Point of Care Ultrasound

Author: Dr Graham Grove, 2016

grovegl

Point of care ultrasonography (POCUS) is the term used when non-radiologist medical staff use a portable ultrasound at the bedside as an adjunct to their clinical examination. Point of care ultrasound use is well established in Emergency and Intensive Care Medicine where it is used to answer a wide variety of diagnostic questions such as determining if a pneumothorax is present or if there is evidence of severe right hear strain suggestive a pulmonary embolism. In palliative medicine, point of care ultrasonography is less well established although it is frequently used for confirming the diagnosis and aiding the drainage of ascites.

Principles of POCUS

Basic physics

An ultrasound works by sending out very high frequency sound waves that are inaudible to human ears and recording and displaying them as they rebound. When displaying this on a screen white is used to show when sound rebounds back and black is used to show when sound does not rebound.

Various factors influence what the way ultrasound travels and rebounds and therefore the way the image looks, including:

- Sound waves travel at different speeds through different substances (e.g. sound travels at a different speed through fat than it does through muscle
- Sound waves tend to reflect when they reach the interface between two different materials (e.g. most of the ultrasound wave gets reflected when it hits a calculus)

Basic terminology

Some of the terminology that is used to describe the ultrasound image displayed include:

- Anechoic = black
- Hypo-echoic = dark
- Hyper-echoic = bright, white
- Homogenous = uniform echo pattern
- Heterogenous = mixed echo pattern

Some basic rules of thumb are:

- Fluid (e.g. ascites) is anechoic
- Air (e.g. bowel gas) is heterogenously hyperechoic
- Calcium and bone is very hyperechoic but as sound does not pass through calcium everything deep to this remains black
- Organs (e.g. liver) are relatively homogenous in their echotexture

Transducers

Uses of palliative POCUS

Point of care ultrasound is useful for non-radiologists to be able to answer specific focussed questions at the bedside. It can be used as an adjunct to clinical examination. It is not a replacement for formal imaging in a radiology department. Common uses of point of care ultrasound in palliative medicine include:

- Confirmation of ascites and aiding drainage of it
- Confirmation of a pleural effusion and aiding drainage of it
- Measuring the bladder volume where urinary retention is thought to be a problem

Additional uses of point of care ultrasound in emergency and critical medicine can be translated for use in the palliative medicine setting with suitable basic training including:

- Identifying dilated, fluid-filled loops of small bowel consistent with small bowel obstruction
- Identifying hydronephrosis in patients with an obstructive uropathy
- Identifying pericardial fluid (suggesting a malignant effusion) or severe right heart strain (suggesting a massive pulmonary embolism) in a patient who suddenly deteriorates with hypotension or dyspnoea
- Identifying features of pulmonary oedema in a dyspnoeic patient
- Measuring the diameter of the optic nerve in patients with suspected raised intracranial pressure

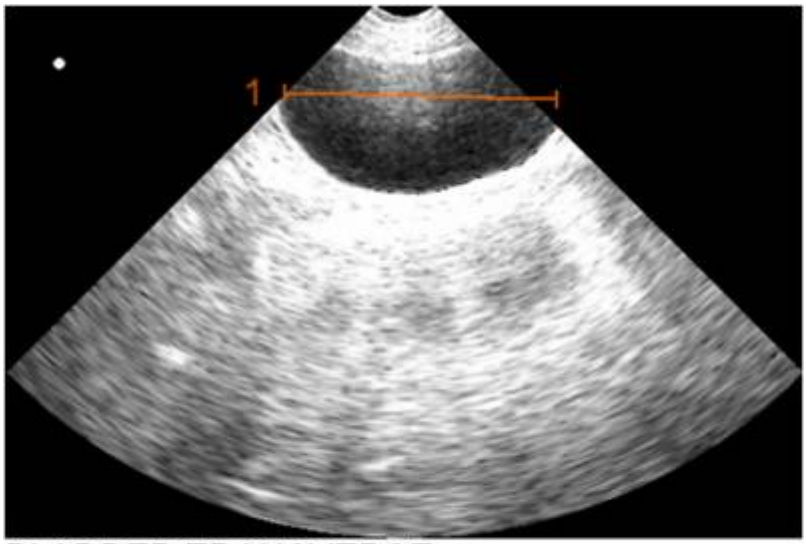
Bladder volume

For details on scanning techinque, see Bladder Point of Care Ultrasonography

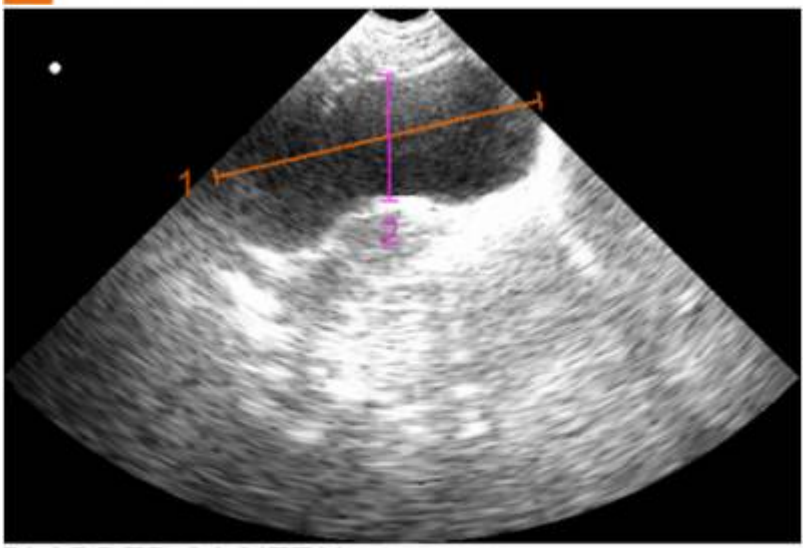
The volume of urine in the bladder can be determined very easily with an ultrasound which can can be relevant when you are concerned that a restless patient near the end of life is restless because of urinary retention. The bladder appears as an anechoic balloon in the suprapubic region. It is very easy for the human eye to tell the difference between ascites and a full bladder whereas a “bladder scanner” may misinterpret urine volume in the presence of ascites.

The bladder can be viewed initially in the transverse plane to measure the length across (+/- depth back) and then the sagittal plane to measure the height (+/- depth back). A good approximation of urine volume for most people is:

> Bladder volume = length across x depth back x 0.72



BLADDER TRANSVERSE
1: 9.38 cm



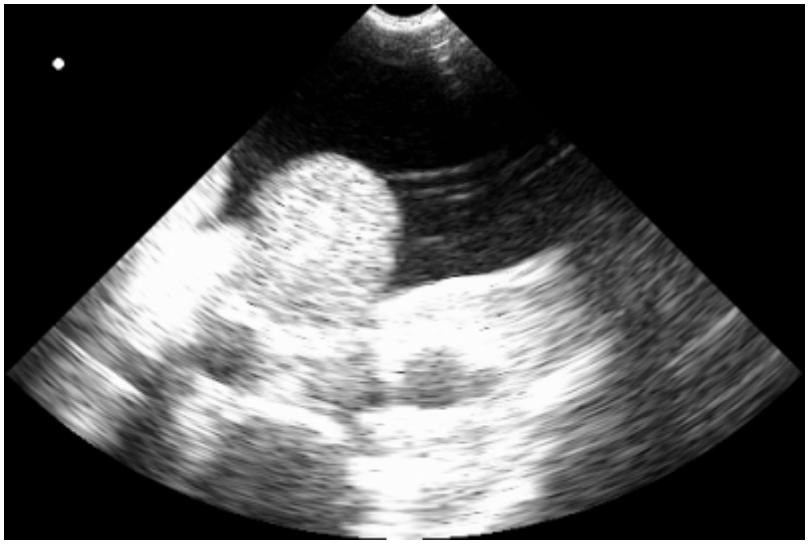
BLADDER SAGITTAL
1: 11.53 cm
2: 4.35 cm

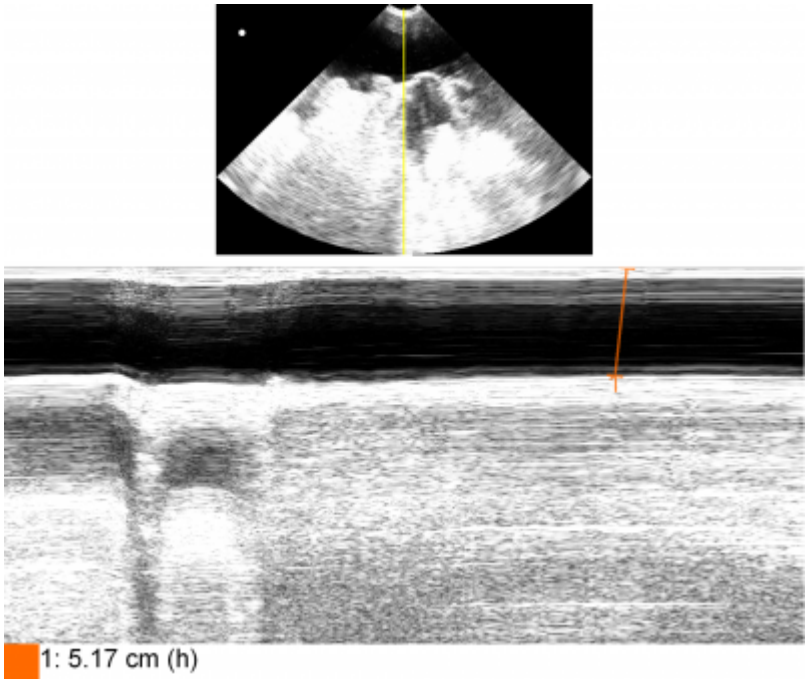
Ascites

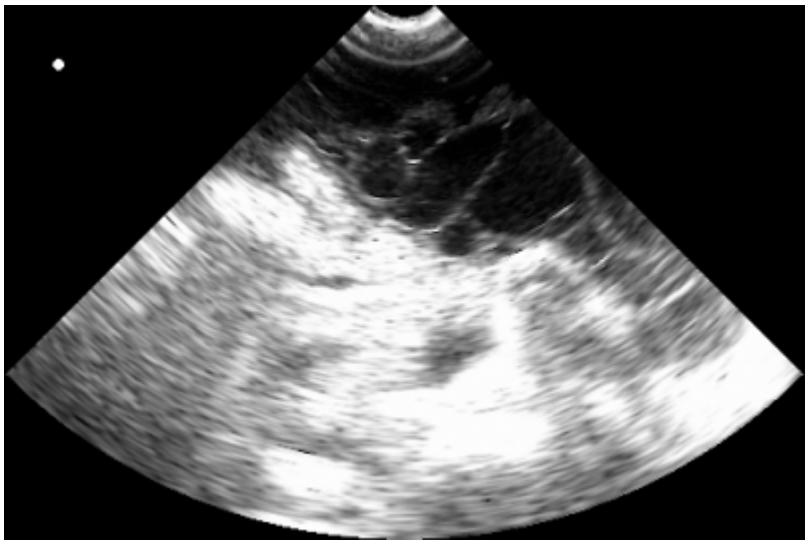
Further details can be found at:

- Therapeutic ascitic tap
- Ascites

Confirming ascites with bedside ultrasonography is extremely straightforward. As it is fluid, ascites appears anechoic. Each cm of depth of fluid represents a significant amount of ascites, and it can be estimated, after finding the deepest point, that there is about 1-2 litres per cm of depth. Ultrasonography is particular useful at noting if the ascites is uniformly spread in the abdomen or if there are only pockets of fluid suggesting a loculated effusion. Ultrasound is very helpful in identifying a safe site for drainage allowing for easy identification and avoidance of superficial loops of bowel.







Hydronephrosis

With practice identifying the kidneys with ultrasound at the bedside becomes relatively straightforward and it is easy to ask the focussed question: is hydronephrosis present? This question is helpful to ask in patients with a rising creatinine who have advanced cancer that might be obstructing the kidneys.

The kidney, from outside to inside, is made up of the outer renal parenchyma, the middle medullary pyramids and the inner renal pelvis. Normally the renal parenchyma is hypoechoic and the the renal pelvis is hyperechoic, however as hydronephrosis develops anechoic dilatation of the renal pelvis and calyces becomes apparent with the pelvis.

Small bowel obstruction

Pleural effusion

Pneumothorax

Pulmonary oedema, pulmonary fibrosis and lymphangitis carcinomatosis

Pericardial effusion

Right heart strain

Dilated optic nerve

pocus, textbook