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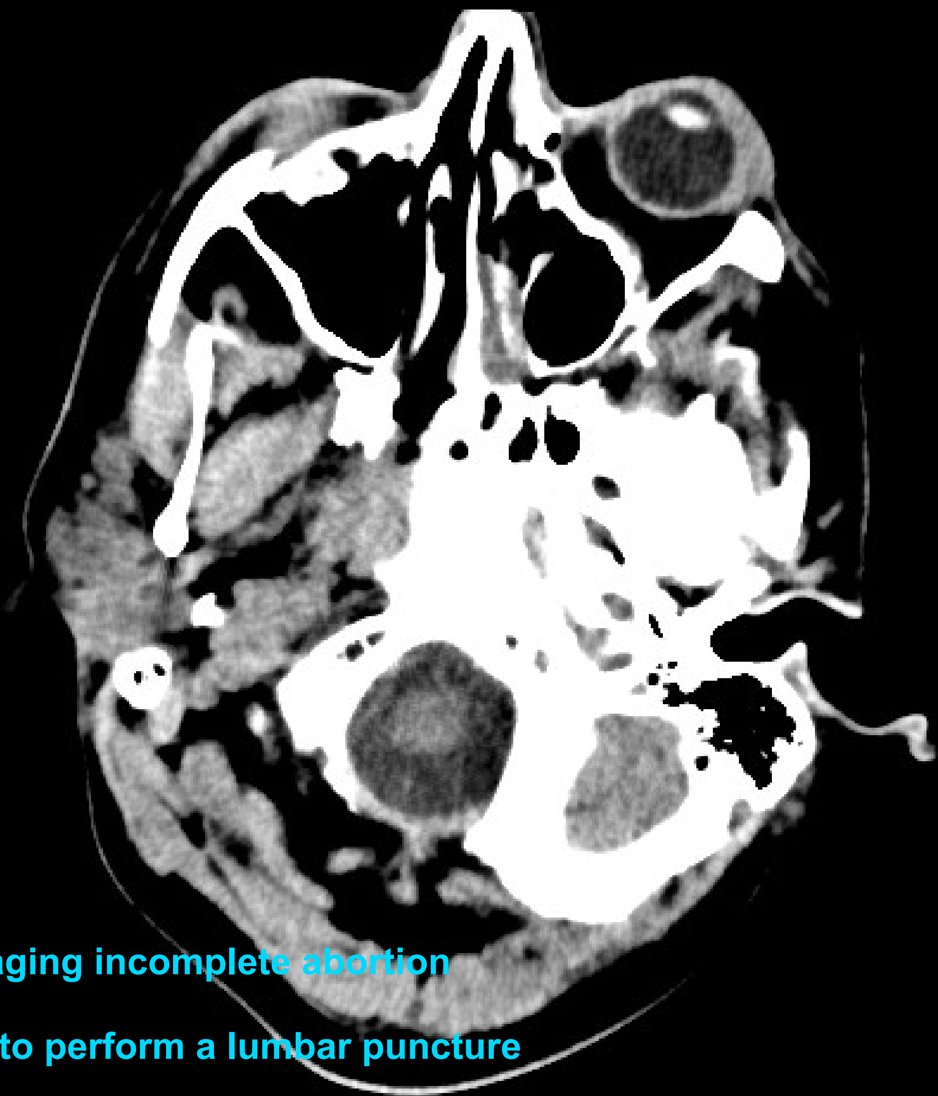
Interpreting an unenhanced CT brain scan



- Managing incomplete abortion
- How to perform a lumbar puncture
- Nurse-led diabetes clinic setup
- Epilepsy management

CONTENTS

Front cover photo: The lowest CT axial slice demonstrates sufficient CSF surrounding the medulla oblongata, indicating that tonsillar herniation is not occurring. See article on page 79. Photo credit: Ashford and St. Peter's Hospitals NHS Foundation Trust.

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All children should enjoy the benefits of immunization

Immunization is one of the most beneficial public health interventions of our time, protecting the population from preventable diseases (like poliomyelitis, diphtheria, measles, whooping cough, and pneumonia) and death. In 2008, the World Health Organization estimated that 17% of deaths in children aged under 5 years were due to preventable diseases[1], representing 1.5 million deaths. This is a colossal yet avoidable loss.

Despite the improvements made in global immunization coverage, a substantial number of children remain at risk. Eighty-six percent of children worldwide received three doses of a diphtheria-, tetanus- and pertussis-containing vaccine (DTP3)[2] in 2015, leaving an estimated 19.4 million children, corresponding to 1 in 7 children, under or unimmunized[3]. In South Sudan the situation is even grimmer, 1 in 2 children missed lifesaving immunization services in 2015[4]. Children who are under or unimmunized miss out on its benefits, and ultimately are deprived of their right to good health and life.

No child should die of a preventable disease, especially in the era of available potent and improved vaccines. Because of the benefits of immunization, access and uptake barriers should be identified and tackled promptly. Important barriers include lack of knowledge about the benefits or availability of immunization services among parents and guardians, poor access to health services due to physical or political challenges, restrictive traditional beliefs, and poverty. These barriers and the prevailing situation in South Sudan, which is characterized by transient populations, mass displacements, and pockets of insecure areas, lead to many children not having access to basic health services, including to life-saving immunization services. *A field experience in 2014 revealed that communities living along administrative boundaries frequently missed scheduled immunization services because of the uncertainty around who had the mandate to deliver immunization services in these communities.* It is these types of complexities that hinder access and sustained use of immunization services in South Sudan, leading to a high number of children missing vaccinations and being unnecessarily exposed to preventable diseases and death.

IN SOUTH SUDAN 1 IN 2 CHILDREN MISSED LIFESAVING IMMUNIZATION SERVICES

These barriers notwithstanding, deliberate efforts must be made to reach all children. First, communities with no or little access to immunization services should be identified. Second, factors affecting access and uptake of immunization services in these communities should also be identified. Thirdly, during planning at national and subnational level, the needs of these communities should be prioritized and measures instituted to enable tracking of progress. Lastly, beneficiaries should be part and parcel of the planning, implementation, and monitoring of immunization services. It is everyone's (community members, government, and private for-profit and non-profit organizations) responsibility to make the benefits of immunization accessible to all children, most especially children in South Sudan who are in a very precarious situation.

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1. http://apps.who.int/immunization_monitoring/diseases/en/ and http://www.who.int/gho/immunization/en/ - 2008
2. DPT3 is used as the main indicator of immunization coverage as it captures the ability of the system to identify and routinely administer three doses of vaccine to the same children.
3. WHO. Global Health Observatory Data Repository, 2015. http://apps.who.int/gho/data/view.main.CM1300RWB?lang=en
4. http://www.who.int/immunization/monitoring_surveillance/data/ssd.pdf

Comparison of manual vacuum aspiration and misoprostol in the management of incomplete abortion

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Background: Incomplete abortions can be managed expectantly, surgically and medically (using misoprostol). Expectant management is safe in places where women have access to information, appropriate care and follow-up; however, in isolated and poor areas women who come for help need an intervention.

Objective: To compare the efficiency of manual vacuum aspiration (MVA) and misoprostol in the treatment of incomplete abortion.

Patients and method: This was a prospective study over five months from March to August 2015. All patients admitted with a diagnosis of incomplete abortion were recruited into the study.

Results: 308 patients with incomplete abortion were randomized into two treatment groups - MVA (done under local anaesthesia) and misoprostol (400 micrograms by the vaginal route). MVA was successfully performed for all patients. Two patients presented with anaemia. In the misoprostol group, 23 patients had vaginal bleeding, and 10 persistence of incomplete abortion.

Conclusion: MVA is more effective than misoprostol with less complications in the treatment of incomplete abortion when it is done by a trained person.

Key words: incomplete abortion, manual vacuum aspiration, misoprostol, management, Chad

Introduction

Incomplete abortion contributes disproportionately to maternal morbidity and mortality in developing countries [1]. According to the World Health Organization 87,000 maternal deaths due to incomplete abortion are recorded yearly in developing countries [2]. Incomplete abortions can be managed expectantly, surgically and medically (using misoprostol with or without mifeprostone). Surgical management has been the standard of care worldwide for many years, and its safety and effectiveness is well proven where there is high-quality medical care [3]. In Chad, surgical treatment of incomplete abortion, either spontaneous or induced, involves evacuation of the uterus with MVA or sharp curettage. MVA was a recent (2010) addition to the management of incomplete abortion in our units and other hospitals in N'Djamana [4]. Medical management of incomplete abortion using misoprostol is gaining ground as a feasible, and low cost means of uterine evacuation [1].

Our study aimed to compare the efficiency of MVA and misoprostol in the treatment of incomplete abortion at N'djamena Mother and Child hospital.

Methods and Patients

This was a prospective study over five months from March to August 2015. All patients admitted for incomplete abortion were recruited. Each patient was given a detailed explanation of both options of management and written consent obtained for the study. Patients that declined to take part and those with a diagnosis in addition to incomplete miscarriage were excluded from the study. The patients were randomised into the two groups depending on the content of the envelope the patient picked from a box containing an equal number of envelopes for each group.

The procedure of manual vacuum aspiration was done under local anaesthesia. Those in the misoprostol group received 400 micrograms of misoprostol by the vaginal route.

Data were collected and analysed using EPI INFO 3.5.1 software.

Results

We registered 308 patients with incomplete abortion. The majority (n=292/308 i.e 94.8%) presented with spontaneous abortion. The remaining 16 were induced abortions (5.2%). In the two groups the majority of abortions occurred after 12 weeks of pregnancy.

MVA was successfully performed for all patients. Two patients presented with anaemia linked with MVA which required hospitalization. No uterine perforation was noted in the group of MVA.

In the misoprostol group, 23 patients had significant vaginal bleeding (14.9%), 10 patients (6.5%) had retained placental tissue that required further intervention. All patients who received misoprostol complained of abdominal pain. A few patients in the misoprostol group reported having fever n= 12(7.8%) or vomiting n= 5 (3.2%).

Patients were treated with amoxicillin and metronidazole to prevent infection.

In the MVA group, the majority of patients stayed in hospital for less than 12 hours. In the misoprostol group, the hospitalization period was 13 – 24 hours for two thirds of patients and more than 24 hours for the remaining third.

Table 1. Period during pregnancy when abortion occurred

Period	MVA group	Misoprostol Group
	n (%)	n (%)
≤ 12 weeks	34 (22.1)	40 (26.0)
> 12 weeks	120 (77.9)	114 (74.0)
Total	**154 (100)**	**154 (100)**

Table 2. Duration of hospitalization

Period	MVA group	Misoprostol Group
	n (%)	n (%)
≤12	139 (90.3)	00 (0)
24 – 13	13 (8.4)	105 (68.2)
>24	2 (1.3)	49 (31.8)
Total	**154 (100)**	**154 (100)**

Discussion

Management of incomplete abortion, whether spontaneous or induced, involves evacuation of the uterus with MVA or misoprostol with or without the use of mifeprostone [5,6]. Most unsafe abortions occur in low-income countries where induced abortion is restricted [7] and contributes substantially to the global burden of maternal mortality and morbidity [8]. Our findings contrast with a high proportion of our patients (94.8%) reporting spontaneous abortion. African authors such as Cissé [9], Lokossou [10] and Baeta [11] have reported a high rate of spontaneous abortion as opposed to induced (ranging from 70.2%- 83%). Our findings could be explained by the fact that some patients did not say they had had an induced abortion. Induced abortion is forbidden in Chad, so women often claim to have had a spontaneous abortion even if it was induced.

Our results confirm previous studies where MVA was found to be an effective and useful tool in low resource settings for women with incomplete abortion and a uterine size of less than 12 weeks [6,7,12]. If uterine size at the time of treatment is equivalent to a pregnancy of gestational age 13 weeks or less, either vacuum aspiration or treatment with misoprostol is recommended for women with incomplete abortion. The recommended regimen of misoprostol is a single dose given either sublingually (400 μg) or orally (600 μg) [13].

The misoprostol group reported complications which were not reported in the MVA group. Tang [14], reported abdominal cramping usually starting within the first few hours but it may begin as early as 10 minutes after misoprostol administration. The pain may be stronger than that experienced during a regular period.

Specific complications linked with misoprostol like fever and vomiting were noted in our study. Blum [2] reported that chills are a common side effect of misoprostol but are transient. Fever is less common and does not necessarily indicate infection. An antipyretic can be used for relief of fever [14]. Nausea and vomiting may occur and will resolve 2 to 6 hours after taking misoprostol. An anti-emetic can be used if needed [14].

The hospitalization period was shorter in the MVA group than the misoprostol group which agrees with earlier studies [2, 9, 14, 15].

Conclusion

This study shows that MVA is more efficient than misoprostol in the treatment of incomplete abortion. More complications are registered for the management with misoprostol. We conclude that in remote areas, misoprostol can be used when MVA is not possible. There should be special training before this so that health workers in areas where MVA is not available can inform women about cramping and fever and know how to get help when they assess the bleeding as 'too much' or there are retained products.

Conflict of interest: All authors have declared that there is no conflict of interest.

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How to interpret an unenhanced CT brain scan. Part 2: Clinical cases

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Introduction

The aim of this article is to illustrate common pathological findings involving the brain encountered in every day practice. This builds upon our first article titled "How to interpret an unenhanced CT Brain scan. Part 1: Basic principles of Computed Tomography and relevant neuroanatomy" [1].

Case 1

A 70-year old patient presented following a fall and was found on the floor by carers. The patient had no recollection of the event (Figures 1-2).

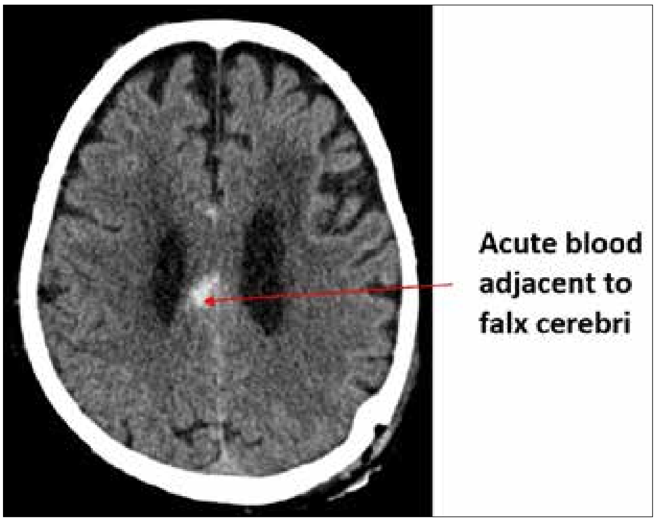

Figure 1 demonstrates a small right sided hyperdensity adjacent to the falx cerebri consistent with an acute intracerebral bleed.

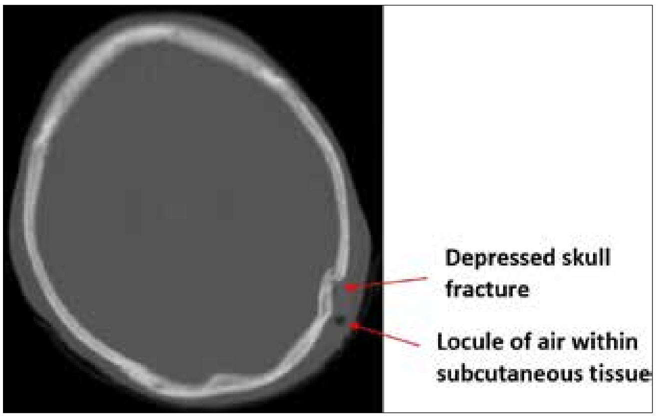

Figure 2. On reviewing the bone windows, a depressed fracture of the left parietal bone is noted. A locule of air is also noted within the subcutaneous tissues consistent with injury to the skin.

Learning points

- On CT, acute blood is displayed as a high Hounsfield unit (HU) and therefore appears bright on the displayed CT image [1]. With time, as the blood products start to break down, the HU of blood decreases and therefore appears darker on the displayed CT image.
- This case illustrates the importance of reviewing all available windows to help recognise pathology.
- In trauma, it is particularly important to review the bone windows to exclude a skull vault fracture [2,]. In this case, had the bone windows not been reviewed, the depressed skull fracture may not have been identified.
- The locule of air noted within the subcutaneous tissues overlying the skull fracture is a further clue that the subcutaneous tissues have been injured due to trauma, allowing air to track under the tissues.

Case 2

A 65-year old male patient presented with acute onset dysarthria and right sided weakness (Figures 3 and 4).

Learning points

- When the clinical question is as to whether a patient has suffered a stroke, it is important to note that in the hyperacute phase (i.e. <3 hours from symptom onset), a normal CT head does not necessarily rule out a stroke [4].
- In the hyperacute phase of stroke, although changes within the brain parenchyma may be happening at the cellular level, the patient may have been scanned at such an early stage that these changes may not yet be identified on CT. Knowing this is critical as a negative CT head in a patient with clinical signs and symptoms of a stroke may otherwise be falsely reassuring.

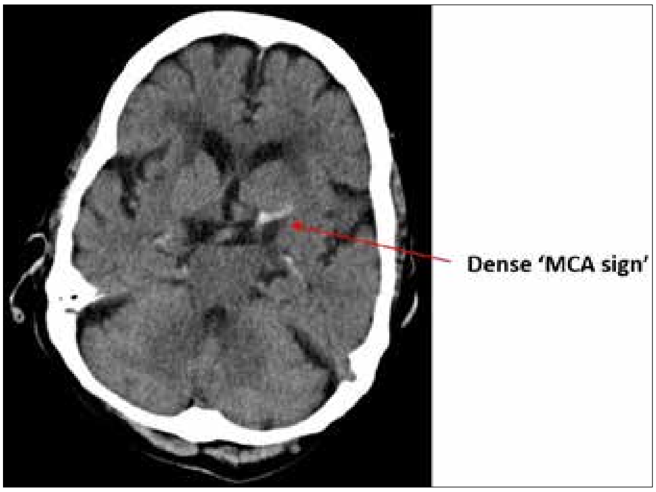

Figure 3. Unenhanced CT head demonstrating a hyperdense left middle cerebral artery (MCA) consistent with an acute thrombus within the left MCA. This radiological sign is known as the 'dense MCA sign'.

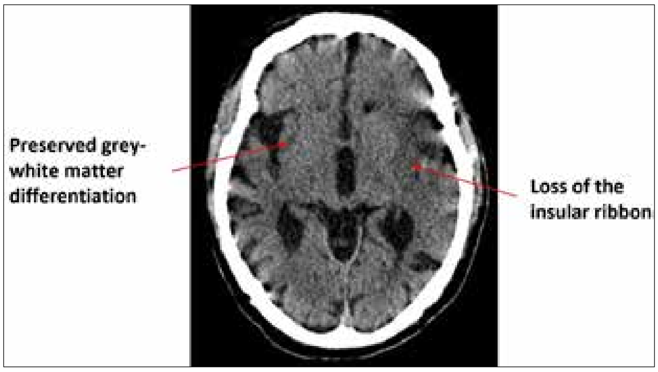

Figure 4. Subtle loss of grey-white matter interface in the region of the left lateral margin of the insular cortex.

- In the early phases of stroke, the main role of a CT head is to exclude an intra- or extra-axial haemorrhage or mass lesion within the brain [3]. In the acute phase, the clinical team can then decide whether the patient should undergo thrombolytic therapy.
- Some early features to look for which may be suggestive of tissue infarction are:
  - ''Loss of the insular ribbon sign''. This refers to loss of the normal grey-white matter differentiation in the region of the insular cortex on the affected side. The insular cortex is particularly vulnerable to ischaemia due to poor collateral blood flow in this region.
  - Hypoattenuation (reduced density/darker) of the caudate nucleus on the affected side. This is due to reduced perfusion of the caudate nucleus which typically gets its blood supply from the lenticuostriate vessels (i.e. deep perforating branches of the middle cerebral artery) [2, 4].
  - Acute hyperdense thrombus within one of the major cerebral arterial vessels of the circle of Willis (Figure 4).

Case 3

A 65-year old male presented with acute onset left sided weakness (Figures 5, 6 and 7).

Learning points

- Major arterial infarcts involve both the grey and white matter and tend to be wedge shaped in appearance.
- Irrespective of the underlying aetiology of a stroke, the end result is the same - brain parenchyma is affected

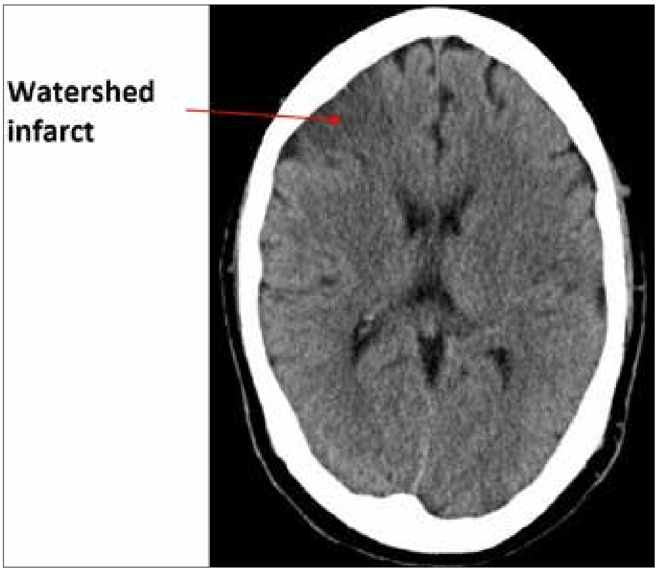

Figure 5. A watershed infarct is demonstrated between the anterior- and middle-cerebral artery territories.

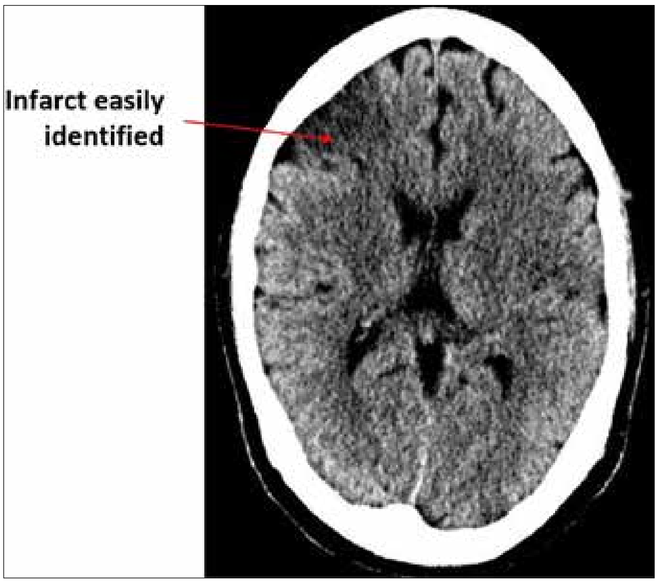

Figure 6. The same area of ischaemia is demonstrated more clearly on a stroke window.

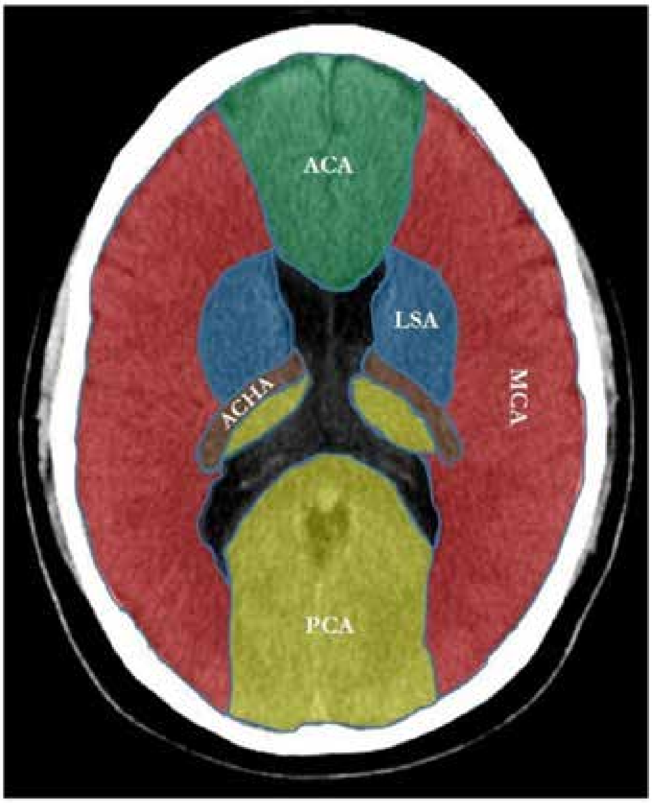

Figure 7 demonstrates the main cerebral vascular territories. ACA, anterior cerebral artery; MCA, middle cerebral artery; PCA, posterior cerebral artery; LSA, lenticulostriate arteries; ACHA, anterior choroidal artery. (Created by Dr Thomas Osborne, Radiology registrar at Ashford and St Peter's NHS Foundation Trust).

by a process known as cytotoxic cell death. This is reflected by a loss of the normal grey-white matter differentiation in the region of the infarct.

- As illustrated in this case, watershed infarcts occur between cerebral vascular territories with no or little anastomoses.
- By changing the window settings to a dedicated stroke window (e.g. HU of window width of 40 and window width of 40) helps aid the visualisation of subtle losses in grey-white matter differentiation [2-4].

Case 4

A 70-year old female with hypertension presented with confusion (Figure 8).

Learning points

- High density material on a CT Brain study may include:
  - Acute blood.
  - Calcification.
  - Intravenous contrast.

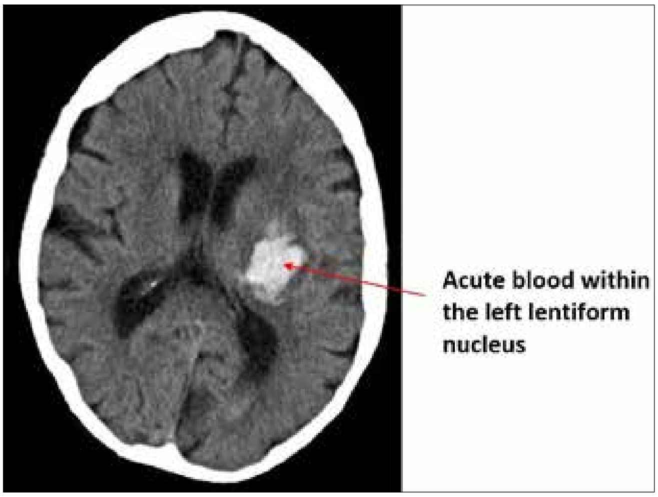

Figure 8 demonstrates an acute bleed within the left lentiform nucleus.

- In the context of a non-traumatic bleed, the following should be considered as possible underlying causes:
  - Hypertensive bleed.
  - Haemorrhagic transformation of an infarct.
  - Haemorrhagic mass (primary or secondary lesion).
- Both the clinical context (such as the presence of cardiovascular risk factors, previous malignancy etc) and the location of the bleed seen on CT can help to identify the underlying cause for the bleed.
- For example, hypertensive bleeds typically affect the basal ganglia. The other common locations for hypertensive bleeds include:
  - 80% lenticulostriate.
  - 10% pons.
  - 10% cerebellum [3, 4].

Case 5

A 35-year old male presented with a sudden onset occipital headache (severity 10/10) and vomiting (Figure 9).

Learning points

- The common causes of a subarachnoid haemorrhage include rupture of an intracerebral aneurysm and trauma.
- Blood accumulates in the following subarachnoid spaces:
  - Sylvian fissure.
  - Basal cisterns.
  - Overlying sulci and surface of the tentorium cerebelli.

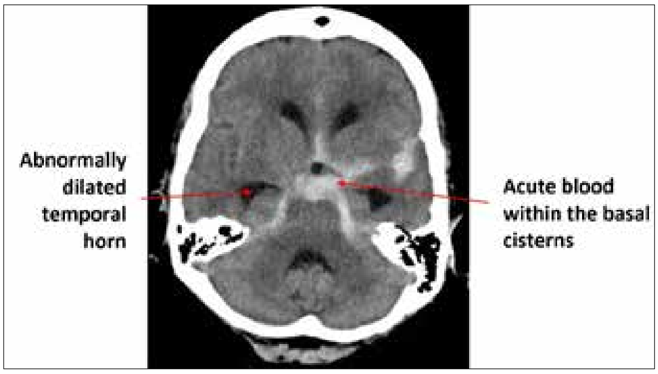

Figure 9 demonstrates acute blood within the basal cisterns consistent with an acute subarachnoid haemorrhage.

- The accumulation of blood within the subarachnoid space may result in the development of hydrocephalus [3, 4].
- As demonstrated in this case, one of the earliest signs suggestive of an evolving hydrocephalus is dilation of the temporal horns of the lateral ventricles.
- If a subarachnoid haemorrhage is confirmed, further investigations should be performed to identify and treat the underlying cause. Investigations may include a CT angiogram or formal angiogram.
- CT has a >95% sensitivity for identifying a subarachnoid haemorrhage within the first 12 hours. The sensitivity declines to 80% after 12 hours [2, 3].
- In the presence of a normal CT Brain study, a lumbar puncture should be performed to exclude a small subarachnoid haemorrhage.

Case 6

A 60-year old alcoholic male presented with worsening confusion over the past month following a fall (Figure 10).

Learning points

- Subdural haematomas are extra-axial collections of blood within the subdural space.
- This results in a crescentic configuration of the subdural haematoma.
- Blood is confined within the subdural space and is therefore unable to cross dural attachments but can cross bone sutures [3, 4].
- To reiterate, acute blood appears bright on CT and becomes darker over time (Figure 10).
- Figure 10 demonstrates a subdural collection of mixed density material which represents both acute and chronic blood products. This therefore suggests that the patient has sustained an acute bleed on a background of a pre-existing haemorrhage.

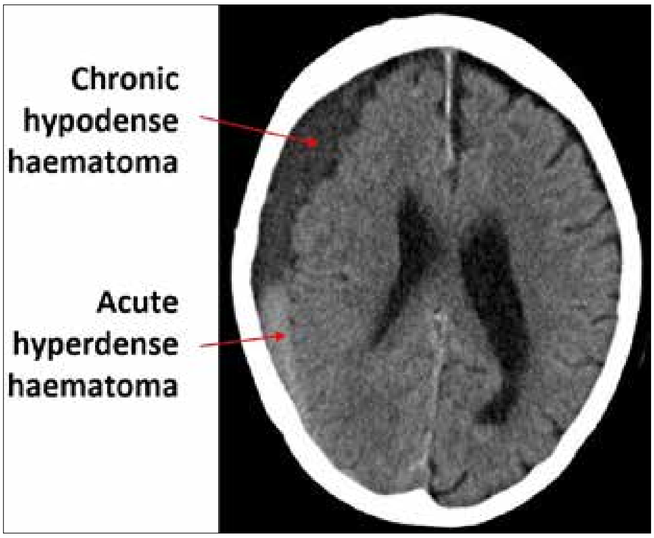

Figure 10 demonstrates an acute-on-chronic right sided frontoparietal subdural haematoma.

- Although an underlying bone fracture was not identified in this case, this is important to exclude by looking at the bone windows.

Case 7

A 70-year old female presented following a fall. A non-ST elevation myocardial infarction was demonstrated on her electrocardiogram. She underwent an urgent CT head to exclude an intracranial bleed prior to commencing antiplatelet therapy (Figure 11).

Learning points

- Although an intracranial bleed was not demonstrated, locules of free intracranial gas were noted at the base of the skull.
- This case again illustrated the importance of viewing all available windows to help exclude pathology. By changing the window setting to lung windows on the same axial slice, intracranial air becomes easier to appreciate.
- In the context of trauma, although an underlying fracture was not identified in this case, the presence of intracranial air raises the suspicion of a base of skull fracture.
- Other helpful clues which can help raise the suspicion of a base of skull fracture include a fluid level within the sphenoid sinuses and clinical signs i.e. CSF rhinorrhea and otorrhea, mastoid ecchymosis (Battle sign) and periorbital ecchymosis (Raccoon eyes) [4].

Case 8

A 45-year old presented with tonic-clonic seizures following a fall (Figures 12-15).

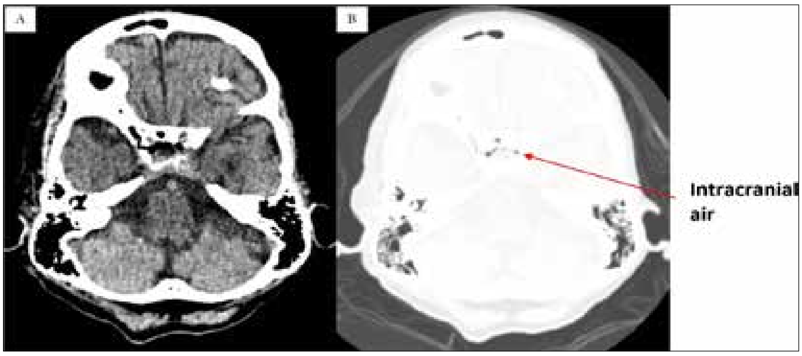

Figure 11. Locules of intracranial air are easily overlooked on Figure 11A on the default brain windows. These are more easily identified on Figure 11B when the settings are changed to lung windows.

Learning points

- In the context of trauma, it is important to identify signs indicative of raised intra-cranial pressure (ICP).
- Raised ICP can lead to 'mass effect' which refers to the distortion of the size and/or position of normal brain structures when they are displaced by an abnormal structure e.g. intracerebral mass or intra- or extra-cranial bleed.
- CT features of raised intracranial pressure include:
- Displacement of midline structures towards the opposite side of the primary intracranial pathology.

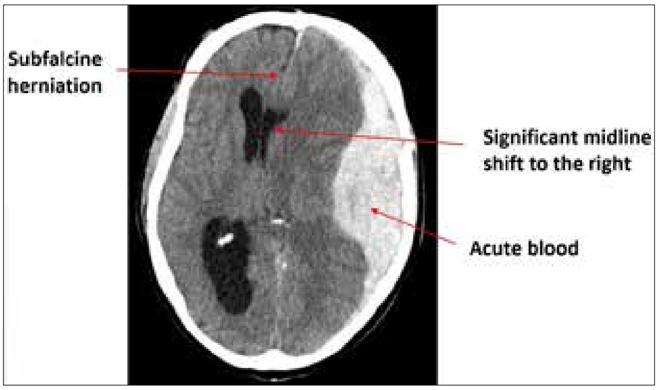

Figure 12 demonstrates a large left-sided acute subdural haematoma. There is significant shift of the midline structures to the right with partial compression of the left lateral ventricle and subfalcine herniation seen to the right.

- Loss of sulci and gyri.
- Various forms of parenchymal herniation including subfalcine, transtentorial and tonsillar herniation (Figure 14).
- It is important to note that a CT study can be used to look for a possible structural cause for the patient's signs and symptoms, however a CT study should not be used to exclude raised ICP.

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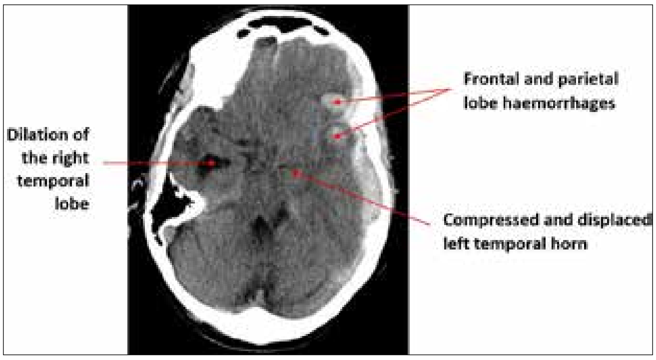

Figure 13 demonstrates near total effacement of the left temporal horn with dilatation of the right temporal horn in keeping with an evolving hydrocephalus. Two further foci of intra-parenchymal haemorrhage are seen within the left frontal and parietal lobes.

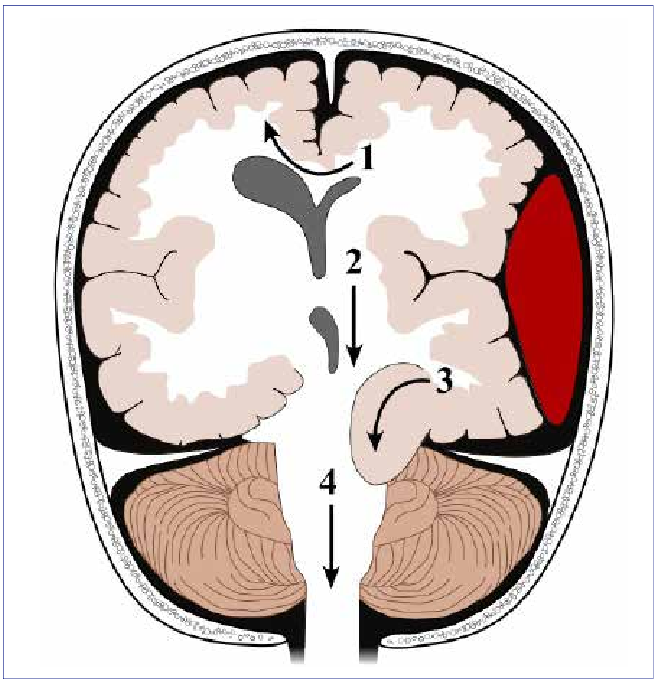

Figure 14 demonstrates four common types of brain herniation secondary to a left extradural haematoma 1. Subfalcine 2. Central 3. Transtentorial 4. Tonsillar. Image obtained from Wikipedia [6].

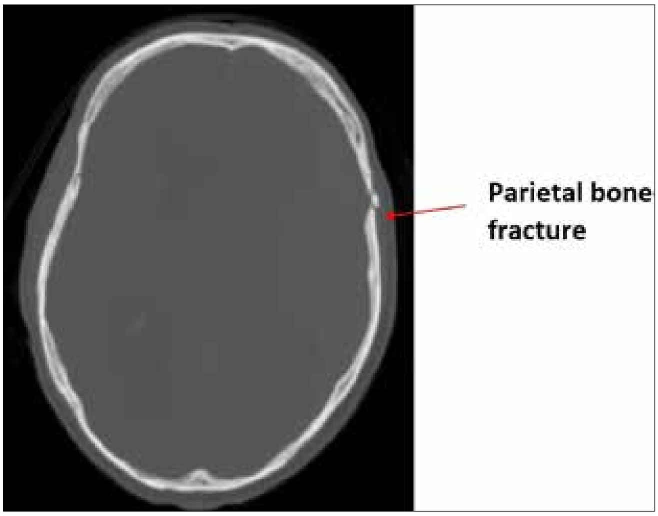

Figure 15 demonstrates a fracture of the left parietal bone on the bone window setting.

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How to perform a lumbar puncture

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Background

The first reports of a lumbar puncture (LP) being undertaken are from the late 19th century [1]. Heinrich Irenaeus Quince (with whom the Lumbar Puncture is commonly associated with) reported to the tenth congress of Internal Medicine in April 1891¬¬ that he had performed in one case 3 lumbar punctures in a patient with suspected tuberculous meningitis who was comatose [1,2]. The procedures were done at 3 day intervals and the patient recovered. The other case was in a patient that had chronic hydrocephalus and suffered headaches. Lumbar puncture in this patient relieved the symptoms. One month after Quincke's report to the congress, Walter Essex Wynter, a Registrar at the time, published in the Lancet 4 cases of cerebrospinal fluid (CSF) aspiration in patients with meningitis suspected [3]. The Lumbar Puncture was a procedure dedicated to the relief of symptoms (at that time mainly meningitis or raised intracranial pressure) [4]. It has subsequently become a procedure that can be diagnostic or therapeutic, and the technique has become more refined with improved instruments, awareness of aseptic techniques and the increased availability and knowledge of anaesthesia.

Indications

- In cases of suspected subarachnoid haemorrhage (SAH)
- Diagnosis of meningitis (bacterial, viral, fungal, malignant, atypical)
- Treat raised intracranial pressure (idiopathic intracranial hypertension or other causes such as meningitis)
- Aid diagnosis of normal pressure hydrocephalus
- Exclusion of neurological, vasculitic, autoimmune or paraneoplastic disorders and syndromes
- Administration of therapeutic agents (for chemotherapy, analgesia/anaesthesia, antimicrobial therapy)

It important to note that in suspected SAH, a lumbar puncture 12 hours after onset of symptoms is ideal, but can be diagnostic after 2 weeks of onset [8]. This is not the case after 4 weeks.

Contraindications

- Suspected intracranial mass lesion or space occupying lesion
- Disorders of coagulation or blood diathesis
- Underlying spinal abscess
- Imaging evidence of midline shift
- Posterior fossa tumour or other suspected 4th ventricular lesion

Consent

It is good practice that consent is obtained before undertaking any invasive intervention or procedure, and this is the case for performing a lumbar puncture.

Equipment and Tools

- Up to 6 sample bottles (usually white top) depending on the tests required from the sample. These should normally be pre-labelled with a number (1-6). Some centres use up to three, others four, but this will depend on the number of tests needed.
- A serum glucose bottle is part of the equipment (a paired serum with CSF glucose is usually sent particularly in infective diagnosis).
- A serum bottle for electrophoresis paired with CSF when checking for oligoclonal bands (when diagnosing multiple sclerosis for instance).
- Drawing up needles for local anaesthetic, with 10-20ml syringe for the administration of the local anaesthetic including a needle for subcutaneous injection and deep tissue injection.
- Spinal needle (we advise 22G Whitcare or 'pencil tip' needle which is atraumatic and is the preferred choice over the cutting or Quincke needles)
- Manometer with 3 way tap
- Dressings pack with appropriate disinfectant, gauze and sterile drapes
- For cytology in suspected cancer 10cc is best, otherwise 1-2 cc per bottle. All these quantities are safe if LP is safe in the first place!
- If pressure is > 25cm I take 30 cc and don't do closing pressure (not reliable).

Positioning

There are two positions that a patient can be in for a lumbar puncture – see Figure 1. The preferred position is lying on their side (left lateral) with the patients legs flexed at the knee and pulled in towards their chest, and upper thorax curved forward in an almost foetal position.

It is important to note that the point at which the needle enters the spine needs to be at the same level as the midline of the spine, which ideally should be at the same level as the patients head to give the most accurate reading5, 6. At times for comfort a pillow may be placed under the patient's head and / or between their legs. The patient's back should be perpendicular to the table.

The second position is the upright or sitting position. This is used when the lateral position has failed. Sit the patient on the edge of bed, with their legs resting on a stool or chair, ask them to roll their shoulders and upper back forwards and the chair is positioned to bring the thighs up towards the abdomen. The opening pressure where indicated is measured in the lateral position.

If the sitting position is adopted for whatever reason and an opening pressure is sought, the patient should be moved carefully into the lateral position once the needle is in the correct space. Once the patient is in this position, the stylet may be withdrawn. It is important not to remove the stylet before the patient is safely positioned onto the lateral side.

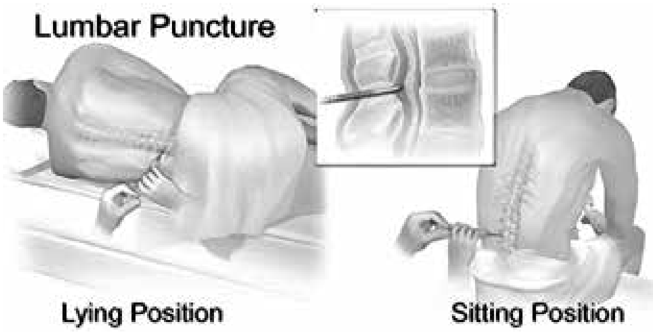

Figure 1. Positioning the patient for Lumbar Puncture – illustration by Chirwa CA &Chirwa M reproduced with permission.

Anatomy

Locating the correct entry point is performed by identifying the surface anatomy of the L3/L4 interspinal space (which is a few mm above the spinous process of L4). This is done generally by palpating the iliac crests.

An imaginary line between the highest points of the iliac crests usually bisects the L3/L4 space. However this will vary according to a number of variables, such as obesity. As such is can be used as a guide in conjunction with palpating for the spinous process of the lumbar vertebrae and their interspaces.

The interspace of L3/L4 or L4/L5 are used as entry points – see Figure 2.

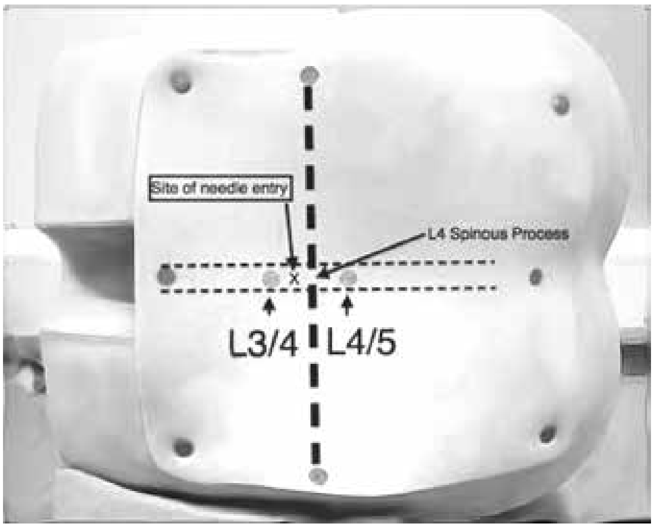

Figure 2. Surface anatomy with markings on a training mannequin for lumbar puncture -Doherty CM. & Forbes RB. Diagnostic Lumbar Puncture. Ulster Medical Journal 2014; 83(2): 93-102 – reproduced with permission.

Technique

Once the correct entry point is identified, clean the skin with antiseptic and proceed with local anaesthetic initially subcutaneously, and then deeper into the layers ensuring a wider distribution of anaesthetic.

After giving the anaesthetic enough time to work, the spinal needle (see Figure 3) may be introduced into the space. Advance the needle slowly towards the umbilicus.

When using a cutting needle it is important to ensure that the bevel of the needle faces parallel to the direction of the cord and spinal fibres. Therefore if in the sitting position, the bevel faces to the side, in the lying position it shall face upwards [6].

This reduces the likelihood of post procedure complications such as headache. The atraumatic needle ('pencil tip') reduces the likelihood of this problem.

The dural space is approximately 4-5cm (see Figure 4) from the surface if the skin [5,6]. When the needle is advanced some practitioners will feel a give or a 'pop' sensation when the needle enters into the space although this is not always the case.

At times with the needle passing through the different layers, there may be similar sensations felt but the needle is not yet in the correct space. As such, some practitioners advance the needle and withdraw the stylet at intervals until the space is entered and CSF is drawn.

If no fluid is obtained, replace the stylet replacing and advance the needle again by a few more centimetres or adjust the angle of the needle. Some patients may require longer needles which are available.

Figure 3. Examples ofSpinal needles (Quincke's) demonstrating the needle with stylet in situ before being withdrawn. Black is 22G and Yellow is 20G.

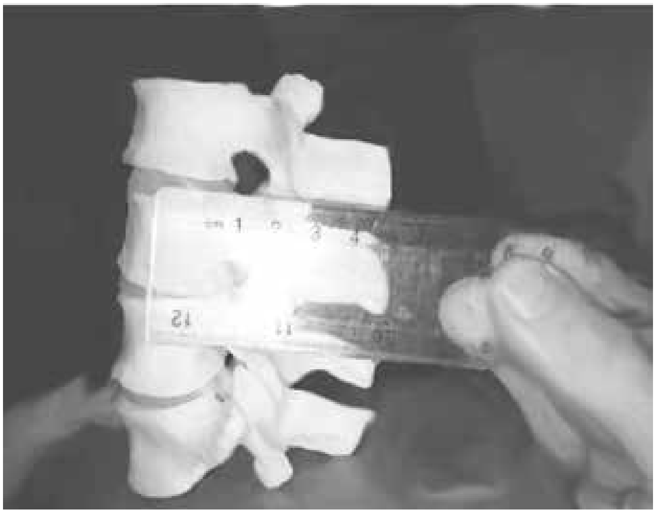

Figure 4. Depicting the distance to the Ligamentum Flavum through which the needle enters and passes through, at which point CSF will be aspirated- Doherty CM. & Forbes RB. Diagnostic Lumbar Puncture. Ulster Medical Journal 2014; 83(2): 93-102 – reproduced with permission.

Figure 5. Manometer with three way tap (stopcock) used for the measurement of opening and closing pressures

The manometer (see Figure 5) is attached to measure the opening pressure (if indicated) one CSF is drawn. This is must be measured in the lying position. A pressure of 10-20cm H2O is normal.

If measuring opening pressures for diagnostic purposes or for therapeutic purposes, a closing pressure is useful, but if the opening pressure greater the 25cm H2O, the closing pressure may not reliable.

Normally 1-5mls of CSF is generally enough per bottle. In general terms up to 20mls in total of CSF can be drawn safely. With idiopathic intracranial hypertension for instance, greater volumes of up to 30-40mls may be needed to aid symptomatic relief.

This may also be needed if the opening pressures are very high (>25cmH2O). However, large volume LP's can lead to complications. It is therefore advisable to discuss this with a neurologist and seek advice on other therapeutic options for patients with high opening pressures.

On the whole fluid is the sent in the appropriate sample bottles for:

- Cell Count and differential
- Biochemistry which includes protein and glucose (for which a paired serum glucose is also sent)
- Microscopy, Culture and Gram Stain (MC+S)

Samples may also be sent for xanthochromia (for SAH), viral PCR, oligloclonal bands, fungal, vasculitic and autoimmune screen, malignancy and prion disease to name but a few. When testing for malignancy, up to 3 LP's may be required. Refer to local lab guidelines for results interpretation.

After obtaining CSF, always replace the stylet before withdrawing the needle.

Things to watch for post procedure [6,9]

- Headache (Post Lumbar Puncture Headache). This is the most common complication, especially in young adults. Can be managed with simple analgesics or non-steroidal anti-inflammatories. Patients are advised to lay flat for 30-60mins post procedure. They may require an additional 2 weeks depending on symptoms after this of strict bed rest. At times anaesthetic management using an epidural blood patch may be required for severe intractable cases.
- Infection can occur as cellulitis, abscesses or discitis, vertebral osteomyelitis, bacterial meningitis.
- Back Painmay occur at the entry site or elsewhere in the back as a consequence of the trauma of the procedure though mild.
- Bleeding may occur at all levels of the dura. This will be significantly worse in those with coagulopathies or anticoagulated (SAH, subdural or epidural haematoma.
- Nerve irritation or damage might occur if the spinal needle impinges on a nerve or nerve root. Also as the needle is withdrawn, it is important that the stylet is replaced before had to prevent the likelihood of a nerve being withdrawn. This also reduces the likelihood of post LP headache as mentioned before.
- Blood in the CSF can occur with initial aspiration of CSF and usually gives falsely raised red cell counts in the first bottle sent to the lab. Subsequent bottles show a reduction in the red cell count.
- Cerebral herniation is rare but a serious complication and vigilance for any symptoms or signs is advised. It is imperative that a pre LP CT scan of the brain is undertaken in patients with reduced consciousness, papilloedema or other neurological features of raised intracranial pressure. In bacterial meningitis, cerebral herniation may occur post LP. Other intracerebral infections such as TB or malaria may also. As such CT is useful in a diagnostic capacity for the cause of altered neurology as well as helping determine the risk of raised intracranial pressure and cerebral herniation in LP. It must be noted that a normal CT will not completely eliminate the risk of herniation and neurological features mentioned must be monitored nevertheless. Treatment of cerebral herniation or raised intracranial pressure is generally to infuse mannitol. Local guidelines for this should be sought.
- Epidermoid tumour this is rare and may occur after a few years, caused by epidermoid tissue being transplanted into the spinal canal during procedure.

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How to set up and run a nurse led diabetes clinic in a resource poor country: Focus on South Sudan

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Introduction

Although this paper draws on the author's experience of a NLDC in the UK, the generic ideas in the process of developing a NLDC in a developing country are similar. The author has not been to South Sudan but has had discussions with Dr Hakim whose knowledge of South Sudan has helped to inform the writing of this paper.

Background

Diabetes Mellitus (DM) affects approximately 415 million people worldwide and by 2040 it is estimated that over 642 million people will have DM [1]. In the UK there are approximately 3.5 million people who have DM and it is suggested that a further 500,000 people have DM but are unaware of it [2], giving an estimated prevalence of approximately 6.2%. Obesity is a major risk factor for developing DM and in 2015 a quarter of adults (aged over 16 years of age) in England were classed as obese (BMI >30kg/m2). In South Sudan the DM estimated prevalence is approximately 10%, and 7.5% are classed as obese [3]. This spiraling level of obesity is therefore likely to increase the prevalence of people developing type 2 DM even further.

DM is a long term condition which can have a huge impact on health and, if not controlled, increases the risk of complications. These include cerebrovascular accident, myocardial infarction, nephropathy, diabetic retinopathy, lower limb amputations and dementia [4]. People with DM, between the ages of 20 and 79 years, account for 14.5% of all global deaths [5].

Developing diabetes specific clinics can help people to manage their condition and reduce the risks of developing complications. A nurse led diabetes clinic (NLDC) can be a cost effective and efficient way to improve patient outcomes [6].

How to establish a NLDC

Initially a business case needs to be developed to fund the service. Then the following are needed:

- Suitable building.
- Utilities such as water and electricity.
- A record system to document care (ideally computerised). This is vital especially if a different nurse is going to see the patient in the future.
- Suitable insurance if not provided by the healthcare provider.

Approximately three rooms with a waiting room, and toilets and hand washing facilities are needed – if several nurses are running the clinic more rooms are needed so that each has a private consultation room. The service would need to be advertised so that patients and healthcare professionals are aware that it is available.

Workforce

Ideally this should include an administrator who can arrange appointments and liaise with the hospital in relation to results and records, etc.

A healthcare assistant can help to prepare the patient, and allow the nurse to have more consultation time by:

- Measuring blood pressure (BP), heart rate, heights and weights (for calculating body mass index).
- taking bloods, and
- Using urinalysis machines and a blood glucose meter.

Qualified nurses with further training in DM are essential so they can offer the support and jointly develop management plans. They need to understand the differences between type 1 and type 2 diabetes and know how to care for people in certain circumstances such as pregnancy. Many specialist nurses in the UK prescribe treatment for diabetes, BP, lipids, etc. so these can be started quickly. If this is not feasible it may be possible to run the NLDC at the same time as a doctor's clinic so that the doctor can prescribe immediately. This can save the need for another appointment and prevents delays in starting treatment. It is important to have reasonable time slots so that nurses can offer an in-depth service and sufficient education so that there is a maximum level of self-management. This helps to prevent admissions for diabetes emergencies such as Diabetic Ketoacidosis (DKA) and reduces the risk of complications.

Equipment needed in the clinic

One of the main components of diabetes care is the general assessment of health and the screening for complications, so it is imperative to have the equipment to do this. It is important to assess BP, lipids, smoking status and glycaemic control and not just "sugar". Control of these factors helps to prevent complications especially cardiovascular disease (CVD). The equipment required is:

- Scales and height measure to measure weight and height so that body mass index can be calculated.
- Sphygmomanometer and stethoscope to assess good BP control for the prevention of CVD and nephropathy. Heart rate should be assessed.
- Urinalysis equipment, including urine pots for the patients, to test for: glucose, ketones and urinary tract infections (UTI). This aids the initial diagnosis of diabetes; assessment of UTI indicates how well the diabetes is being controlled. Urinalysis equipment is also necessary to test for Microalbuminuria and so to assess the possible development of nephropathy.
- A blood glucose meter to measure blood glucose. This is only helpful in the short term to identify blood glucose level at the time of the test – for example to identify hypoglycaemia. Ideally blood glucose meters should be available to people with diabetes, especially if they are on insulin or a sulphonylurea. This allows them to self-manage their DM by being able to adjust medication and lifestyle factors. However, these may not be available. Even if they are, the strips and lancets may not be, or may be very expensive as with insulin which can be marked up from suppliers [7].
- Sharps boxes for the safe disposal of sharps equipment.
- Insulin fridges for the safe storage of insulin if feasible.

Assessment needed

Equipment to take blood, analyse and report the results must be available for the consultation between nurse and patient. The following tests should be included (table 1).

Table 1. Tests for DM assessment

HbA1c (glycosylated haemoglobin)	To assess the overall diabetes control
U&E (urea & electrolytes	To review kidney function -needed to review complications and possible side effects of medication and any adjustments needed.
LFT (liver function tests)	To assess any effects of medications or to identify other problems such as other conditions or the effect of alcohol use.
TFT (thyroid function tests)	To routinely check for autoimmune thyroid conditions especially in people with type 1 diabetes as they will be more prone to developing other autoimmune conditions.
Lipids	To assess the cholesterol levels and breakdown of the cholesterol such as Total cholesterol, LDL, Triglycerides, HDL and non HDL levels. This is so that the lipids can be treated if they are high and so help reduce the risk of CVD
FBC (full blood count)	To screen for any conditions such as anaemias and how these will affect the HbA1c results and also possible complications as the cause such as nephropathy.

Other blood tests should also be considered periodically. For example, Vitamin B12 and serum folate levels in people who have been on Metformin, and screening for other autoimmune conditions for people with type 1 diabetes such as coeliac screen and pernicious anaemia.

Assessment of complications should also take place by a qualified person [8] including a minimum assessment of eyes by checking visual acuity with a Snellen chart at twenty feet distance. Ideally eye drops should be administered to dilate the pupils so that the back of the eyes can be examined with an ophthalmoscope to screen for retinopathy.

The lower limbs should be examined and the feet checked with a 10g monofilament to assess the nerve endings for neuropathy. The pulses should be checked to assess the circulation including checking the dorsal is pedis and posterior tibial pedal pulses if the nurse has been trained.

The findings, treatment and information given must be documented so that they can continue to be reviewed, to assess what treatment has worked and what information has been delivered. This will give anyone seeing the patient at follow up, the knowledge of what has already been delivered or tried. The results of the consultation and care planning will dictate how frequently the person should be followed up. For instance in the author's area of practice, someone with well controlled type 2 DM, may be followed up every 6 months. However a pregnant woman is followed up twice a month. An average follow up for an individual who is not pregnant can be between 3-6 months.

The results can also be used for audit especially if there are any results available prior to setting up the service. This can assess the effectiveness of the service and patient satisfaction. Even if the data collected only covers prevention of DKA or hypoglycaemia, it can show the effectiveness of the service. However a word of caution. If the data are not being collected currently then initially it will appear that there is an increase in complications or problems when in actual fact there is no increase but just an improvement in documentation and recording.

Equipment for the management of diabetes

The equipment needed includes

- Blood glucose meters for patients' home monitoring if available.
- Insulin administration equipment such as insulin syringes.
- Possibly a small stock of insulin so that this can be started when the person is first seen. However this may not be feasible if the insulin cannot be securely stored in insulin fridges. It may be possible for the clinic to establish links with the International Diabetes Federation who can help to supply insulin and essential equipment to children with DM.
- Hypoglycaemic treatments in case an individual has a hypoglycaemic episode.

Education materials

Education is an essential element of diabetes management and is needed at every step.

Areas which should be covered over time should include:

- What diabetes is.
- Healthy eating including carbohydrate counting if appropriate.
- Attaining and maintaining a healthy weight.
- Exercise.
- Access to medication and equipment.
- Sharps disposal.
- Timing of medication and how they work.
- How insulin works and what would happen if it was stopped.
- Injections, including sites, technique, dose adjustments.
- Prevention and management of hypoglycaemia.
- Sick day rules and prevention of DKA.
- Pregnancy.
- Smoking cessation.
- Alcohol consumption and keeping safe when drinking alcohol.
- Living with diabetes.
- Complications.

The education could be delivered verbally on a one-to-one basis or as a group education session. However, it is usually helpful to give leaflets or supportive material so that the person can refer to it later. Depending on the person's ability and resources, information can be in pictorial or written form; it could be as hard copy or electronic, especially via mobile phones and applications which are now available. It could be in the form of a care plan. –see examples at www.diabetes.org.uk.

Referral

As with any practitioner the nurse should be aware of her/his limitations and so be able to refer to a specialist or other services as needed. This could include:

- Consultant.
- Dietician.
- Podiatrist.
- Eye specialist.
- Smoking cessation service.
- Education sessions.
- Psychologist.
- Other services e.g. maternity.

Conclusion

This article suggests what is needed to set up a NLDC. The list is not exhaustive and requirements may change over time. However it has tried to include everything which ideally is needed, and thus may be something of a "gold standard"; only elements may be feasible. South Sudan and other low-resource areas need to assess what can realistically be achieved.

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Managing epilepsy in South Sudan

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Introduction

Epilepsy is the most common serious chronic disorder of the brain. According to estimates, at least 50 million people and their families are affected worldwide across different socio-economic groups, of which one in five is resident in Africa [1].

Untreated epilepsy carries significant risks to physical wellbeing including the risk of death or traumatic injury during seizures and SUDEP (sudden unexpected death in epilepsy). In addition, the diagnosis carries a psychosocial burden which may result from societal prejudice [2, 3].

Data from resource-rich settings demonstrate that complete seizure control can be achieved in at least two thirds of individuals, making it one of the most treatable chronic neurological conditions [4]. A similar rate is seen when sufferers in South Sudan have access to appropriate treatment [3]. This implies that there is great scope to bring about effective management of epilepsy on a global scale, and a positive impact on the quality of lives of millions of people. However, identification and treatment of neurological disease in resource-poor countries is a challenge.

This article does not give a prescriptive account of how epilepsy should be managed in South Sudan, but considers a framework to approach it. It then describes current strategies in action around the globe of which elements may be transferable to South Sudan.

Epilepsy in South Sudan and Sub-Saharan Africa

There is a lack of available data around epilepsy in South Sudan, which presents a challenge when addressing the problem. However we presume a degree of overlap with neighboring countries [3].

It has been estimated that 85% of those with epilepsy are in developing countries [5]. The incidence is higher here compared to industrialised nations - 100-190/100000 and 40-70/100 000 respectively – due to the presence of additional aetiological factors [6]. A recent survey in rural Tanzania showed age-adjusted prevalence of 13.2/1000 [7]. When measured in terms of disability-adjusted life years lost, the burden of epilepsy in lower or middle income countries is 13 times that of high income regions [8].

Seizure disorders may follow cerebral infections. Those in South Sudan include: viral encephalitis, bacterial meningitis, granulomatous disease, HIV (and associated opportunistic infections) and parasitic infections - cerebral malaria, neurocysticercosis and onchocerciasis [2,3,9,10]. Onchocerciasis has been associated with 'Nodding syndrome' a subtype of epilepsy locally restricted to South Sudan, Tanzania and Uganda [11].

Perinatal factors have been cited as a cause of epilepsy in poorer countries - reduced access to obstetric care and higher frequency of unsupervised home deliveries gives rise to a high rate of complications including hypoxic brain injuries. In South Sudan only 19% of women were assisted by skilled personnel during delivery [10, 12].

Higher incidence of head trauma (e.g. road traffic incidents) and less availability of post-traumatic specialist care is also contributory [2, 9]. In sub-Saharan Africa traumatic brain injury occurs up to 170 per 100 000 – higher than the global average (106) [13].

The majority of those with epilepsy in developing countries are not appropriately treated; this is quantified by calculating the *'treatment gap'* – the number of individuals who are not receiving treatment expressed as a percentage of those with active epilepsy in a given population and point in time. In poorer areas this may be as high as 90% therefore a significant number of individuals remain vulnerable to the risks of uncontrolled seizures [5, 8]. Disability and mortality from seizures globally is greatest in Africa [1]. In particular, drowning and burns are a greater risk for those who use open wells and cook on an open fire [10].

Causes for the treatment gap

This gap mostly arises from resource deficiencies and cultural beliefs. There is a lack of access to: correct information about epilepsy, medical expertise, imaging and other diagnostic facilities and treatment. Barriers to accessing appropriate care may be geographical (lack of local availability); financial (inability to pay) or cultural (locally held beliefs meaning resources are under-utilised) [9,10].

Available information

Information readily available to the general population is important in identifying patients with epilepsy and tackling taboos. Epilepsy may not be recognized as a medical condition; there may be widely held beliefs that seizure disorders are caused by evil spirits or that epilepsy is contagious [2]. Poor literacy rates compound the difficulties in providing accurate information – only 13% of young women in South Sudan are literate [12]. Healthcare professionals may lack access to information about recent advances e.g. through unavailability of internet facilities or costly neurology journals [10].

Policy

Compared with infectious disease, epilepsy has been under-represented in national health plans and in the millennium development goals [9].

Medical expertise

Developing countries have few or no neurologists – 0.03 per 100 0000 in the African region – and lack sub-specialists such as paediatric neurologists [6]. The management of epilepsy is therefore generally by primary care. Doctors tend to be unevenly distributed towards urban centres.

A study in 2010 estimated there were approximately 500 Southern Sudanese doctors with basic medical degrees, for a population of approximately 10 million people. None were found in the specialty of neurology [14].

Diagnostics

The availability of neuro-imaging and basic diagnostic investigations (e.g. CSF analysis and EEG) is widely deficient in sub-Saharan Africa [10]. In South Sudan CT imaging has recently become available in the capital [15]. However for an MRI patients need to travel out of the country. The opportunity to discuss images with a neuro-radiologist is not readily available in South Sudan.

Treatment

Anti-epilepsy medications are the cornerstone of treatment and generally needed long term. Treatment costs – medication itself and the costs of travel to the clinic - present barriers. Phenobarbital is the most widely used treatment in sub-Saharan Africa – it is generally efficacious and is the medication which can be most reliably delivered to pharmacies [3, 9] although this is not universally so [6, 9]. Without a guaranteed and regulated supply patients may be at risk of exposure to poor quality drugs. The drawbacks of phenobarbital include: long half-life: hepatic enzyme induction (impacting on the half-life of TB medication, oral contraception and anti-retroviral treatment) and risk of withdrawal if stopped suddenly [3,9].

Surgical treatment of epilepsy is rarely a viable option in resource poor settings [10].

Cultural barriers

Those with epilepsy are at greater risk of discrimination and social isolation.This presents a barrier to seeking and complying with treatment. The stigma around epilepsy may negatively impact on marriage prospects or cause loss of employment [3, 10]. Traditional healers may be the first point of contact for those seeking help [3, 9].

Suggestions for improvement - general measures

There have been recent international motions to place the management of epilepsy on the global healthcare agenda.

The ‘Out of the Shadows’ campaign launched in 1997 was the result of collaboration between the World Health Organization, International League against Epilepsy and International Bureau for Epilepsy. It declared a mission to ‘improve acceptability, treatment, services and prevention of epilepsy worldwide”. They aimed to achieve this by supporting departments of health and conducting demonstration projects to exemplify good models of care [5]. It is unclear whether there has been any discernable lasting impact of these projects in resource poor settings. A declaration for the African region was produced in Dakar in 2000 and proclaimed an intention to treat epilepsy as a healthcare priority [1]. Its message is summarized in information box 1.

A successful public health approach needs to include interventions at the level of:

- The population in question - for example, preventative strategies, increasing awareness.
- The individual - improving identification, diagnosis, treatment and education [2].

Suggestions for improvement - specific examples

Population interventions

It would be ideal to prevent epilepsy from developing in the first place where possible, by targeting reversible causes: optimising the treatment of infections, road safety and perinatal care. Other community-based measures could include public information broadcasts via media outlets such as television and radio.

Supporting individuals

A significant barrier to identification and care has been the limited number of doctors. Short term solutions are not easily delivered. The role of existing community healthcare workers could be expanded to include identification of cases, utilizing pre-existing infrastructures [9]. However this would add to the burden of current services. Also, the diagnosis and treatment of epilepsy is no simple undertaking. Determining if apparent seizures represent epilepsy depends on clinical skills of history taking and pattern recognition.

There have been examples in other resource poor settings of how new and emerging technologies could be applied to this issue. In Nepal and India an 11-part questionnaire has been developed to simplify a

Box 1. African Declaration on Epilepsy

Epilepsy is a healthcare priority in Africa requiring every government to develop a national plan to:

1. Address the needs with respect to epilepsy in terms of access to trained personnel, modern diagnostic equipment, antiepileptic medication and surgical treatment, information communication, prevention and social integration
2. Educate and train healthcare and other relevant professionals about epilepsy
3. Educate those affected by epilepsy and the general public about epilepsy as a universal neurological, non communicable and treatable condition
4. Eliminate discrimination in all spheres of life, particularly at school and the work place
5. Encourage incorporation of prevention and treatment of epilepsy in national plans for other relevant healthcare issues such as maternal and child health, mental health, infections, head trauma, neurovascular diseases and community based rehabilitation programs
6. Encourage the public and private sectors and NGOs to get involved in the local activities of the Global Campaign against Epilepsy
7. Promote interaction with traditional health systems
8. Encourage basic and applied research on epilepsy
9. Proclaim a National Epilepsy Day
10. Encourage regional and continental co-operation

diagnostic strategy and empower non-medical healthcare workers. The questions result in a probability score for the likelihood of the episode being epilepsy. It has been developed as a mobile phone application –which enables data to be retained and communicated. This technique demonstrates principles of telemedicine i.e. utilizing non-conventional methods to expand the reach of medicine [2].

Personal mobile phone ownership in South Sudan was estimated at 1 million in 2013 but was predicted to rise rapidly since then along with plans to develop fibre-optic technology in the country [16]. This opens up opportunities to conduct follow up clinics by telephone. In Malaysia SMS has been used to support ongoing epilepsy education and support adherence with medication [17]. Low literacy rates may limit progress in South Sudan [12].

Making phenobarbital free of charge may encourage compliance – but evidence suggests that the journey to the clinic may be too difficult due to cost and safety factors [18].

Conclusions

The majority of the world population lives in developing countries of which sub-Saharan Africa makes up a substantial part. The spectrum of neurological illness here is different to those of more developed nations and the overall disease burden is greater. These qualitative and quantitative differences are particularly apparent when considering epilepsy specifically.

Tackling the problem of epilepsy in South Sudan and globally requires first and foremost a recognition of the scale of the issue by international communities. It will also require collaborative working and innovative approaches to optimise the available resources.

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