Diagnostic and Therapeutic Role of Endosonography in Gastrointestinal Diseases

ESSAY

Submitted in partial fulfillment
for the requirement of Msc degree in
Tropical Medicine

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2009

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

﴿ قَالُواْ سُبۡحَٰنَكَ لَا عِلۡمَ لَنَآ إِلَّا مَا عَلَّمۡتَنَآۖ إِنَّكَ أَنتَ ٱلۡعَلِيمُ ٱلۡحَكِيمُ ٣٢ ﴾

البقرة: ٣٢

جامعه القاهره / كليه الطب
الدراسات العليا

محضر

اجتماع لجنة الحكم على الرسالة المقدمة من

الطبيب / [illegible]

توطئة للحصول على درجة الماجستير / الدكتوراه

فى [illegible]

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تحت عنوان : باللغة الانجليزية : Diagnostic and Therapeutic Role of Enteroscopy in Gastrointestinal Diseases

باللغة العربية : الدور التشخيصي والعلاجي للإنتروسكوبي لأمراض الجهاز الهضمي

بناء على موافقة الجامعة بتاريخ ٢٥ / ١١ / ٢٠٠٩ تم تشكيل لجنة الفحص والمناقشة للرسالة المذكورة أعلاه على النحو التالي :-

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بعد فحص الرسالة بواسطة كل عضو منفردا وكتابة تقارير منفردة لكل منهم انعقدت اللجنة مجتمعة فى يوم الخميس بتاريخ ٢٣ / ١٢ / ٢٠٠٩ بقسم [illegible] مدرج [illegible]
بكلية الطب – جامعة القاهرة وذلك لمناقشة الطالب فى جلسة علنية فى موضوع الرسالة والنتائج التى توصل اليها وكذلك الأسس العلمية التى قام عليها البحث .

قرار اللجنة :

توقيعات أعضاء اللجنة :-

المشرف الممتحن	الممتحن الداخلى	الممتحن الخارجى
عصام	[illegible]	[illegible]

Abstract

EUS combines two modalities: endoscopic visualization and high-frequency US. EUS has a significant impact on diagnosis and management of GIT tumors. Multiple studies suggest that EUS is superior to other imaging modalities for tumor (T) and lymph node (N) staging of luminal and pancreaticobiliary malignancies. The ultimate choice of staging modalities is largely dependent upon patient selection and local expertise. EUS continues to grow and develop, though relative lack of trained practitioners, high costs of EUS processors and long duration of maneuver.

Key words:

EUS , Endosonography, gastrointestinal, FNA-EUS, interventional,

ACKNOLEDGMENT

First of all thanks to **God Allah** for blessing me in this work until it has reached its end. I always feel deeply indebted to my God, the real guide and the real supporter.

I would like to express my profound thanks, sincere and deep gratitude to Prof. Dr. **Ayman Yosry**, Professor of tropical medicine, Faculty of medicine, Cairo University for his valuable suggestions, kind guidance, sincere help and parental support not only in this work but throughout my residency in the department.

I am particularly indebted to Prof. Dr. **Rabab Fouad,** Professor of Tropical Medicine, Faculty of Medicine, Cairo University for her indispensable scientific help, excellent collaboration and suggestions which have been of great help in the preparation of this work.

Words are short of expressing my deepest gratitude to Dr**. Waleed Fouad** Lecturer of Tropical Medicine, Faculty of Medicine, Cairo University who was very patient with me and gave me much of his time, effort and care.

Last but not least, I would like to thank my **family** for their patience and support without which the completion of this work would have not been possible.

Finally, my thanks also offered to **all staff members** and my colleagues of the tropical medicine department for their valuable suggestions and encouragement.

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LIST OF ABBREVIATIONS

AICP	Autoimmune Chronic Pancreatitits
AIP	Autoimmune Pancreatitis
AJCC	American Joint Committee On Cancer
Ao	Aorta
CBD	Common Bile Duct
CEA	Carcino-Embryonic Antigen
CHOP	Cyclophosphamide, Doxorubicin, Vincristine And Prednisone
CI	Confidence Interval
CLN	Celiac Axis Lymph Node
CP	Chronic Pancreatitis
CPB	Eus-Guided Celiac Plexus Block
CPN	Celiac Plexus Neurolysis
CT	X-Ray Computed Tomography
CT-FNA	Computerized Tomographic Fine Needle Aspiration
CYA	Cyanoacrylate
EAS	External Anal Sphincter
EAS	External Anal Sphincter
EAUS	Endoanal Ultrasonography
ECD	Endoscopic Ultrasound-Guided Cholangio Drainage
EIS	Endoscopic Injection Sclerotherapy
EMR	Endoscopic Mucosal Resection
ESD	Endoscopic Submucosal Dissection
EUS	Endoscopic Ultrasonography
EUS-FNA	Endoscopic Ultrasound Guided Fine Needle Aspiration
EUS-FNI	Endoscopic Ultrasound Guided Fine Needle Injection
EUS-TCB	EUS-Guided Trucut Biopsy
FAP	Familial Adenomatous Polyposis
FDG-PET	18-Fludeoxyglucose Positron Emission Tomography
Fr	French Catheter Scale
GI, GIT	Gastrointestinal Tract
GISTs	Gastrointestinal Stromal Tumor
Hz	Hertz
IAS	Internal Anal Sphincter
IAS	Internal Anal Sphincter
IDUS	Intraductal Ultrasound
IOC	Intraoperative Cholangiography
IPMNs	Intraductal Papillary Mucinous Neoplasms
IUAC	International Union Against Cancer
IVC	Inferior Vena Cava
JGCA	Japanese Gastric Cancer Association
LGF	Large Gastric Folds
LRV	Left Renal Vein

MALT	Mucosa-Associated Lymphoid Tissue
MCN	Mucinous Cystic Neoplasms
MDR-CT	Multidetector-Row CT
MEN-1	Multiple Endocrine Neoplasia Type 1
MHz	Mega Hertz
mm	Millimeter
MRCP	Magnetic Resonance Cholangiopancreatography
MRI	Magnetic Resonance Imaging
MS	Mediastinoscopy
NE	Nutcracker Esophagus
NPV	Negative Predictive Value
para-ECVs	Para-Esophageal Collateral Veins
PD	Pancreatic Duct
PEG	Percutaneous Endoscopic Gastrostomy Tube
PEN	Pancreatic Endocrine Neoplasms
peri-ECVs	Peri-Esophageal Collateral Veins
PET	Positron Emission Tomography
PGL	Primary Gastric Lymphoma
PPV	Positive Predictive Value
PSC	Primary Sclerosing Cholangitis
PTA	Percutaneous Transluminal Angioplasty
PV	Portal Vein
PV	Portal Vein
RA	Renal Artery
RIP	Recurrent Idiopathic Pancreatitis
RLP	Linitis Plastica Of The Rectum
RV	Renal Vein
SA	Splenic Artery
SC	Subcarinal, Subcutaneous
SMA	Superior Mesenteric Artery
SMV	Superior Mesenteric Vein
SOM	Sphincter of Oddi Manometry
SV	Splenic Vein
TEM	Transanal Endoscopic Microsurgery
TEUS	Transrectal EUS
TUS	Transabdominal Ultrasound
UC	Ulcerative Colitis
UMP	Ultrasonic Microprobe
US	Ultrasonography
US	Ultrasound
VIP	Vasoactive Intestinal Peptide
κ	Kappa Value

INTRODUCTION & AIM OF WORK

Endoscopic ultrasound (EUS) has emerged as an excellent tool for the imaging of the gastrointestinal wall and surrounding structures ***(Al-Haddad & Eloubeidi, 2008)***.

Although conventional endoscopy provides excellent visualization of gastrointestinal mucosa, it provides little information about intramural or nearby extramural lesions ***(Sandhu & Bhutani, 2002)***.

The imaging of intra-abdominal structures by conventional transabdominal ultrasound is degraded by ultrasound energy attenuation with distance. The provision of an ultrasound probe on a flexible gastrointestinal endoscope, to form an echoendoscope, provides excellent imaging of the gastrointestinal wall and of adjacent extramural structures ***(Sandhu & Bhutani, 2002)***.

EUS became the test of choice for evaluating pancreatic cysts and mass lesions, biliary strictures and masses, abnormal adenopathy accessible from the GI tract, and GI submucosal lesions ***(Al-Haddad & Eloubeidi, 2008)***.

Endoscopic ultrasonography (EUS) has been used for staging of esophageal and gastric cancers based on the ability to demonstrate the different layers of the gastrointestinal wall and detect small periintestinal lymph nodes ***(Grimm et al., 1993)***.

Submucosal lesions, which are frequently encountered during endoscopy, are difficult to diagnose because they are covered by normal mucosa. In such cases, EUS, which enables intramural scanning of the GI tract, can provide some data, i.e., originating layer, internal echogenicity, and internal echo pattern however, with limited accuracy in distinguishing malignant from benign ***(Chak, 2002)***.

It has been shown that endosonography could be a useful technique for the diagnosis and follow-up of esophageal and gastric varices during intravariceal sclerotherapy ***(Ziegler et al., 1991)***. Moreover EUS Doppler-guided manometry of esophageal varices is feasible and accurate method for noninvasive measurement of variceal pressure ***(Pontes et al., 2002)***.

Combined EUS with Doppler study has been shown to be an accurate modality in the detection of portal venous system thrombosis ***(Lai & Brugge, 2004)***.

A recent work showed that contrast-enhanced harmonic EUS is a useful modality for depicting the microcirculation of digestive organs ***(Kitano et al., 2008)***.

EUS elastography is a new application in the field of endosonography and seems to be able to differentiate fibrous and benign tissue from malignant lesions thus guiding the diagnosis and therapy of gastrointestinal-related tumors ***(Giovannini et al., 2006)***. It has also been used in fecal/anal incontinence, inflammatory bowel disease (fistula and abscesses) and staging of anorectal carcinoma ***(Dietrich, 2007)***.

EUS-guided fine needle aspiration has allowed tissue sampling of a variety of lesions within or accessible from the gastrointestinal (GI) tract ***(Al-Haddad & Eloubeidi, 2008)***.

Moreover EUS-FNA has become an indispensable examination as the applications have widened to include pseudocyst drainage, biliary drainage, ethanol injection therapy, immunotherapy, and gene therapy ***(O'Toole et al., 2001)***.

AIM OF WORK:

To review the role of endosonography in diagnosis and interventional therapy of gastrointestinal diseases.

Chapter -1-

Basic Principles and Fundamentals of EUS Imaging

An understanding of the fundamental mechanisms of ultrasound (US) is useful to both the beginning and experienced endosonographer ***(Hwang et al., 2009).***

Basic principles:

Sound is mechanical energy that is transmitted as a wave through a fluid or solid medium ***(Curry et al., 1990; Powis et al., 1984).*** The periodicity or frequency of sound waves per unit of time varies widely and is measured in the number of cycles of the wave that are formed in one second, termed a ***hertz*** (Hz). Each wave cycle has both a positive and a negative pressure component. Sound higher in frequency than can be heard by the human ear is called ultrasound (Figure 1.1). The frequencies of waves commonly used in medical imaging are between 3.5 and 20 million Hz, usually abbreviated as 3.5 to 20 megahertz (MHz) **(*Curry et al., 1990*)**.

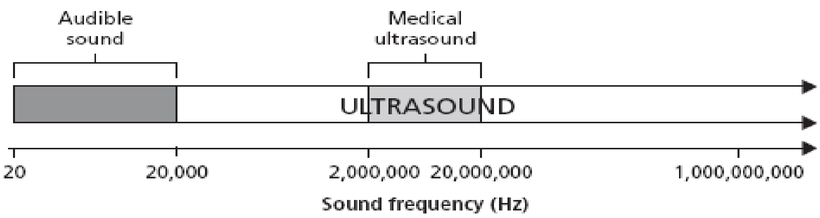

Figure 1.1 The frequencies of audible sound and ultrasound ***(Hwang et al., 2009)***

The high-frequency sound waves used in imaging have some interesting properties that affect how they are used. Unlike lower-frequency audible sound waves that travel well through air, high-frequency sound is more readily absorbed and attenuated by air and is strongly reflected at the boundary between tissue and air. This is why gas-filled lungs and bowel limit the use of transcutaneous ultrasound in imaging of mediastinal and retro-peritoneal structures ***(Hwang et al., 2009).***

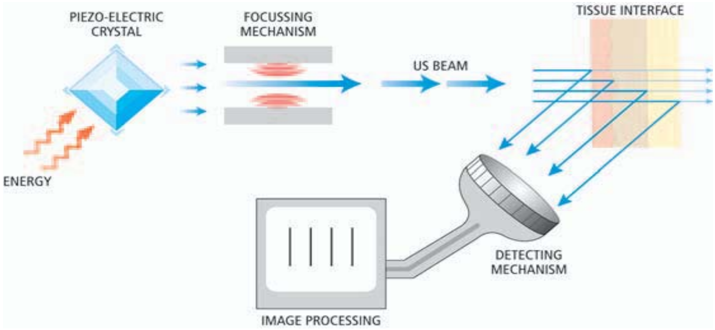

Figure 1.2 is a diagrammatic depiction of the principles of sonography. Pulses of high frequency ultrasound are directed at tissue and energy is transmitted through, absorbed and/or reflected at each interface, the relative proportions being determined by the nature of the interface and the adjacent structures. The intensity or 'brightness' of echo reflection is determined by interface characteristics, with amount of air, gaseous or liquid material and scatter being important additional factors ***(Schiller et al., 2002).***

Ultrasound transducers are composed of either one large crystal or, more commonly, multiple crystals aligned in an array. These transducers change an electrical signal to a sound wave and also receive the reflected sound wave back from the tissue. Ultrasound transducers typically emit a series of waves or a pulse, and then stop transmitting while they wait to detect the returning echo ***(Hwang et al., 2009).***

Ultrasound waves propagate through tissue at a speed that is determined by the physical properties of the tissue ***(Kimmey, 1992)***.

The speed of transmission is largely determined by the stiffness of the tissue: the stiffer the tissue, the faster the speed. For soft tissue, the variation in speed is only approximately 10%, ranging from 1460 meters per second in fat to 1630 meters per second in muscle ***(Goss et al., 1980)***.

Ultrasound waves are reflected back to the transducer when the sound wave encounters a tissue that is more difficult to pass through. For example, water easily transmits ultrasound, but air and bone do not, Sound waves that are reflected by tissue components back to the transducer are detected by the same piezoelectric crystals that created them. These crystals then translate the waves back into electrical signals for processing into an image ***(Hwang et al., 2009).***