



## **Ultrasonography: The Third Eye of Anaesthesiologist**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JPRI/2021/v33i37A32004

#### Editor(s):

(1) Dr. Juan Carlos Troiano, University of Buenos Aires, Argentina.

#### Reviewers:

(1) Suman Rajagopalan, Baylor College of Medicine, USA.

(2) Thomas Rolf Erdmann, Universidade Federal de Santa Catarina, Brazil.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/71265>

**Mini-review Article**

**Received 10 May 2021**

**Accepted 14 July 2021**

**Published 15 July 2021**

## **ABSTRACT**

Anesthesiology is an evolving branch. Most of the procedures done by anesthesiologists, are blind except for endotracheal intubation. Ultrasonography (USG) helps anesthesiologists to see the actual anatomy in real time and thus helps them to give safe anesthesia minimizing the complications in every aspect of the field like difficult airway, vascular access, regional anesthesia, chronic pain management and critical care.

*Keywords: USG; reflection; refraction; scatterin and absorption.*

## **1. INTRODUCTION**

Anesthesia field has evolved from ether to desflurane, endotracheal tube to LMA, Boyle's

machine to anesthesia workstations, hand ventilation to ventilators with advanced mode of ventilations [1]. Anesthesiologists do all the procedures blindly and thus the accuracy and

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safety of such procedures are sometimes doubtful, and complication can occur even in skilled hands. Ultrasound serves as a quick and accurate tool for anesthesiologists to effectively manage emergencies [2,3].

**History-** In 1918 during world war 1, ultrasound was introduced by the Navy to detect enemy submarines. Ultrasound is high frequency sound and refers to mechanical vibrations above 20khz. Human ears can hear sounds with frequencies 20hz to 20khz. USG frequencies commonly used for medical diagnosis are between 2-15mhz.

**Physics** - The USG wave travels through the tissue, it is subjected to a number of physical interactions. The most important features are:

**Reflection-** Reflection depends on the difference of impedance between two different mediums. If impedance is equal, there is no reflection. If there is a significant difference, then there is complete reflection.

**Refraction-** Change in sound direction when crossing the boundary between two media is called refraction.

**Scattering-** Scattering is redirection of sound in any direction by a rough surface or by heterogeneous media.

**Absorption-** Absorption is defined as the direct conversion of sound energy into heat.

**PARTS OF USG:** 1. Transducer-probe and pulse control. 2. CPU (central processing unit). 3. Keyboard. 4. Display. 5. Storage device. 6. Printer.

## 2. USG MODES

**A-Mode-** The transducer sends the single pulse of ultrasound into the medium.

**B-Mode** - Two-dimensional image of the area that is simultaneously scanned by a linear array of 100-300 piezoelectric elements rather than a single one.

**M-Mode-** A single beam in a USG Scan can be used to produce a picture with a motion signal where movement of a structure such as a heart valve can be depicted in a wave like manner.

**Doppler Mode-** The term describes a change in frequency or wavelength of a sound wave resulting from relative motion between the sound source and sound receiver.

Although the physics behind USG generation, propagation, detection, and transformation into practical information is rather complex, its clinical application is much simple. USG is noninvasive and simple technique to provide a more accurate clinical assessment and localization of the field of interest. New USG machines are compact and portable with enhanced tissue penetration with better resolution [4]. USG machine aids to make clear anatomic pictures thereby making 2D and 3D visualization of the anatomic structure. It is very important for an anesthesiologist to learn the expanding applications of this modern technology and master it for daily use to widen the safety margin [5].

### 2.1 USG and Airway

USG is being increasingly used for cricothyroidotomy, facilitation of percutaneous dilatation tracheostomy, confirmation of endotracheal intubation and assessing vocal cord palsy and goiter. It is also used for prediction of appropriate size of endotracheal tube, & proper size of double lumen tube. Difficult airway prediction is better with USG. We can visualize trachea, larynx, vocal cord, and cricothyroid membrane.

### 2.2 USG and Vascular Access

USG is used for vascular access. It helps us to see the presence, position, latency, and direction of the vessel. Vascular mapping helps to detect vessel. It is an established gold standard unless not available. There should be efforts to make it available at the working place to ease anatomical judgement. This will help to avoid complications like postprocedural pneumothorax. You can visualize valves and thrombi in USG. USG guided vascular calculation should be considered the tool of first choice to provide access to central venous and arterial vessels as well as difficult peripheral venous cannulation in critically ill patients. USG is used before (to define the anatomy and the best target vessel), during (with real time technique in short, long and oblique approach) and after cannulation (to demonstrate the optimal catheter position) as well as ruling in or out worrisome complications like pneumothorax.

### 2.3 USG and Heart

Transthoracic echo is helpful to recognize cardiac malfunction, inferior vena cava, a clot in any chamber and cardiac echo during surgery to check valve replacement and all.

### 2.4 USG and Regional Anesthesia

Regional anesthesia is another developing area of USG use. Portable 2D USG allows the clinician to place needles with precision guided by a real time image of patient's actual anatomical landmarks. Such techniques offer potential advantages over established techniques including improved success rates, reduced complications and enhanced teaching<sup>4</sup>. USG for regional anesthesia is gold standard now. The success and accuracy of blocks have increased drastically. All blocks can be performed under USG guidance. General anesthesia has its own pitfalls, and multiple drugs interactions, thereby increasing the cost [6]. Also, GA is potential aerosol generator which cannot be ignored in COVID era. Nowadays, in the era of day care surgeries, regional anesthesia is preferred for early recovery and discharge. Another important application of USG is in lower limb surgeries where spinal anesthesia is risky or contraindicated e.g., patient with low ejection fraction where hypotension is detrimental, regional techniques are preferred.

### 2.5 USG and Pain Management

Pain management has evolved as a separate specialty in today's era as an important offshoot of anesthesia. For acute pain management, placing peripheral nerve catheters under ultrasound guidance to give local anesthetics is a current practice, like adductor canal block in TKR. For chronic pain management, USG allows direct visualization of tissue structure for various nerve blocks like stellate ganglion blocks or intra articular joint injections. Musculoskeletal ultrasonography & interventions is the order of the day [7]. The ability of USG to provide detailed anatomic visualization while avoiding radiation exposure continues to make it an appealing tool for many practitioners of chronic pain management [5]. USG has utility in visualizing soft tissue and vascular structures in anatomic region of interest resulting in increased use for perianal, peripheral nerve and joint related structures. USG is useful for medical

branch block and intraarticular facet block in the cervical and lumbar spine [8-12].

### 2.6 USG and Stomach

Anesthesia belongs to emergency medicine branch. Anaesthetizing a case in emergency with full stomach is a nightmare. We are always worried about dreaded aspiration risk. Gastric USG help us for assessment of gastric content and thus help us to estimate the risk and manage.

### 2.7 Usg and Critical Care

There is increasing interest in the use of USG to assess and guide the management of critically ill patients. The ability to carry out quick examination by bedside to answer specific queries. It is repeatable as well, giving a clear advantage in an acute care setting. USG explains the utility of echocardiography in ICU to manage hemodynamically unstable patients. Lung USG has advantage over chest radiography USG is rapidly emerging as an important tool in the hands of ICU physicians<sup>6</sup>. POCUS elaborate on POCUS is emerging as an important bedside tool to enable decision making faster. USG is a handy tool to aid the work, especially POCUS, in IVC collapse and central line insertion in a heavy ICUs to reduce the work stress.

### 2.8 USG and Trauma

The focused assessment with sonography in Trauma (FAST) is an ultrasound protocol developed to evaluate pericardium and three potential spaces in peritoneal cavity for pathological fluid. FAST assess for hemoperitoneum and hemopericardium. Many institutions have introduced the Extended FAST (eFAST) protocol in their trauma algorithm. The eFAST examines each hemithorax for the presence of hemo thoraces and pneumothoraces<sup>7</sup>.

### 2.9 USG and Central Neuraxial Block

USG assisted Neuraxial block is advanced technique for use in patient with difficult spinal anatomy. The use of a pre procedural scan improved the technical efficiency of central Neuraxial block by facilitating precise identification of underlying anatomical structures.

### 3. CONCLUSION

In the field of Anesthesiology there are numerous USG procedure applications. It will be very helpful for anesthesiologist to perform under vigilance where USG will act as the third eye. In future, an anesthesiologist may need to carry a portable USG machine in his/her Anesthesia kit.

### CONSENT

It is not applicable.

### ETHICAL APPROVAL

Ethical Approval taken from institutional ethics committee.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

### REFERENCES

1. Daquan Xu. Physics of ultrasound [Internet]. New York: NYSORA (New York School of Regional Anesthesia); 2021. Available from: <https://www.nysora.com/foundations-of-regional-anesthesia/equipment/physics-of-ultrasound/>
2. Jain K, Yadav M, Gupta N, Thulkar S, Bhatnagar S. Ultrasonographic assessment of airway. J Anaesthesiol Clin Pharmacol. 2020;36:5-12.
3. Buran T, Sanem Gökçe Merve Kılınc, Elmas Kasap. Prevalence of extraintestinal manifestations of ulcerative colitis patients in Turkey: Community-Based monocentric observational study. Clinical Medicine and Medical Research. 2020;1(2):39-46. DOI:<https://doi.org/10.52845/CMMR/2020v1i2a8>
4. Blanco P. Ultrasound-guided vascular cannulation in critical care patients: A practical review. Med Intensiva. 2016 Dec;40(9):560-571.
5. Carty S, Nicholls B. Ultrasound-guided regional anaesthesia. Continuing Education in Anaesthesia Critical Care & Pain. 2007;7(1):20-24.
6. Daniel V, Daniel K. Perception of nurses' work in psychiatric clinic. Clinical Medicine Insights. 2020;1(1):27-33. DOI:<https://doi.org/10.52845/CMI/2020v1i1a5>
7. Perrine DC, Votta-Velis G, Borgeat A. Ultrasound indications for chronic pain management. Current Opinion in Anaesthesiology. 2016;29(5):600-605.
8. Chacko J, Brar G. Bedside ultrasonography: Applications in critical care: Part I. Indian Journal of Critical Care Medicine. 2014;18(5):301.
9. Dr. Anubha Singh, Dr. Preetaish Kaul. Effectiveness of ManSure, a herbal reproductive health supplement, on semen quality (sperm count, sperm quality, sperm motility) in infertile men International Journal of Scientific Research and Education. 2018;06,01 (Jan-18):7788- 91.
10. Eman A Shakir, Zainab Nazar. Obesity increase the risk of carpal tunnel syndrome, International Journal Of Scientific Research And Education. 2017;05,04(April-17):6309-12.
11. Daniel V, Daniel K. Exercises training program: It's Effect on Muscle strength and Activity of daily living among elderly people. Nursing and Midwifery. 2020; 1(01):19-23. DOI:<https://doi.org/10.52845/NM/2020v1i1a5>
12. Ghosh S, et al. FANZCA FRCPC, Ultrasound-guided lumbar central neuraxial block, BJA Education. 2016;16(7):213-220.

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Peer-review history:

The peer review history for this paper can be accessed here:  
<https://www.sdiarticle4.com/review-history/71265>