REVIEW PROF-655

INTERVENTIONAL ULTRASONOGRAPHY

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Surgeons are usually creative, active and innovators by nature (To some, they are born sadists). They are soft at heart but pragmatic and always planning to offer patients maximum comfort. They love challenges and improvements in surgical skills and methods. The surgeons are changing to become scientific artists with the developments and improvements in understanding of physiologic and pathologic bases of diseases.

The surgery used to be heroic few centuries ago. It is minimally invasive today and is likely to be micro-invasive or even non invasive in near future.

Interventional ultrasonography is performance of various procedures under ultrasound guidance. Radiological guidance is also required some-times to complete the procedures. It is a step towards future.

Needle puncture and aspiration were first described, during 1930. The developments in ultrasound technology have improved its resolution to diagnose the lesions reasonably precisely and to intervene per cutaneously under guidance. Ultrasound aspiration probes were devised during 1970 to conduct interventions easily.

OBJECTIVES OF INTERVENTION

To offer micro-invasive choice of treatment.
To decrease the morbidity and mortality.
To provide economy of treatment.
To provide quality assurance
To confirm diagnosis pre-operatively

ADVANTAGES

Ultrasound guided intervention is possible even in critically ill patients as the machine can be shifted to bed side for intervention.

It is essential for up-to-date trauma care. If helps to avoid to significant number of negative laparotomies in abdominal trauma patients by improving pre-operative diagnosis.

Ultrasound guidance for aspiration, drainage and biopsy offers safety, accuracy and portability. The procedure is less time consuming.

It confirms results (drainage, FNAC and biopsy) immediately and checks complications.

Color flow Doppler helps to avoid vascular injuries while conducting procedures under ultrasonographic guidance by showing vessels very precisely.

Specially designed ultrasound needles, which allow placement into target lesion, under real time control (as small as 1 cm size) in critical anatomic areas.

The approach is under vision and real time dynamic control.

It is economical.

The interventional ultrasonography has certain disadvantages and limitations as well. As the skills are improving and further developments in the ultrasound technology and its accessaries are being made, these are getting less and less.

LIMITATIONS

All disease processes can not be treated by this method. The presence of drains and dressings may cause technical problems. Technical difficulties due to poor resolution and non availability of special instruments are faced in obese patients.

DIAGNOSTIC INDICATIONS OF INTERVENTION

The ultrasound examination helps in visualization of lesion. FNAC, biopsy and aspiration of fluids is required to confirm the diagnosis. Ultrasound guidance helps to avoid bowel perforation during intra peritoneal aspiration.

Primary or secondary neoplastic lesions of the liver can be biopsied under ultrasound guidance. Collection of sample tissue is more accurate and risks of injury to other abdominal viscera are minimized. FNAC or even core needle biopsy of the gall bladder mass can be performed under ultrasound control with safety and precision.

Renal tumours are picked up on ultrasonography at early stage. These can be staged and FNAC or true cut needle biopsy can be performed at the same time. These procedures can be used for abdominal, pelvic and retro-peritoneal masses as well to have pre-operative confirmation of diagnosis and planning of treatment.

Dynamic infusion cavernasometry & cavernasography is effective in evaluating the haemodyamic status of erectile dysfunction[1].

Intra vascular ultrasonography is performed with a catheter based miniature sonographic probe (transducer). It is introduced into the vessels and it provides high resolution, cross sectional, real time imaging of vessel wall and lumen.

Intra vascular ultrasonography (IVUS) is used for iliac vein compression[2]. It is also used to investigate arteries and veins. It has potential to increase the accuracy of per cutaneous intervention and device sizing[9].

Ultrasound guidance for central vein cannulation makes it easy and avoids complications in critically ill patients[3]. Aspiration of fluid collection / pus / blood is achieved in many lesions and its diagnosis is confirmed.

Antegrade nephrogram is a better choice in the diagnosis of obstructive uropathies. It helps in drainage of obstructed kidney and diagnosis of site and type of obstruction without any anaesthesia or endoscopic equipment.

Amniocentesis can be done safely and precisely at 12-13 weeks of gestation in patients with higher risk of pregnancies with congenital neural tubes defect or other abnormalities. Chorionic villous sampling is also performed under ultrasound guidance and it provides better information about various fetal abnormalities antenatally

Cordocentesis is also performed under ultrasound control for karyotyping and diagnosis of other blood dyscrasias such as thalassemia. Special gel is available for insertion into uterus and fallopian tubes to be seen by ultrasonography. It helps to show the anatomy of interior of uterus and tubes while investigating the infertile females.

Follicle tracking, required for various procedures of assisted fertilization in infertile or subfertile females is performed with ultrasound guidance.

THERAPEUTIC INDICATIONS FOR INTERVENTION

Per cutaneous drainage of liver abscess has become a standard first line treatment for this problem. It has minimized the morbidity of patient and cost of surgery. It takes only few minutes to complete the procedure. Splenic abscess is a rare condition and it can be drained similarly.

Ultrasound-guided radio-frequency thermal ablation is a relatively safe, well tolerated and versatile treatment that offers excellent local control of primary and metastatic liver tumours[4]. It is an effective option with irresectable hepatic malignancies with careful patient selection based on tumour size, location, number and on clinical status of the patient[5].

PAIR (Puncture, Aspiration, Injection and Re-aspiration) and PEVAC (Per cutaneous evacuation of cyst content) are used for the treatment of echinococcal cysts. Ultrasound guided puncture of the cyst and aspiration of cyst fluid to release intra cystic pressure to avoid leakage; aspiration and evacuation of daughter cysts & endocysts through large bore cannula followed by injection of saline (or other scolecidals) is a very satisfactory method of treatment in uncomplicated echinococcal cysts[6].

Endoprosthesis or sphincterotomy and external drainage of cysto-biliary fistula is performed for the treatment of cysto-biliary fistulas. The catheter is removed only after

complete cyst collapse and closure of fistula is confirmed on cystography[6].

Ultrasound guided per-cutaneous injection of fibrin glue is used in liver and splenic trauma.(grade I & II. injuries).

Ultrasound controlled per cutaneous drainage gives an important contribution in the treatment of the hardest forms of acute pancreatitis and represents a safe and less aggressive method in the treatment of liquid collections and steatonecrosis formed during an acute pancreatitis attack[7].

Drainage of abdominal / pelvic abscess is simple, safe and less hazardous.

Low output fistulous collections (50 ml / day) usually close with per-cutaneous aspiration drainage and antibiotics cover under ultrasound guidance.

Per-cutaneous large drainage of haemoperitoneum under ultrasound control is very effective to avoid the complications after blunt trauma. Drainage of biliary stasis or per cutaneous cholecystostomy in very ill (patients suffering from Acalculous cholecystitis or cholecystitis with stones. Drainage of peri-renal & peri-urethral haematomas & collections can also be drained effectively.

Renal cyst aspiration and drainage of obstructive uropathies is now accepted first line treatment. (Ante-grade nephrostomy for renal outflow obstruction/Per-cutaneous drainage of obstructed kidney)

Prostatic Cysts can be aspirated under ultrasound guidance and major surgery may be avoided. Drainage of psoas abscess is easily performed under ultrasound guidance.

Fibrin glue injection into pseudo aneurysm of femoral artery and dissecting aneurysm of aorta are being used effectively with the help of ultrasound[6].

Intravascular ultrasonography (IVUS) is a useful adjunct in the diagnosis and endovascular management of iliac vein compression syndrome. A catheter based miniature sonographic transducer is introduced into the vessel to achieve high resolution, cross sectional, real time imaging of vessel wall and lumen. It has potential to increase the accuracy of per cutaneous interventions[9].

Pericardial effusion drainage is effectively and precisely performed under ultrasound guidance.

Ovum retrieval for In-vitro fertilization is also conducted under ultrasound control. Amnioreduction in patients with polyhydramnios is done under ultrasound guidance. Selective fetal salvage in multiple pregnancies (more than three) by Inj magnesium sulphate into the fetus is performed antenatally under ultrasound guidance.

Intrauterine fetal exchange transfusion in Rh. sensitized mothers is performed antenatally with the help of ultrasound.

The ultrasound guided intervention should be either avoided or performed with great care and by a very experienced and skilled person in following condition;

1. Poorly defined abscess
2. Extensive and multi-compartment abscesses and multi-location abscesses
3. Major bleeding problems i.e. coagulopathies
4. Thick, infected and necrotic material i.e. pancreatic abscess.
5. Lack of safe access

PREPARATION OF PATIENT

Intervention under ultrasound guidance is an alternate to major surgical procedure. Similar complications and problems are expected. It is important to do proper patient counseling. All the risks, benefits and alternatives of procedure should be explained.

Written Patient consent should be obtained. Patient's preparation and assessment should be similar to any surgical procedure. I-V cannulation and all other hospital emergency arrangements are performed before intervention is undertaken.

ANAESTHESIA / ANALGESIA

Normally local anaesthetic agent is infiltrated in the skin covering the puncture area. I/V analgesia or short

general anaesthesia for 5 - 10 minutes during the intervention is helpful for pediatrics patients as they are not so co-operative.

Epidural anesthesia can also be used depending upon the type of intervention. Needle Selection is performed according to the disease process for which intervention is required. Fine needles 22G, Tracker cannulas or Catheter holding needles are used for various procedures.

Ultrasound Guidance can be direct. (Needle guidance method) when an intervention probe is used which has built in hole or grooves or the probe has attachable needle guides. It offers continuous needle guidance and very small lesions can be treated precisely.

In indirect guidance the ultrasonography of the diseased area is performed and intervention site or depth are marked with hub of needle or cotton bead pressed with the ultrasound probe.

Later on the procedure is performed through the marked site. The advantage of this method is that it can be done in operated patients with dressings on and the needle is passed through a separate selected site.

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