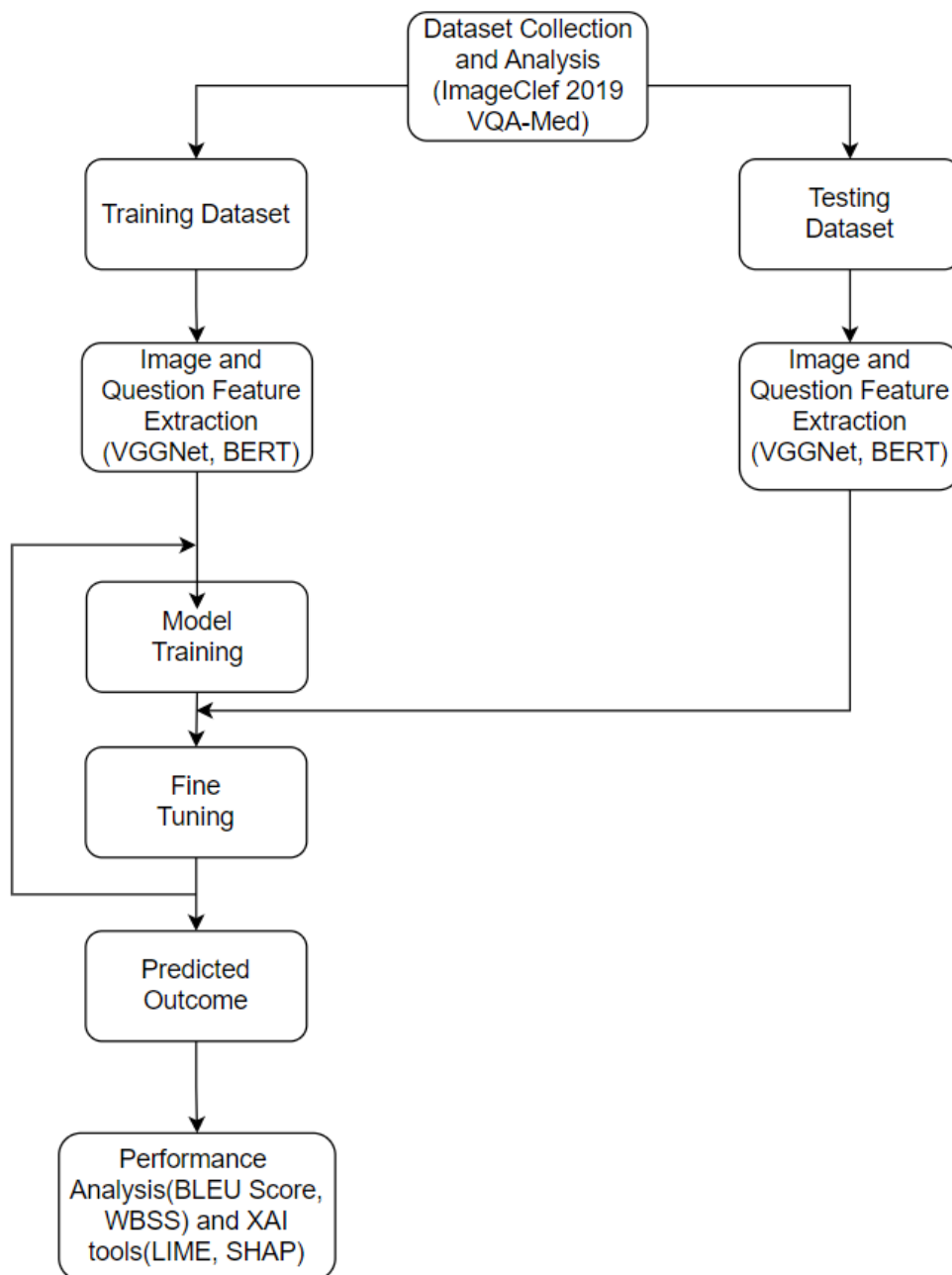# VISUAL QUESTION ANSWERING FOR MEDICAL IMAGES WITH EXPLAINABLE AI

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Third Review - Flow

Proposed System Architecture

1. Dataset Description

Dataset	Images	Question Category	No. of Questions	No. of Classes
Training	3200	Modality	3200	44
		Plane	3200	15
		Organ System	3200	10
		Abnormality	3192	1484
		Total	12792	-
Validation	500	Modality	500	-
		Plane	500	-
		Organ System	500	-
		Abnormality	500	-
		Total	2000	-
Testing	500	All	500	-

2. Performance Analysis

Category	No. of Samples	Accuracy	BLEU Score	WBSS
Modality	125	65.6	68.79	71.66
Plane	125	64.8	64.8	65.35
Organ	125	50.4	53.19	54.82
Abnormality	125	6.4	7.65	12.03
Overall	**500**	**46.8**	**48.61**	**50.97**

Model	Accuracy	BLEU Score	WBSS
Task Winner	62.4	64.4	–
Proposed Model	46.8	48.61	50.97

3. Demo - Answer Generation

Actual Answer: us ultrasound

```
generateAnswer('synpic40333','what imaging modality was used to take this image?')
```
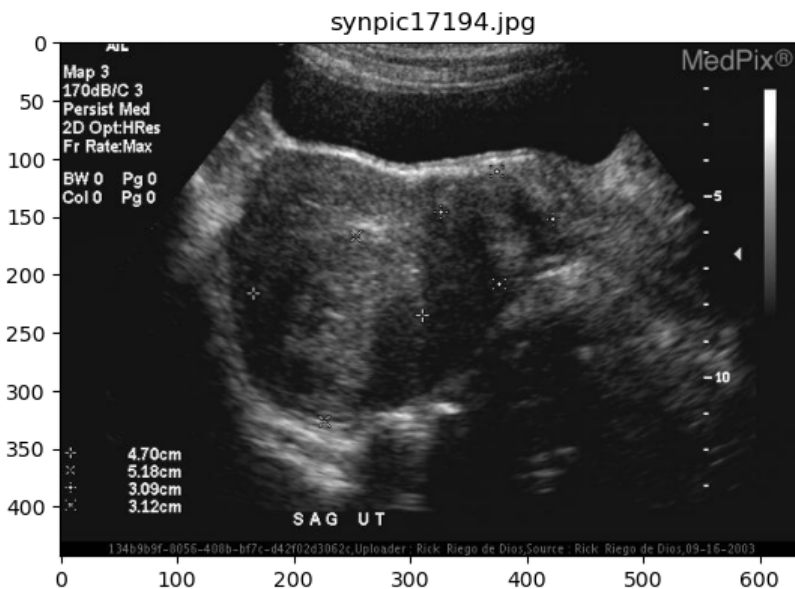
synpic40333.jpg
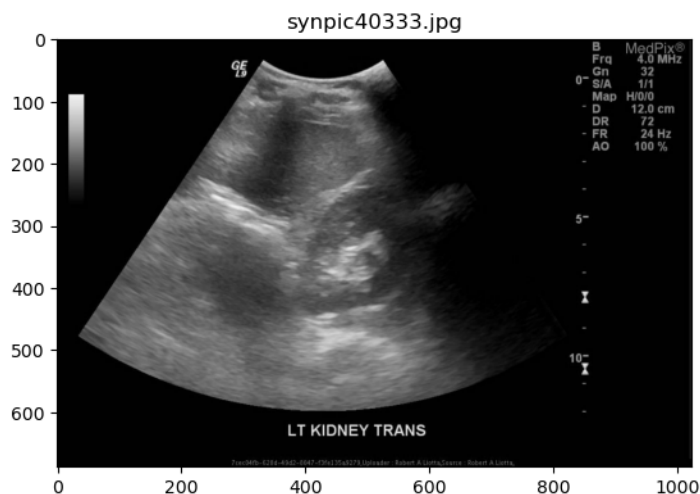

```
Generating Answers...
us
ultrasound
[SEP]

'us ultrasound '
```

Actual Answer: sagittal

```
generateAnswer('synpic17194','what is the plane shown in this image?')
```
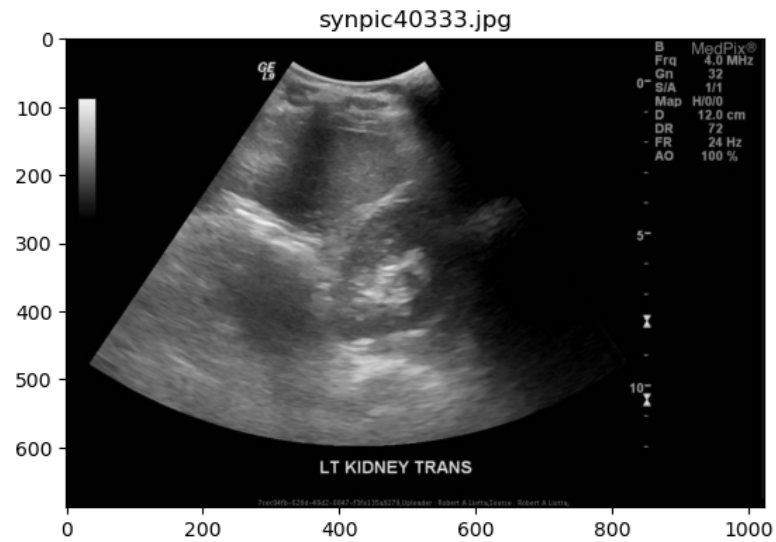
synpic17194.jpg


```
Generating Answers...
sagittal
[SEP]

'sagittal '
```

Actual Answer: gastrointestinal

```
generateAnswer('synpic40333','what organ system is imaged?')
```

synpic40333.jpg


```
Generating Answers...
gastrointestinal
[SEP]

'gastrointestinal '
```

Actual Answer: pancreatic duct adenocarcinoma

```
generateAnswer('synpic18173','what is the primary abnormality in this image')
```
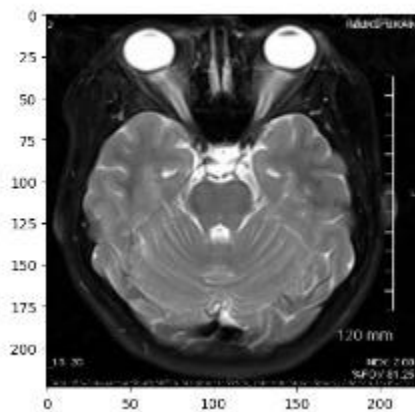
synpic18173.jpg
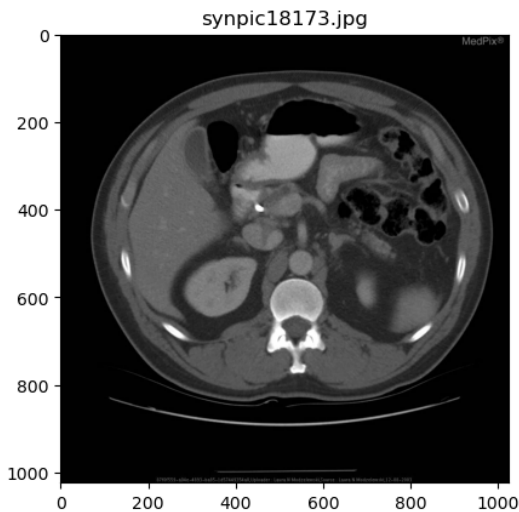

```
Generating Answers...
pancreatic
adenocarcinoma
[SEP]

'pancreatic adenocarcinoma '
```
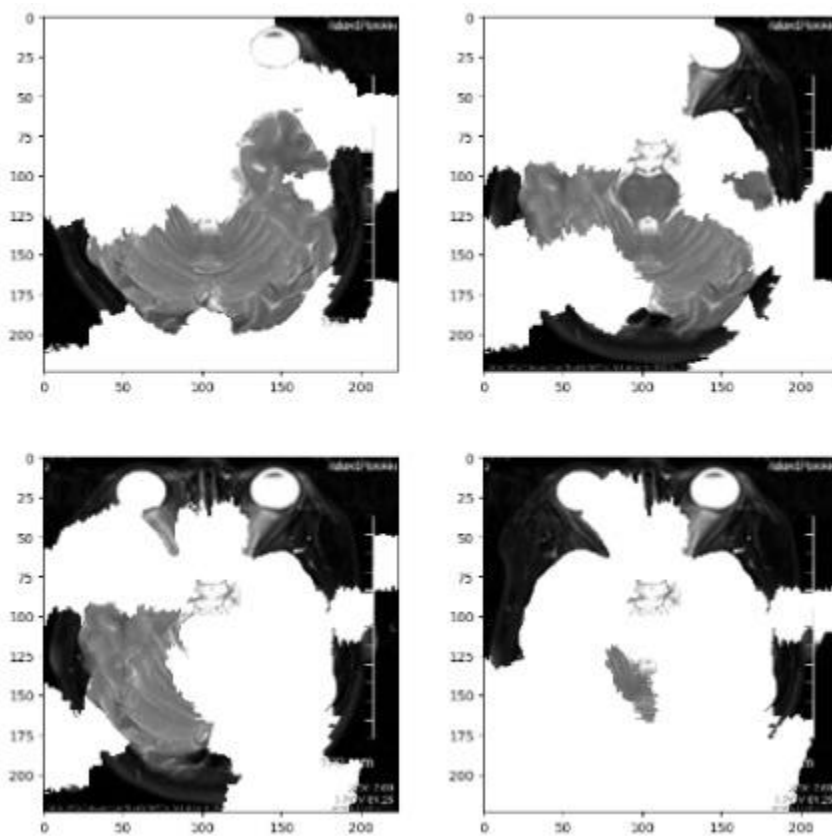
4. XAI Technique - LIME Interpretation

Input Image:

Image ID: synpic56918

Perturbed Dataset:

LIME output for the image queried about the organ

Image ID: synpic56918

LIME Explanations for a set of images with common question about the organ

Question: what organ system is displayed in this image?

Image ID: synpic16333
Actual Answer: skull and contents
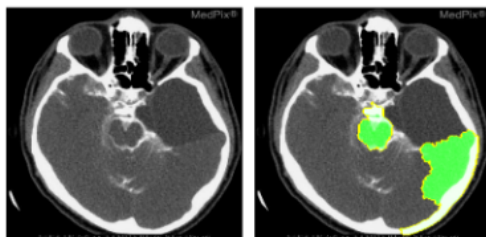**Generated Answer:** face, sinuses and neck

Image ID: synpic53848
Actual Answer: skull and contents
Generated Answer: skull and contents
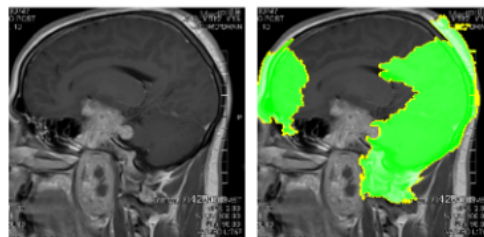
Image ID: synpic31015
Actual Answer: face, sinuses and neck
Generated Answer: face, sinuses and neck

Image ID: synpic56918
Actual Answer: skull and contents
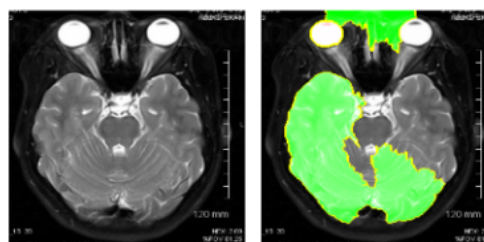**Generated Answer:** skull and contents

Image ID: synpic26227
Actual Answer: musculoskeletal
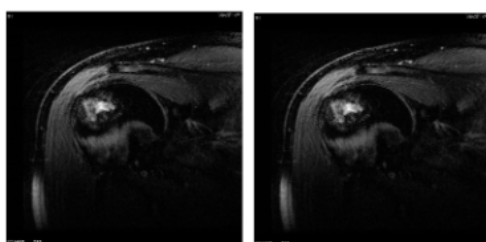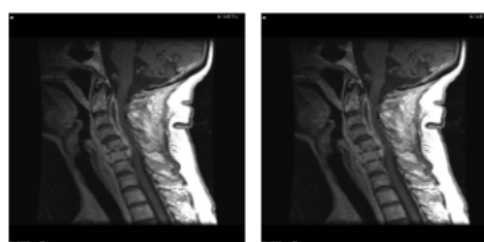**Generated Answer:** musculoskeletal

Image ID: synpic31996
Actual Answer: spine and contents
Generated Answer: spine and contents

LIME Explanations for a single input for 4 different questions of different categories

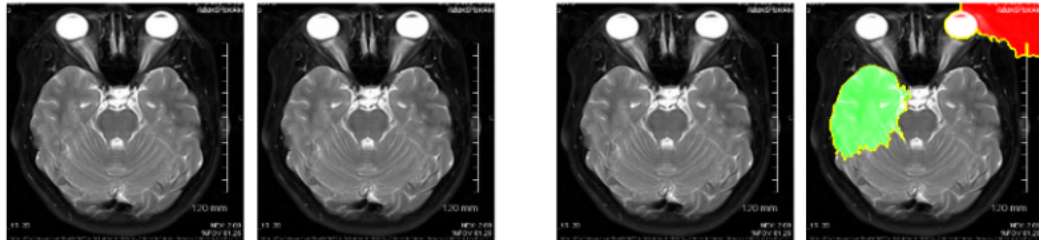### Image ID: synpic56918

Qn: what type of imaging modality is shown?
Actual Answer: mr t2 weighted
Generated Answer: mr t2 weighted

Qn: What is the plane of this image?
Actual Answer: axial
Generated Answer: axial

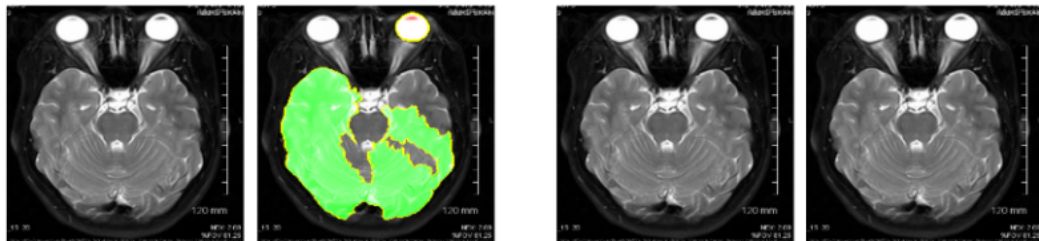**Qn:** what organ system is displayed in this image?
Actual Answer: skull and contents
Generated Answer: skull and contents

Qn: what is the primary abnormality in this image?
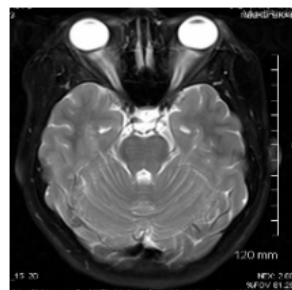**Actual Answer:** pituitary gland cyst
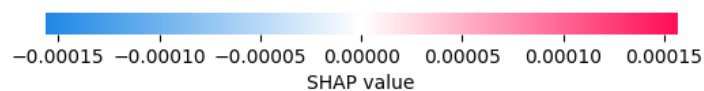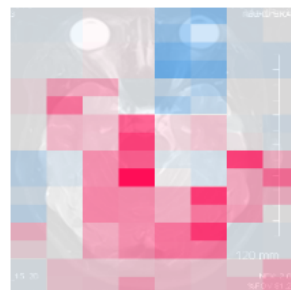**Generated Answer:** cavernous hemangioma

5. XAI Technique - SHAP Interpretation

SHAP output for the image queried about the organ

SHAP Explanations for a set of images with common question about the organ

Question: what organ system is displayed in this image?

Image ID: synpic16333
Actual Answer: skull and contents
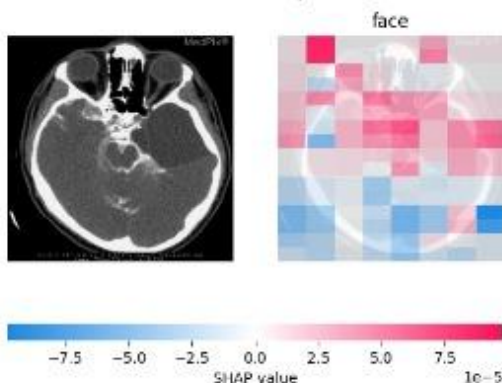Generated Answer: face, sinuses and neck

Image ID: synpic53848
Actual Answer: skull and contents
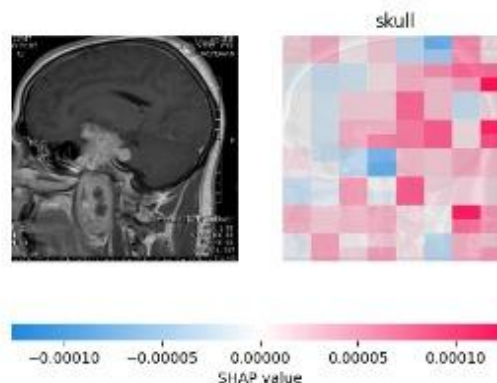Generated Answer: skull and contents

Image ID: synpic31015
Actual Answer: face, sinuses and neck
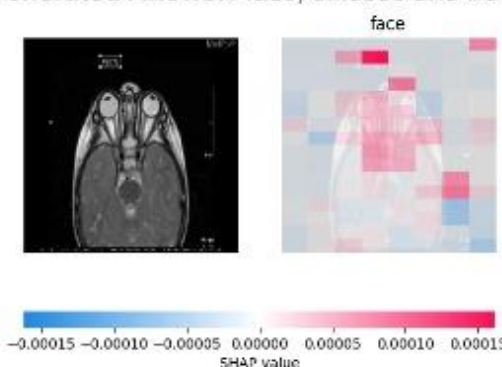Generated Answer: face, sinuses and neck

Image ID: synpic56918
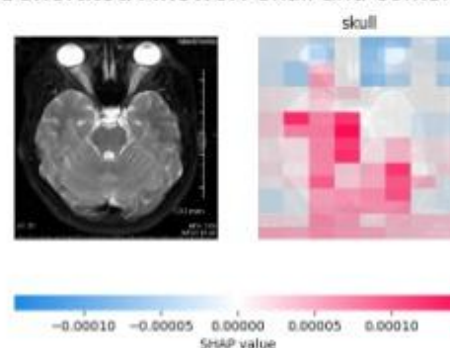Actual Answer: skull and contents
Generated Answer: skull and contents

Image ID: synpic26227
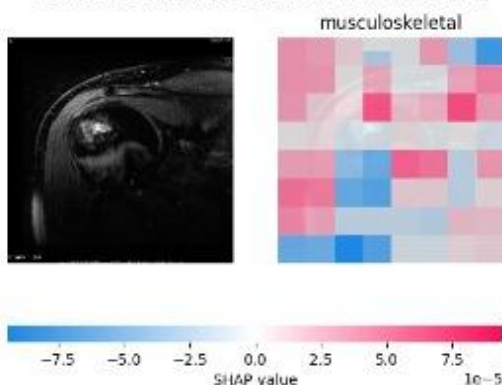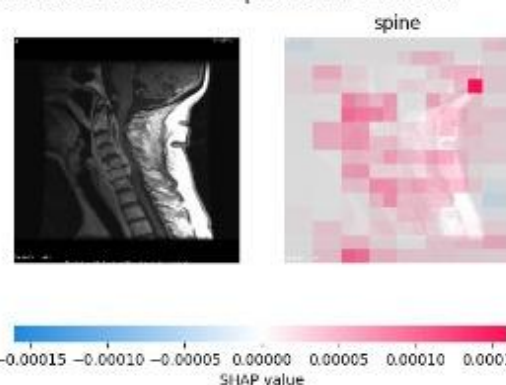Actual Answer: musculoskeletal
Generated Answer: musculoskeletal

Image ID: synpic31996
Actual Answer: spine and contents
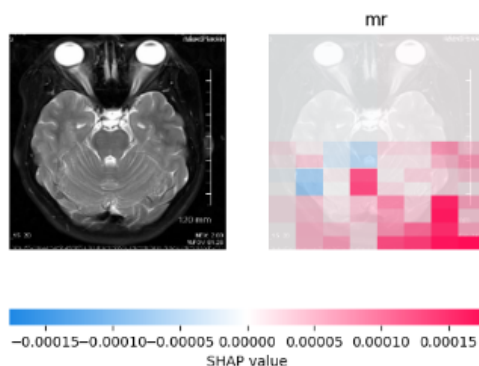Generated Answer: spine and contents

SHAP Explanations for a single input for 4 different questions of different categories

Image ID: synpic56918

Qn: what type of imaging modality is shown?
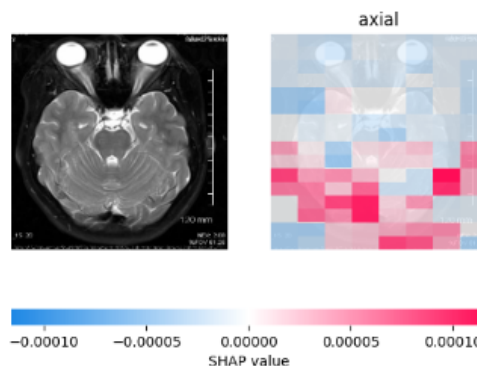**Actual Answer:** mr t2 weighted
Generated Answer: mr t2 weighted

Qn: What is the plane of this image?
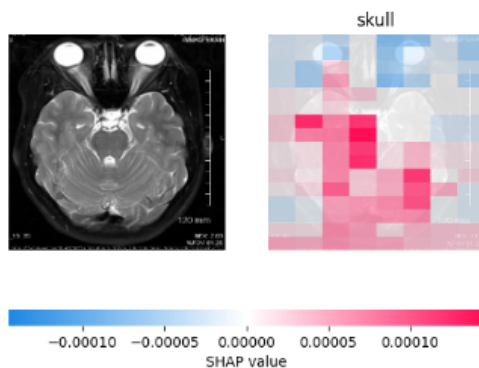**Actual Answer:** axial
Generated Answer: axial

Qn: what organ system is displayed in this image?
Actual Answer: skull and contents
Generated Answer: skull and contents

Qn: what is the primary abnormality in this image?
Actual Answer: pituitary gland cyst
Generated Answer: cavernous hemangioma