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24/03/2016

Dear Dr. Atalabi,

Re: Essential Surgical Skills for Trauma in Africa: Letter of Acceptance

I am pleased to inform you that your revised manuscript **'Essential Radiology for Trauma in a Primary Health Care Setting'** submitted for publication in the above book has been accepted.

Please accept my hearty congratulations.

It has been sent to the Publishers who will be contacting you directly shortly.

Once again, congratulations.

Sincerely,

E.Oluwabunmi Olapade-Olaopa Esq.
Lead Editor

15

Essential Radiology for Trauma in a Primary Health Care Setting

Omolola M. Atalabi

Introduction

This chapter is to intimate the doctor who must have had some background training in radiology with the essential radiological investigations required for trauma patients who can be managed in a non-tertiary hospital setting. In addition, the doctor should be able to correctly interpret the radiograph which will inform the decision whether or not to refer the patient to a bigger hospital with facilities for the next level of care.

It is assumed that the primary health care setting has a well-trained and board certified radiographer or technician who can operate the available basic x-ray equipment. The doctor should be able to perform and interpret basic abdominal and pelvic ultrasound scans, the findings of which will guide the doctor on the care needed by the patient. A good history and thorough clinical examination are the first steps to guide the request for the appropriate investigation.

The aims of initial evaluation of any trauma patient are:

i. To identify any life-threatening condition
ii. To stabilize the patient
iii. To carry out relevant investigations to identify suspected conditions (Laboratory and Radiology)
iv. To commence definitive treatment or arrange for transfer to a hospital with the necessary facilities if warranted.

Note: It is important to note that though examinations are important, the patient's clinical condition must be stabilized first in order to reduce morbidity and mortality.

There are two imaging modalities/equipment that are widely available and will serve useful purposes in imaging various trauma conditions in non-tertiary health care settings. These are:

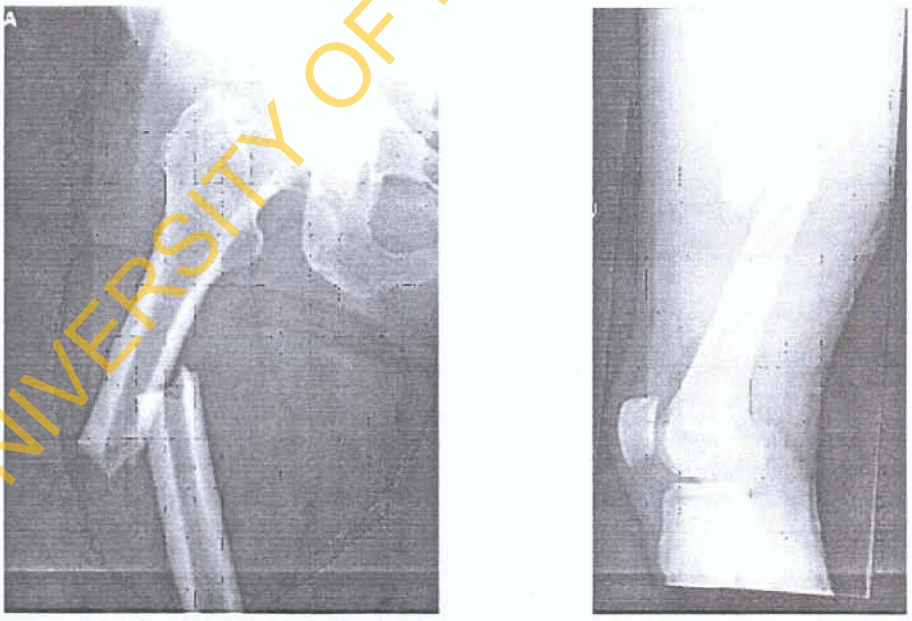
1. Conventional x-ray machine
2. Ultrasound machine

For ease of understanding, radiological investigations will be highlighted using the following body anatomical regions:

1. Appendages
2. Abdomen and pelvis
3. Chest
4. Head and Neck
5. Spine
6. Obstetrics

Appendages (Bone Fractures)

The long bones and those of the hands and feet are most commonly fractured in trauma. A plain x-ray is the imaging modality used for identifying bony fractures. It is important to do antero-posterior (A-P) (fig. 15.1(a) and lateral views of the affected bone. Occasionally, a tangential view may be required, especially when the small bones like the phalanges, carpal or metacarpal bones are involved.



a b

Figure 15.1 Antero-posterior (a) and lateral (b) radiographs of the femur showing displaced simple fracture.

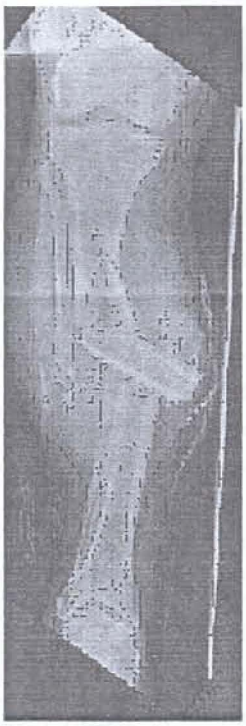


Figure 15.2 Radiograph showing comminuted facture of tibia and fibula.

Ensure that at least one joint, either above or below and related to the fractured bone, is shown on the radiograph.

The type of fracture will dictate the type of treatment given. Simple fractures can be treated at a non-tertiary health facility while a more complex fracture should be promptly referred to avoid life-long disability.

Simple fractures can be managed in the primary health care setting but a comminuted fracture (see fig. 15.2) must be referred for expert management.

Abdomen and Pelvis

Injuries in this area of the body can involve the abdominopelvic organs or the bony pelvis. Affected patients are also prone to internal haemorrhage; therefore the ABCD of resuscitation should be strictly adhered to and these injuries sought for.

X-ray:

- A plain erect A-P x-ray of the abdomen should be performed to rule out air under the diaphragm which indicates that there is perforated viscous.
- A lateral shoot-through should be performed for patients who cannot stand or sit up.
- A-P and lateral x-rays of the pelvic bones should be done to rule out bony fractures.

Ultrasound Scan: It is imperative that the intra-abdominal organs be examined using ultrasound. The liver, spleen and kidneys are the major organs that can be injured. Look out for evidence of lacerations of varying degrees, contusions and rupture of these organs in the scan.

Ultrasound can also be used to detect a small amount of intra-abdominal fluid collection in Morrison's pouch (the potential space that separates the right kidney from the liver) and paracolic gutters. Intraperitoneal fluid collection in a trauma patient is considered a positive sign for haemoperitoneum.

Cystogram: This special investigation may be necessary to rule out urinary bladder rupture. About 20-30mls of Urografin contrast medium is diluted with water for injection to make up 100mls of diluted contrast and introduced into the urinary bladder through an in-dwelling Foley's catheter. An A-P radiograph of the pelvis is done. If there is leakage of the contrast in the area surrounding the loops of bowel, between mesenteric folds and in the paracolic gutters (fig. 15.3), the patient has intraperitoneal bladder rupture. If on the other hand, there is a variable path of extravasation of contrast which may give a flame-shaped appearance (fig. 15.4), the patient has extra-peritoneal bladder rupture and the patient should be referred immediately.

Figure 15.3 Intraperitoneal bladder rupture showing contrast tacking around the loops of bowel and paracolic gutters.

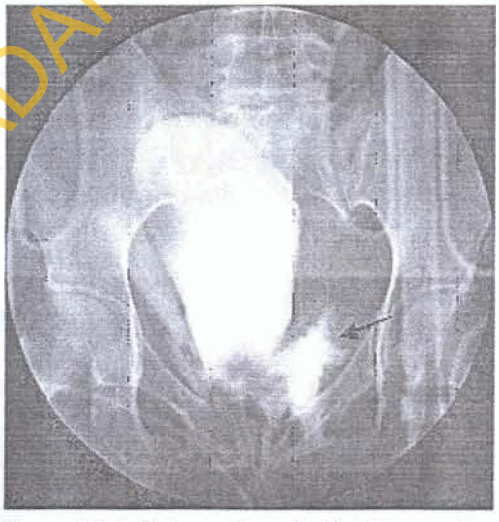


Figure 15.4 Extraperitoneal bladder rupture showing a flame-shaped leakage (arrow) of contrast in the pelvis.

Urethrogram: This is used to assess the degree of urethral injury. 50mls of Urografin contrast medium is diluted with 50 mls of water for injection to make 100mls. The diluted contrast is introduced into the urethra through an appropriate-sized Foley's catheter which is secured at the level of the fossa navicularis. An oblique radiograph of the penile shaft is taken while the contrast is being injected. Extravasation of the contrast (fig. 15.5) suggests urethral rupture.

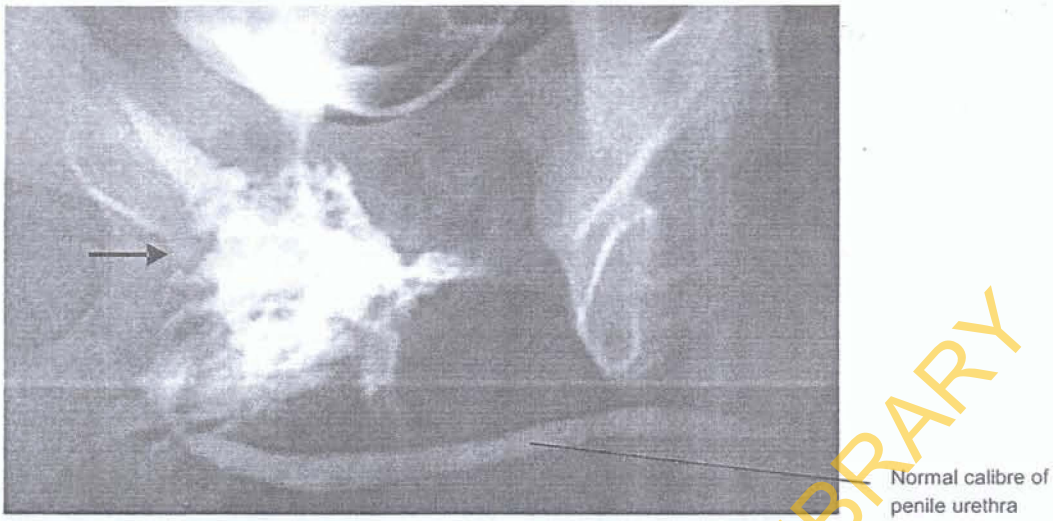


Figure 15.5 Extravasations of contrast (arrow) from rupture of the membrano-prostatic urethra.

➢ Chest

The chest is the most x-rayed part of the body. An antero- posterior x- ray of the chest (fig. 15.6) may reveal clavicular and rib fractures. Trace the outline and cortex of each rib meticulously from the posterior end to the anterior end. Look out for subtle (hairline) discontinuation of the bony cortex.

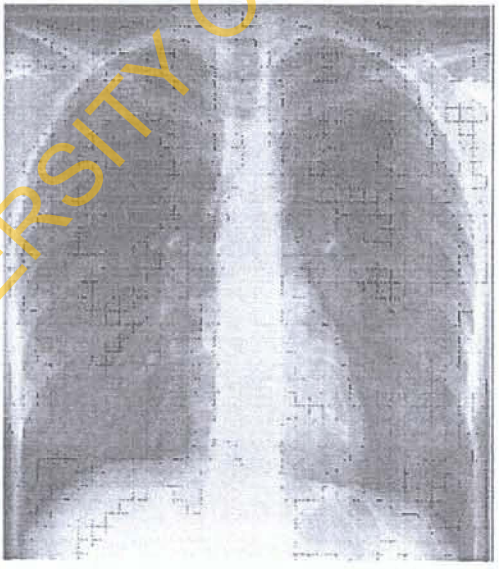


Figure 15.6 Normal postero-anterior (PA) chest x-ray.

- Lateral radiographs are important to look out for subtle hairline factures. Occasionally a tangential view of the suspected area might be necessary.
- Look out for a rib or ribs fractured in two places (fig. 15.7). This condition may result in a 'flail chest' and this is responsible for paradoxical movement of the chest wall during respiration. This is an acute emergency which requires immediate intervention.
- Subcutaneous emphysema, pneumothorax, haemothorax and lung collapse should be carefully sought for. Depending on the severity, there will be a shift of the mediastinum (fig. 15.8) to the contralateral (opposite) side.

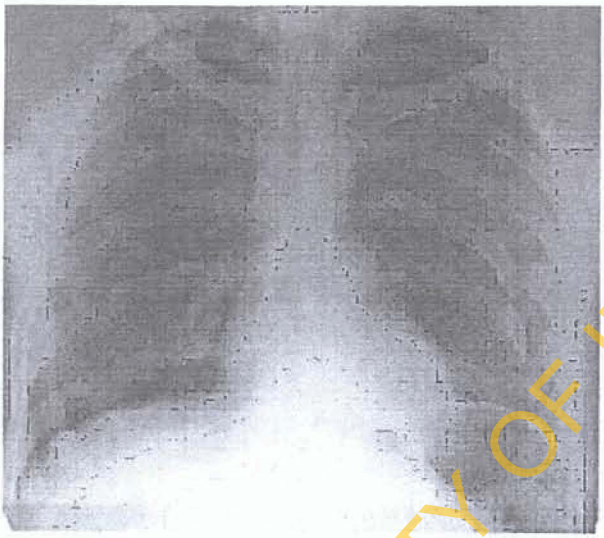


Figure 15.7 Postero-anterior chest radiograph showing multiple rib fractures with some ribs fractured in two places.

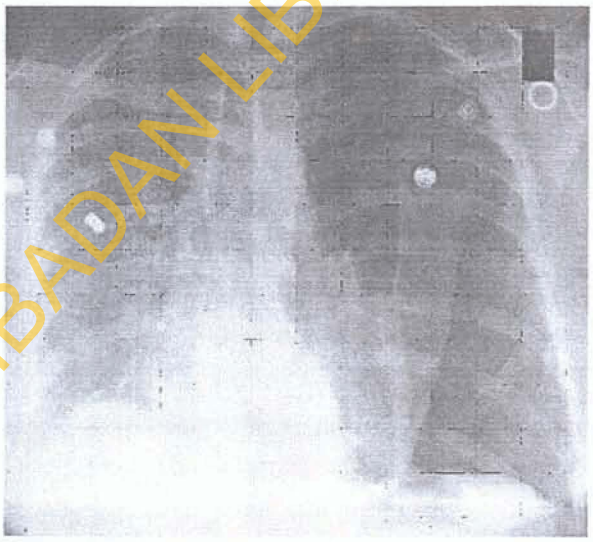


Figure 15.8 Chest radiograph showing pneumothorax, lung collapse on the left hemithorax and shift of the mediastinum to the contralateral side.

Signs of pulmonary oedema or congestion should also be looked for. This is an indication of fluid in the alveolar space and may show on a chest x-ray as:

1. Kerley B lines (fig. 15.9)
2. Patchy alveolar infiltrates : cotton wool appearance (fig. 15.10)
3. Bilateral hilar opacities giving the ' Bat wing' appearance
4. Pleural effusion

A globular heart (fig. 15.11) may be due to pericardial effusion and pneumo-pericardium and these should also be excluded.

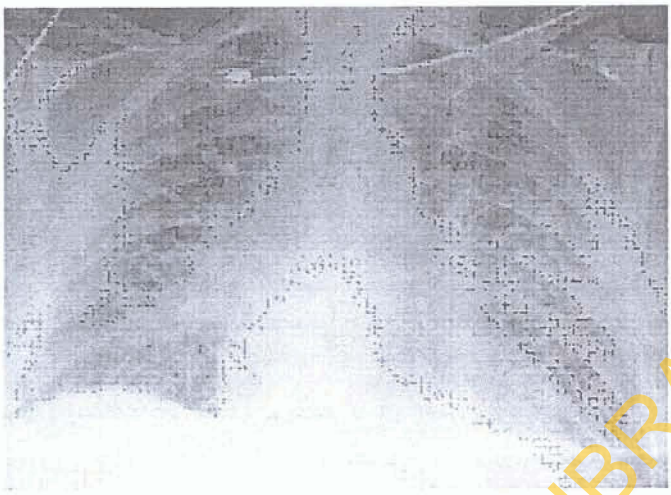


Figure 15.9 Postero-anterior chest radiograph showing alveolar infiltration that is more concentrated in the peri-hilar region. Notice how the streaky opacities fan out from the hilar region.

Figure 15.10 Postero-anterior chest radiograph showing the typical cotton wool appearance often associated with pulmonary oedema.

Figure 15.11 PA chest radiograph showing a globular heart.

➢ Head and Neck

Trauma to the head and neck is very common. Affected patients are better investigated in bigger hospitals with facilities such as the computerized tomography machine. Care must be taken when moving the patient on and off the x-ray table to avoid destabilizing fractures, especially those of the spine.

Computerized tomography (CT) is the accepted standard radiological investigation for trauma patients, however, in primary health care settings where CT is not likely to be available; a plain x-ray of the skull can be done.

Craniofacial injuries are usually severe and clinical examination may just be all that is needed for patient referral. In addition, care must be taken not to take special views that can worsen the patient's condition. It is safer to take A-P and lateral skull x-ray and leave other views to be taken in hospitals with better facilities. Antero-posterior and lateral views are sufficient to make initial judgement, especially in a primary health care setting.

It is important not to confuse cranial sutures with fracture lines. Suture lines are serrated (fig. 15.12) while those of fractures are not.

Figure 15.12 Lateral x-ray of the skull. Note the serrated lambdoid suture (arrow) in the occipital area, as opposed to the fracture lines (arrowheads).

Antero-posterior view will allow assessment of the following:

- Sutures – These are seen as serrated interlocking lucent lines.
  - Sagittal suture (in the midline)
  - Coronal suture (across the frontal bone)
- The bony orbit
- Frontal sinuses

- Maxillary sinuses (two triangular outlined lucencies on both sides of the nasal bone.
- Ethmoidal air cells (rounded lucencies in between the orbits).
- The alveolar bone and the upper set of teeth

Air-fluid level within the sinuses should be identified. Complex facial (Le Fort) fractures should be identified and referred to the appropriate surgeons (maxillofacial).

Lateral view - The right and the left structures of the head are superimposed on one another. It allows assessment of the following:

- The skull bone appears opaque (outer and inner tables with the diploe space in between)
- The lambdoid suture (across the occipital bone)
- The sella
- The sphenoid sinus (band like lucency below the sella)
- The maxillary sinuses
- The ethmoidal air cells
- The nasal bone
- The tempero-mandibular joint (TMJ)
- The mastoid air cell

Other special views used in assessing the skull include :

i. Occipito frontal (OF) view
ii. Occipito mental (open mouth) view is used to assess the atlanto-axis complex, especially fractures of the odontoid peg.
iii. Town's (Half axial) view
iv. Submento vertical view
v. Tangential view for detecting depressed skull fracture

If there is bleeding from the ear and nose, the patient probably has a fracture at the base of the skull, and time should not be wasted in performing x-rays. The patient should be stabilized and promptly referred to a tertiary health centre.

Facial bone fractures (fig. 15.13) are usually comminuted and can be classified into three types based on Le Fort classification (see chapter 6 pp.43-44). All patients with any type of facial bone fracture should be promptly referred.

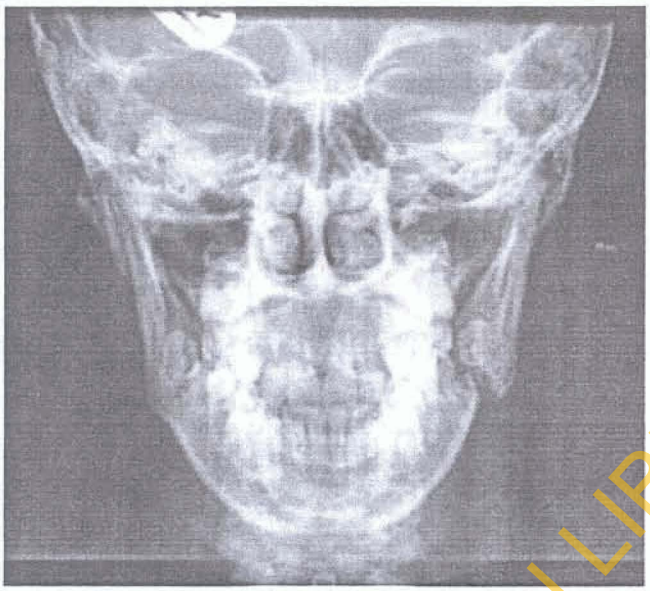


Figure 15.13 Radiograph showing facial fracture of the ramus of the left mandible.

➢ **SPINE:**

Extreme care must be taken when imaging the spine to avoid injury to the spinal cord.

i. Antero-posterior x-ray of the segment of interest (cervical, thoracic or lumbo-sacral) is usually sufficient.

ii. The vertebral bodies, pedicles, spinous processes must be examined for fractures.

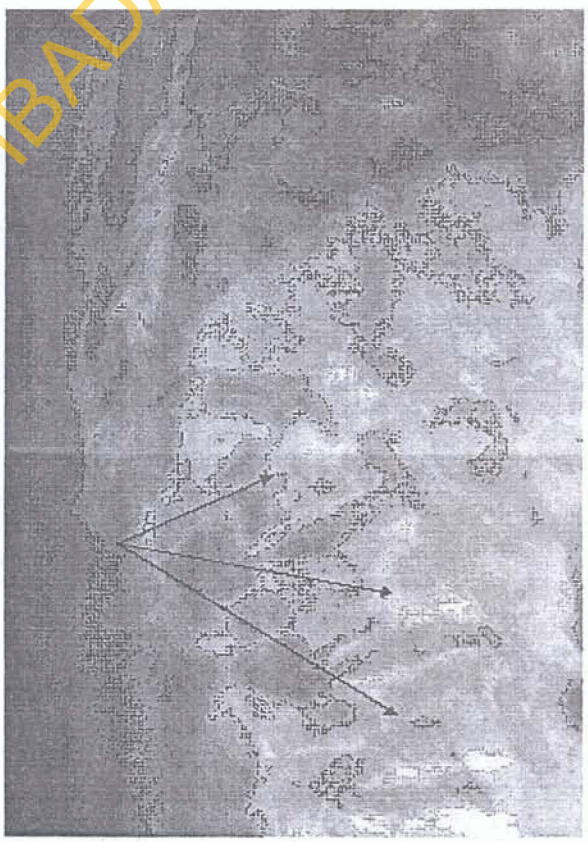


Figure 15.14 Lateral x-ray of the spine showing fractures of multiple vertebrae.

➢ Obstetrics

Pregnant women involved in accidents would require obstetric ultrasound to assess the wellbeing of the foetus. Ultrasound is the most valuable equipment in imaging obstetric and gynaecological emergencies even in the tertiary centre. Most hospitals have an ultrasound machine in strategic areas of the department. The patient should be scanned in both the longitudinal and transverse planes.

1st Trimester

- Full bladder is required.
- Look for foetal echo and ensure there is cardiac activity from 6 weeks gestation and the embryo should be more than 5mm in length. The B mode of the ultrasound machine should be used. The M mode can be used to obtain accurate heartbeat rate.
- Is pregnancy single or multiple?
- Assess the gestational age using the gestational sac or the crown hump length.
- Placenta location –At this stage, you cannot decide if the placenta is previa or not.
- Assess the adnexea and pouch of Douglas to rule out ectopic gestation.

Figure 15.15 Normal first trimester ultrasound scan showing the foetus in the uterus surrounded by amniotic fluid.

2nd and 3rd Trimesters

- Full bladder not necessary as the uterus has grown out of the pelvic region.
- Look for the heart beat and record the number of beats using both the B and M modes of the machine. Normal heart beat is usually between 110 to 180 beats per minute.

- Determine the GA by using at least 2 methods (biparietal diameter, head circumference, femur length, abdominal circumference)
- The estimated foetal weight is usually calculated using a combination of the above GA methods depending on the machine used.
- Check for the placenta location, rule out any type of placenta previa. This is very important, especially if the patient is bleeding per vagina. This may be due to placenta abruption (fig. 15.16), i.e. separation of the placenta from lining of the wall of the uterus.

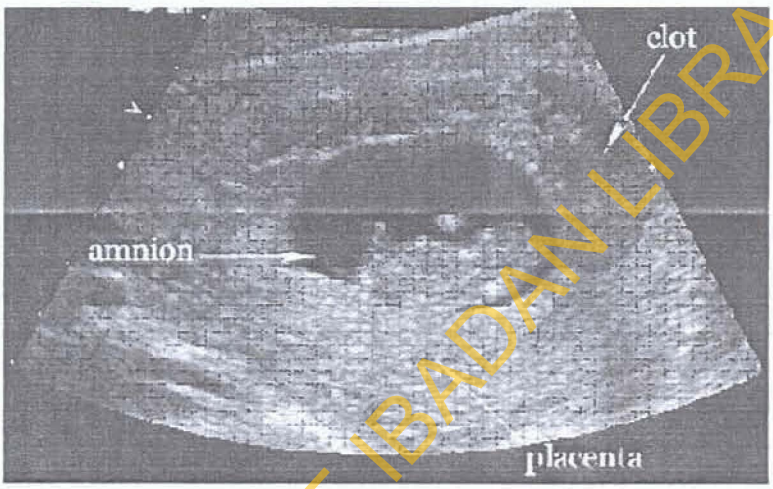


Figure 15.16 Obstetric ultrasound showing placenta abruption.

- Check for other placenta abnormalities such as calcification or evidence of abruption (premature separation of the placenta from the lining of the wall of the uterus). In this latter situation, there is fluid between the detached placenta and the uterine wall.
- Estimate the amount of liquor – adequate, reduced or excessive. Low level echoes seen in the liquor suggest bleeding, probably from the placenta.
- Check the adnexea and the pouch of Douglas for possible fluid collection (haemoperitoneum).

Figure 15.17 Normal second trimester ultrasound scan. Note the reduction in amniotic fluid as the foetus has increased in size.

Conclusion

This chapter does not cover all trauma conditions that may warrant emergency radiological investigations in a primary health care setting. It is therefore safer, if in doubt, to refer the patient to a better-equipped/staffed health facility.

Further Reading

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