Gunshot Wound

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RAD 4001

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Clinical History

- History
  - 33 yo woman presenting with self-inflicted gunshot wound to the head
  - Vital signs stable, GCS 3 (intubated), bilateral breath sounds and palpable distal pulses were present
  - Two ballistic injuries to bilateral temporal regions were present with active brain extravasation on the right

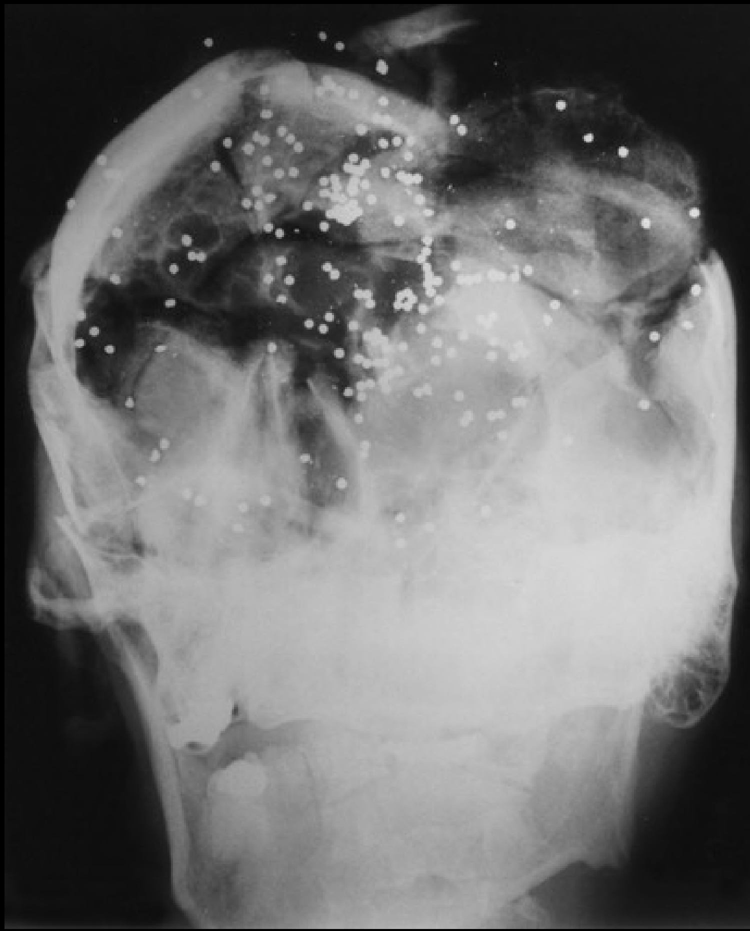
Skull 1 View Dx

Normal

Patient

- Single AP view of the skull demonstrates comminuted skull fractures related to gunshot wound.
- No radiopaque evidence of a retained foreign body (bullet fragments)

Fragments from shotgun wound

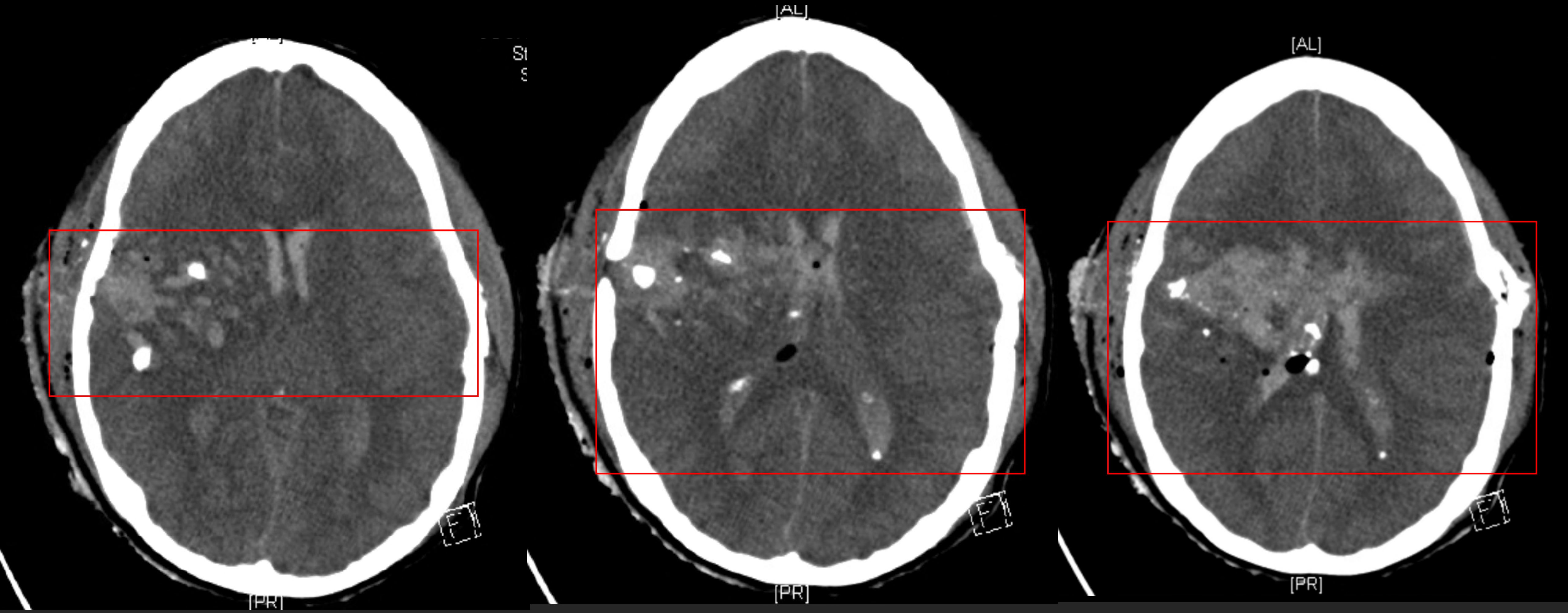


CT Brain w/o Contrast

Extensive multicompartment hemorrhage with right to left travel of the bullet through the frontal lobes leading to intraparenchymal hemorrhage along the bullet tract and consequent displacement of bone fragments into the brain

Mild compartmental hemorrhage including parenchymal hemorrhage in the frontal lobes, intraventricular hemorrhage, subarachnoid hemorrhage over the cerebral convexity

CT Brain w/o Contrast



Brain CTA

Warning: Not for diagnostic use

No injury to the major neck arteries

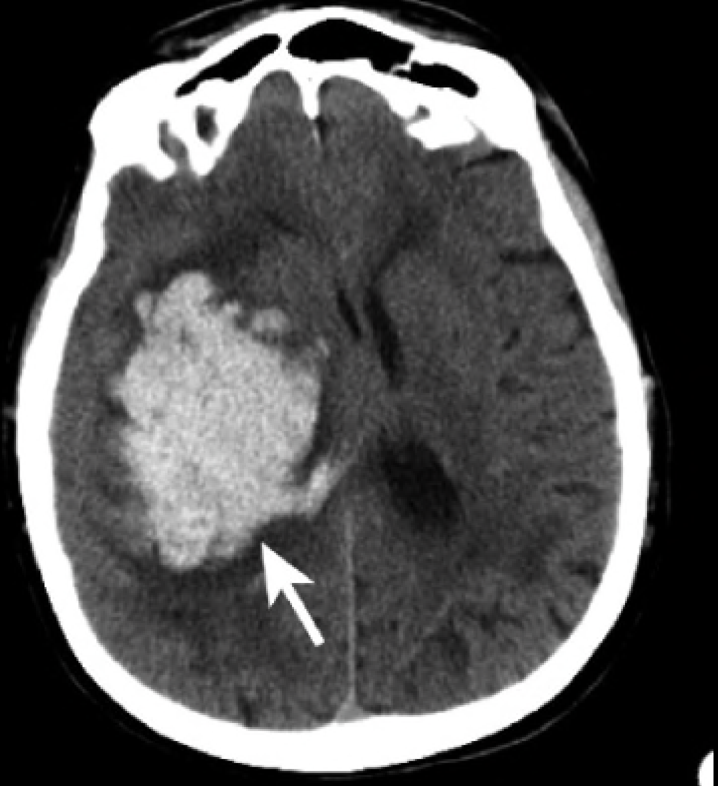
Overall vascular attenuation of the right cerebral hemisphere is diminished compared with the left and the number of MCA branches is considerably reduced

Intracerebral Hemorrhage

non-contrast head CT: right parietotemporal intracerebral hemorrhage

Post op CT demonstrates hemorrhage within the deep frontal lobe that has ruptured into the left lateral ventricle.

Spot sign in a hypertensive patient with a large intraparenchymal hemorrhage



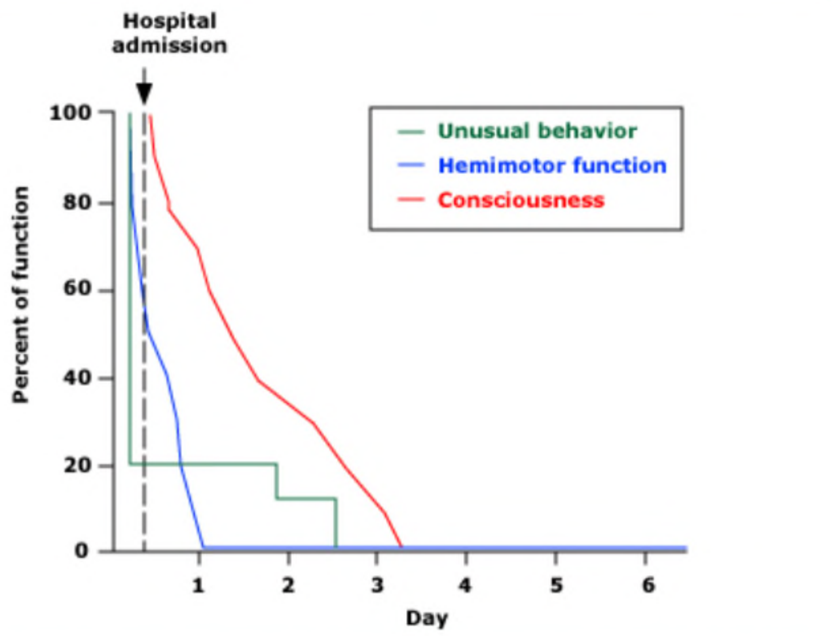
Intracerebral Hemorrhage

- There are many underlying pathological conditions associated with ICH
  - Hypertension
  - Amyloid angiopathy
  - Ruptured saccular aneurysm
  - Vascular malformation
- A traumatic etiology of ICH can be diagnosed with confidence in the patient who has had recent trauma and lesions in the location and with the appearance of contusion and traumatic hemorrhages

Onset and Progression

- Most hypertensive hemorrhages occur during routine activity.
- The neurologic symptoms and signs usually increase gradually over minutes or a few hours in contrast to brain embolism and subarachnoid hemorrhage, where the neurologic symptoms and signs are often maximal at onset.
- Neurologic signs vary depending upon the location of the hemorrhage

Time course of neurologic changes in intracerebral hemorrhage



Schematic representation of rapid downhill course in terms of unusual behavior (green), hemimotor function (blue), and consciousness (red) in a patient with intracerebral (intraparenchymal) hemorrhage.

Imaging

- Neuroimaging with brain computed tomography (CT) or magnetic resonance imaging (MRI) is mandatory to confirm the diagnosis of ICH
- Pre-contrast CT scan is the imaging procedure of choice to evaluate intracerebral hemorrhage. Acute hematoma is seen by pre-contrast CT imaging as an area of high density. CT can detect acute intracerebral blood as small as 2 mm, due to contrast between high density of blood and low density of surrounding brain.
- Once acute ICH is confirmed by imaging, the etiology must be determined based upon clinical and imaging features.
- The main considerations are patient age, associated risk factors (primarily hypertension), and ICH location.

Steps of Evaluation Overview

- Prehospital
  - The primary goal of prehospital management for severe TBI is the prevention and treatment of hypotension and hypoxia, two systemic insults known to be major causes of secondary injury after TBI.
  - Secure airway and administer fluids if needed
- Emergency Department
  - Airway assessment
  - Vitals
  - Neurologic examination including ICP
  - CBC, BMP, toxicology screen

Steps of Evaluation Continued

- Neuroimaging
  - CT is the preferred imaging modality in the acute phase of head trauma and should be performed as quickly as possible, as certain lesions will indicate potentially lifesaving neurosurgical interventions
  - Follow-up CT should be performed if there is any sign of clinical deterioration
- Screening for blunt force cerebrovascular injury
  - Injury to the carotid and vertebral arteries most commonly occurs as a result of skull base or vertebral fractures that involve vulnerable segments of these vessels.

Prognosis

- Cohort studies have suggested that patients with severe head injury (Glasgow Coma Scale [GCS] score ≤8) have approximately a 30 percent risk of death. At least one cohort study found that survivors of TBI continue to have a substantially increased risk of mortality for at least 13 years after the trauma

Treatment

- Wound washed in closed in the ED by neurosurgery
- Supportive care
- Admission to NTICU

ACR appropriateness Criteria

Clinical Condition: **Head Trauma**

Variant 7: **Suspected intracranial arterial injury.**

Radiologic Procedure	Rating	Comments	RRL*
CTA head and neck with IV contrast	9	This procedure is an alternative; either CTA or MRA can be performed, depending on institutional preference.	☢☢☢
MRA head and neck without and with IV contrast	9	This procedure is an alternative; either CTA or MRA can be performed, depending on institutional preference.	O
MRI head without IV contrast	9	This procedure is complementary, in conjunction with MRA.	O
CT head without IV contrast	9	This procedure is complementary, in conjunction with CTA.	☢☢☢
MRA head and neck without IV contrast	7	This procedure is an alternative; either CTA or MRA can be performed, depending on institutional preference.	O
Arteriography cervicocerebral	6		☢☢☢
MRI head without and with IV contrast	3		O
CT head without and with IV contrast	1		☢☢☢
MRI head without IV contrast with DTI	1		O
CT head with IV contrast	1		☢☢☢
X-ray skull	1		☢
Tc-99m HMPAO SPECT head	1		☢☢☢☢
FDG-PET/CT head	1		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 1: **Sudden, severe headache or "worst headache of life." Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
CT head without IV contrast	Usually Appropriate	☢☢☢
CTA head with IV contrast	May Be Appropriate (Disagreement)	☢☢☢
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRI head without and with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
Arteriography cervicocerebral	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢

Imaging Costs

- Ct Head Or Brain W/O Con Charges $3,157 Insured $98
- Ct Angio Head W/O-W Con Charges $4,460 Insured $127
- Ct Head Or Brain W/O Con Uninsured $1,137
- Ct Angio Head W/O-W Con Uninsured $1,606

Take Home Points

- There are many etiologies of intracerebral hemorrhage
- Imaging is a necessary step to determine location and cause of bleed
- Airway and blood pressure management are essential in patients with TBIs

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Questions?