

Inteligența Artificială în Gastroenterologie, Hepatologie și Ultrasonografie

Prof. Dr. Ioan Sporea

**Past-President al Federației Mondiale de
Ultrasonografie (WFUMB)**

Director, Centrul de Educație al WFUMB

Membru Titular al Academiei de Științe Medicale

"Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning." -- *Albert Einstein*

De la CAD (Computer Assisted Diagnosis) la IA (Inteligența Artificială)

- Am început să folosim în ecografie CAD de mai bine de 10 ani, publicând articole în acest domeniu.
- Am folosit-o pentru a cuantifica mai obiectiv încărcarea grasă a ficatului la ecografie, iar ulterior am încercat să o folosim la evaluarea Leziunilor Hepatice Circumscrise cu ajutorul Ecografiei cu Contrast (CEUS).

“Early time”: CAD pentru cuantificarea steatozei: 2013

Original papers

Med Ultrason 2013, Vol. 15, no. 3, 184-190
DOI: 10.11152/mu.2013.2066.153.dmm1vg2

Computer aided diagnosis method for steatosis rating in ultrasound images using random forests

Dan Mihai Mihăilescu¹, Vasile Gui¹, Corneliu Ioan Toma¹, Alina Popescu², Ioan Sporea²

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“Early time”: Computer Assisted Diagnosis

Original papers

Med Ultrason 2017, Vol. 19, no. 3, 252-258
DOI: 10.11152/mu-936

Is Contrast Enhanced Ultrasonography a useful tool in a beginner’s hand? How much can a Computer Assisted Diagnosis prototype help in characterizing the malignancy of focal liver lesions?

Tudor Voicu Moga¹, Alina Popescu¹, Ioan Sporea¹, Mirela Danila¹, Ciprian David², Vasile Gui², Nicoleta Iacob³, Gratian Miclaus³, Roxana Sirli¹

¹Department of Gastroenterology and Hepatology, “Victor Babes” University of Medicine and Pharmacy, ²Electronics and Telecommunications Faculty, “Politehnica” University, ³Department of Anatomy and Embryology, “Victor Babes” University of Medicine and Pharmacy, Timișoara, Romania

Inteligența artificială pentru CEUS







Personalized Medicine **2021**, 11, 1388.



Article

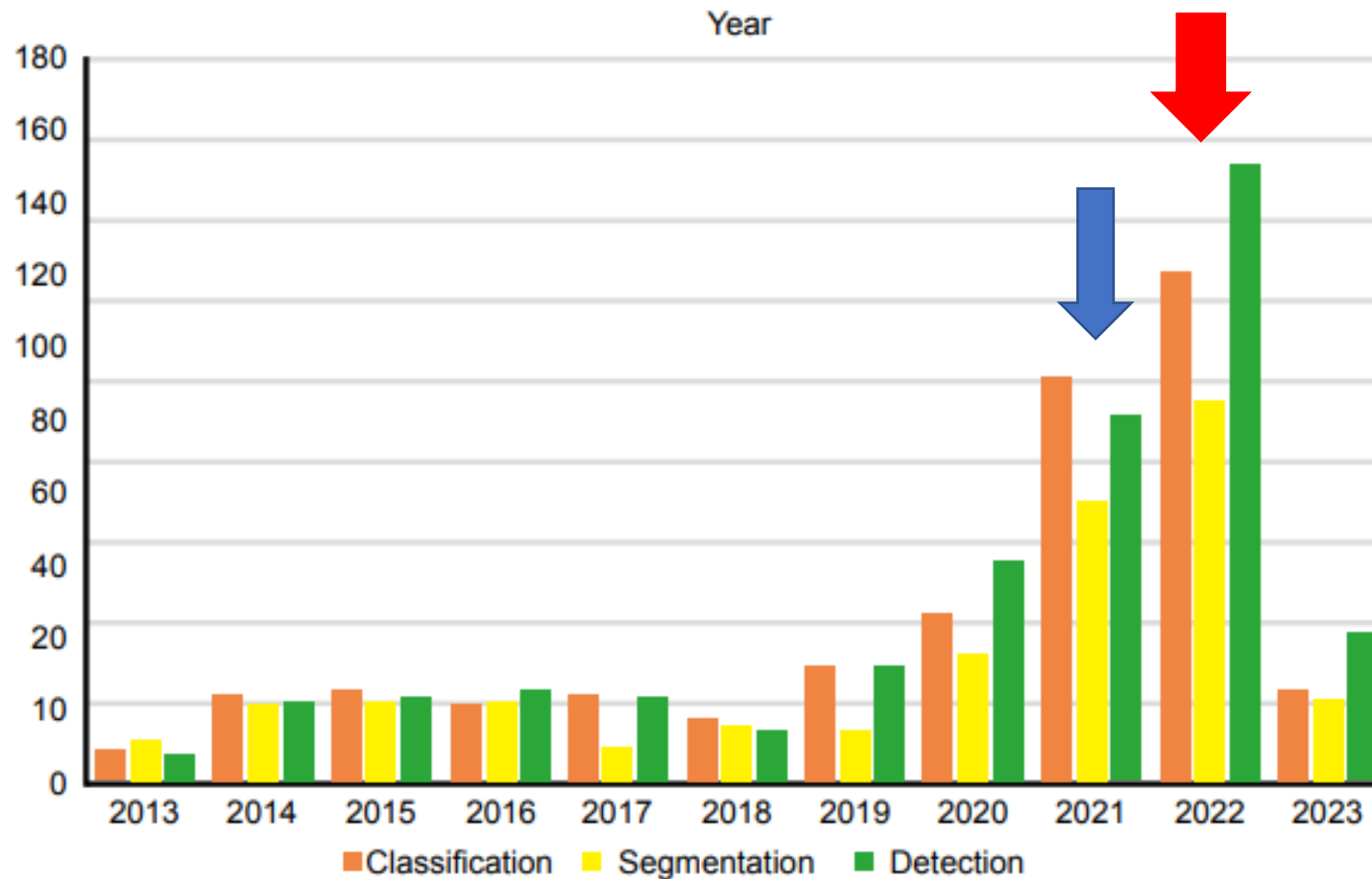
Multiparametric Ultrasound Approach Using a Tree-Based Decision Classifier for Inconclusive Focal Liver Lesions Evaluated by Contrast Enhanced Ultrasound

Tudor Voicu Moga ¹ , Ciprian David ², Alina Popescu ¹, Raluca Lupusoru ^{1,3,*} , Darius Heredea ¹, Ana M. Ghiuchici ¹, Camelia Foncea ¹, Adrian Burdan ¹, Roxana Sirli ¹ , Mirela Danilă ¹, Iulia Ratiu ¹ , Teofana Bizerea-Moga ⁴ and Ioan Sporea ¹

Situația actuală

- Această terminologie de “Artificial Intelligence” am auzit-o pentru prima dată acum aproximativ 6-7 ani, la Congresul European de Radiologie de la Viena.
- De atunci și mai ales în ultimii 3-4 ani, nu mai putem “scăpa” de acest termen!
- Dar tot ce auzim este fascinant și evolutiv.

Dezvoltarea cercetării în IA in ultrasonografie



1 The results of AI-based ultrasound image processing research in classification, segmentation and detection in the past ten years.

Data Centre de IA în lume

1. USA

2. China

3. Germany

AI datacenters are not evenly distributed

Countries with public cloud AI compute on their territories.

Page 1 of 2 >

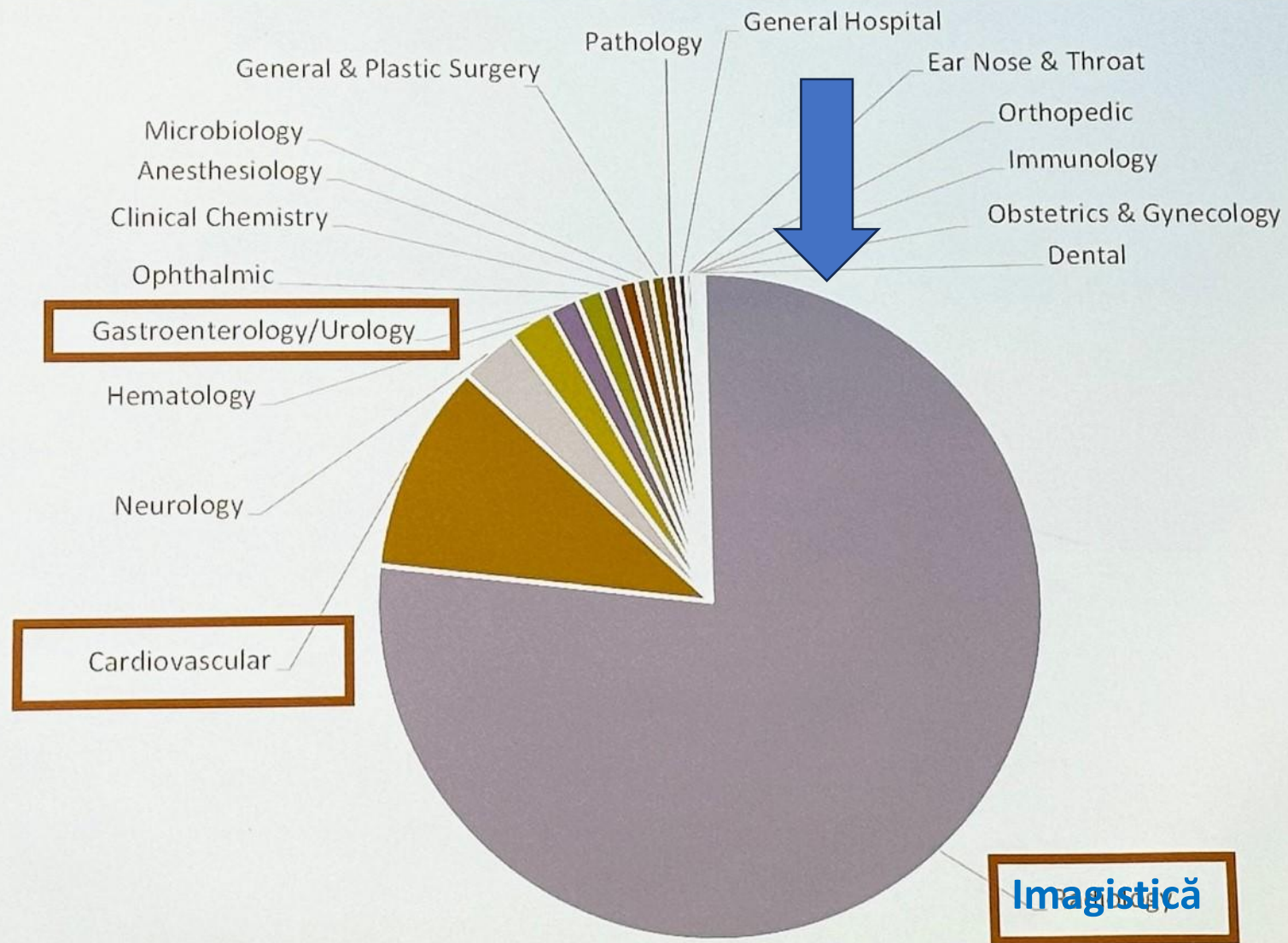
Country	Number of compute regions ▾
 United States	26
 China + Hong Kong	24
 Germany	7
 Singapore	6
 India	5
 United Kingdom	5
 France	5
 Canada	5
 South Africa	4
 South Korea	4
 Japan	4
 Italy	4
 Australia	4
 Ireland	3
 United Arab Emirates	3
 Sweden	2
 Poland	2
 Netherlands	2
 Israel	2
 Switzerland	2

Based on a census of 225 cloud regions situated on the territories of 43 different countries.

Source: Oxford University

Sherwood

AI in the medical field



IA: de ce, când și cum în medicină?

Editorial

eISSN 2005-8330

<https://doi.org/10.3348/kjr.2022.0834>

Korean J Radiol 2022;23(12):1119-1125

Korean Journal of Radiology

KJR



Randomized Clinical Trials of Artificial Intelligence in Medicine: Why, When, and How?

2022

Seong Ho Park¹, Joon-Il Choi², Laure Fournier³, Baptiste Vasey⁴

¹Department of Radiology and Research Institute of Radiology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea;

IA în Endoscopia digestivă

IA pentru detecția de polipi la colonoscopie

“Artificial intelligence-aided colonoscopy significantly reduces adenoma miss rate”

- Wallace MB & al. Gastroenterology, 15 March 2022
- **Takeaway:**
 - . *Colonoscopic screening with the aid of artificial intelligence (AI) reduces the adenoma miss rate (AMR) by nearly half, compared with standard colonoscopy without AI assistance.*

Ghid practic AGA despre IA în diagnosticul polipilor colonici

Gastroenterology 2023;165:1568–1573

CLINICAL PRACTICE UPDATE

AGA Clinical Practice Update on the Role of Artificial Intelligence in Colon Polyp Diagnosis and Management: Commentary



Jason Samarasena,¹ Dennis Yang,² and Tyler M. Berzin³

¹Division of Gastroenterology, University of California Irvine, Orange, California; ²Center for Interventional Endoscopy, AdventHealth, Orlando, Florida; and ³Center for Advanced Endoscopy, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts

IA și scăparea de polipi la colonoscopie

Gastroenterology 2022;163:295–304

ARTIFICIAL INTELLIGENCE

Impact of Artificial Intelligence on Miss Rate of Colorectal Neoplasia



Michael B. Wallace,^{1,2} Prateek Sharma,³ Pradeep Bhandari,⁴ James East,⁵ Giulio Antonelli,^{6,7,8}

IA pentru Screeningul Cancerului de colon

Clinical Gastroenterology and Hepatology 2023;21:337–346

Artificial Intelligence–Assisted Colonoscopy for Colorectal Cancer Screening: A Multicenter Randomized Controlled Trial



Hong Xu,^{1,a,b} Raymond S. Y. Tang,^{2,3,a,b} Thomas Y. T. Lam,^{3,4,5,a,b} Guijun Zhao,⁶ James Y. W. Lau,^{3,7} Yunpeng Liu,⁸ Qi Wu,⁹ Long Rong,¹⁰ Weiran Xu,¹ Xue Li,⁶ Sunny H. Wong,^{2,3,12} Shuntian Cai,⁸ Jing Wang,⁹ Guanyi Liu,¹⁰ Tantan Ma,¹ Xiong Liang,⁶ Joyce W. Y. Mak,^{2,3} Hongzhi Xu,⁸ Peng Yuan,⁹ Tingting Cao,¹ Fudong Li,¹ Zhenshi Ye,⁸ Zhang Shutian,¹¹ and Joseph J. Y. Sung^{2,3,5,12}

¹Department of Gastroenterology and Endoscopy Center, First Hospital of Jilin University, Jilin, China; ²Department of

ENDOSCOPY

Impact of Artificial Intelligence on Colonoscopy Surveillance After Polyp Removal: A Pooled Analysis of Randomized Trials







Yuichi Mori,^{1,2,3,*} Pu Wang,^{4,*} Magnus Løberg,^{1,2} Masashi Misawa,³
Alessandro Repici,^{5,6} Marco Spadaccini,⁵ Loredana Correale,⁵ Giulio Antonelli,^{7,8}
Honggang Yu,^{9,10,11} Dexin Gong,^{9,10,11} Misaki Ishiyama,³ Shin-ei Kudo,³
Shunsuke Kamba,¹² Kazuki Sumiyama,¹² Yutaka Saito,¹³ Haruo Nishino,¹⁴
Peixi Liu,⁴ Jeremy R. Glissen Brown,¹⁵ Nabil M. Mansour,¹⁶ Seth A. Gross,¹⁷
Mette Kalager,^{1,2} Michael Bretthauer,^{1,2} Douglas K. Rex,¹⁸ Prateek Sharma,¹⁹
Tyler M. Berzin,²⁰ and Cesare Hassan^{5,6}

IA în oncologia colonului

Review

Applications of Artificial Intelligence in Screening, Diagnosis, Treatment, and Prognosis of Colorectal Cancer

Hang Qiu ^{1,2,*}, Shuhan Ding ³, Jianbo Liu ^{4,5}, Liya Wang ¹ and Xiaodong Wang ^{4,5,*}

¹ Big Data Research Center, University of Electronic Science and Technology of China, Chengdu 611731, China; hbigdata@uestc.edu.cn

IA în detecția leziunilor endoscopice

ne

TYPE Systematic Review

PUBLISHED 04 November 2022

DOI 10.3389/fmed.2022.1018937

Diagnostic accuracy of artificial intelligence for detecting gastrointestinal luminal pathologies: A systematic review and meta-analysis

Om Parkash¹, Asra Tus Saleha Siddiqui¹, Uswa Jiwani²,
Fahad Rind³, Zahra Ali Padhani⁴, Arjumand Rizvi²,
Zahra Hoodbhoy⁵ and Jai K. Das^{4,5*}

IA în diferențierea endoscopică a ulcerelor benigne de maligne

Clinical and Experimental Gastroenterology

Dovepress

open access to scientific and medical research

 Open Access Full Text Article

ORIGINAL RESEARCH

Differentiation Between Malignant and Benign Endoscopic Images of Gastric Ulcers Using Deep Learning

Eyal Klang¹⁻³

Yiftach Barash^{1,3}

Asaf Levartovsky^{2,4}

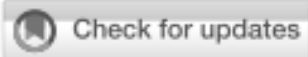
Noam Barkin Lederer^{2,4}

Background and Aim: Endoscopic differentiation between malignant and benign gastric ulcers (GU) affects further evaluation and prognosis. The aim of our study was to evaluate a deep learning algorithm for discrimination between benign and malignant GU in a database of endoscopic ulcer images.

IA pentru diagnosticul endoscopic al gastritei atrofile

 **frontiers** | Frontiers in **Medicine**

TYPE Systematic Review
PUBLISHED 02 May 2023
DOI 10.3389/fmed.2023.1134980



OPEN ACCESS

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Diagnostic value of artificial intelligence-assisted endoscopy for chronic atrophic gastritis: a systematic review and meta-analysis

Yanting Shi¹, Ning Wei¹, Kunhong Wang¹, Tao Tao¹, Feng Yu^{1*} and Bing Lv^{2*}

IA în predicția remisiei Rectocolitei ulcero-hemoragice

Gastroenterology 2023;164:1180–1188

INFLAMMATORY BOWEL DISEASE

Artificial Intelligence Enabled Histological Prediction of Remission or Activity and Clinical Outcomes in Ulcerative Colitis



Marietta Iacucci,^{1,2,3,4,*} Tommaso Lorenzo Parigi,^{1,*} Rocio Del Amor,^{5,*}
Pablo Mesequer,^{5,*} Giulio Mandelli,⁶ Anna Bozzola,⁶ Alina Bazarova,⁷ Pradeep Bhandari,⁸

Poziție oficială a ESGE legat de IA în endoscopie

Article published online: 2022-10-21

Position Statement

Thieme

Expected value of artificial intelligence in gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement



2022

Authors

Helmut Messmann¹, Raf Bisschops² , Giulio Antonelli^{3,4}, Diogo Libânio^{5,6} , Pieter Sinonquel², Mohamed Abdelrahim⁷, Omer F. Ahmad^{8,9,10} , Miguel Areia¹¹ , Jacques J. G. H. M. Bergman¹², Pradeep Bhandari⁷, Ivo Boskoski¹³ , Evelien Dekker¹² , Dirk Domagk¹⁴, Alanna Ebigbo¹, Tom Eelbode¹⁵, Rami Eliakim¹⁶, Michael Häfner¹⁷, Rehan J. Haidry^{8,9}, Rodrigo Jover¹⁸, Michal F. Kaminski^{19,20,21}, Roman Kuvaev^{*,22,23}, Yuichi Mori^{19,24} , Maxime Palazzo²⁵, Alessandro Repici^{26,27}, Emanuele Rondonotti²⁸ , Matthew D. Rutter^{29,30} , Yutaka Saito³¹, Prateek Sharma^{32,33}, Cristiano Spada^{13,34}, Marco Spadaccini^{26,27}, Andrew Veitch³⁵, Ian M. Gralnek^{36,37}, Cesare Hassan^{***,26,27}, Mario Dinis-Ribeiro^{***,5}

IA pentru managementul apendicitei







diagnostics

2025



Review

A Systematic Integration of Artificial Intelligence Models in Appendicitis Management: A Comprehensive Review

Ivan Maleš ¹ , Marko Kumrić ^{2,3} , Andrea Huić Maleš ⁴, Ivan Cvitković ⁵, Roko Šantić ², Zenon Pogorelić ^{6,7,*} 
and Joško Božić ^{2,3} 

IA în genetica bolilor gastrointestinale




diagnostics

2025



Systematic Review

Genetic Artificial Intelligence in Gastrointestinal Disease: A Systematic Review

Kwang-Sig Lee ^{1,*}  and Eun Sun Kim ^{2,*} 

¹ Department of Internal Medicine, Seoul National University Hospital, Seoul, Korea

IA în diagnosticul *precoce* al bolilor gastrointestinale



diagnostics



Review

Explainable Artificial Intelligence in the Early Diagnosis of Gastrointestinal Disease

Kwang-Sig Lee ^{1,*}  and Eun Sun Kim ^{2,*} 

¹ AI Center, Korea University Anam Hospital, Seoul 02841, Korea

² Department of Gastroenterology, Korea University Anam Hospital, Seoul 02841, Korea

IA pentru microbiotă. “Multi-Omics”

Gastroenterology 2025;169:487–501

Machine Learning and Artificial Intelligence in the Multi-Omics Approach to Gut Microbiota



Tommaso Rozera^{1,2,3,*}



Edoardo Pasolli^{4,*}



Nicola Segata^{5,6}



Gianluca Ianiro^{1,2,3}

2025

IA în Hepatologie

Artificial intelligence models for the
diagnosis and management of liver
diseases

Naoshi Nishida, Masatoshi Kudo

Department of Gastroenterology and Hepatology, Kindai University Faculty of Medicine,
Osaka, Japan

ULTRA
SONO
GRAPHY

REVIEW ARTICLE

<https://doi.org/10.14366/usg.22110>
pISSN: 2288-5919 • eISSN: 2288-5943
Ultrasonography. 2022 Sep 6.
Epub ahead of print

IA in diagnosticul morfopatologic al NASH

Development of diagnostic support system for fibrosis of nonalcoholic fatty liver disease using artificial intelligence and deep learning

Journal:	<i>Journal of Gastroenterology and Hepatology</i>
Manuscript ID	JGH-00912-2023
Manuscript Type:	Original Article - Hepatology (Experimental)
Date Submitted by the Author:	30-May-2023
Complete List of Authors:	Preechathamwong, Noppamate ; Phramongkutklao College of Medicine, Gastroenterology and Hepatology Charoenpitakchai, Mongkon ; Phramongkutklao College of Medicine, Pathology Wongsason, Nutthawat ; Phramongkutklao College of Medicine, Pathology

IA în diagnosticul morfopatologic hepatic Meta-analiză





diagnostics

Diagnostic 2023



Systematic Review

Artificial Intelligence-Based Opportunities in Liver Pathology—A Systematic Review

Pierre Allaupe ^{1,*}, Noémie Rabilloud ², Bruno Turlin ^{1,3} , Edouard Bardou-Jacquet ^{3,4}, Olivier Loréal ³, Julien Calderaro ^{5,6}, Zine-Eddine Khene ^{2,7}, Oscar Acosta ², Renaud De Crevoisier ^{2,8}, Nathalie Rioux-Leclercq ¹, Thierry Pecot ⁹  and Solène-Florence Kammerer-Jacquet ^{1,2}

IA pentru *prognostic* în hepatopatii cronice avansate

Original Article | Gastrointestinal Imaging

eISSN 2005-8330

<https://doi.org/10.3348/kjr.2022.0494>

Korean J Radiol 2022

Korean Journal of Radiology

KJR



Prediction of Decompensation and Death in Advanced Chronic Liver Disease Using Deep Learning Analysis of Gadoxetic Acid-Enhanced MRI

Subin Heo^{1, 2}, Seung Soo Lee¹, So Yeon Kim¹, Young-Suk Lim³, Hyo Jung Park¹, Jee Seok Yoon⁴, Heung-Il Suk^{4, 5}, Yu Sub Sung⁶, Bumwoo Park⁷, Ji Sung Lee⁸

IA pentru diagnosticul NAFLD/NASH (MASLD/MASH)

Received: 23 November 2022 | Accepted: 23 November 2022

DOI: 10.1097/HEP.0000000000000211

CORRESPONDENCE



Reply: Machine learning models for NAFLD/NASH and cirrhosis diagnosis and staging: accuracy and routine variables are the success keys

Inteligența artificială pentru evaluarea Hipertensiunii portale din ciroză

Research Article

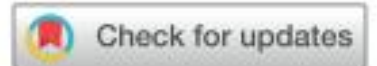
Innovative Diagnostics, Modelling and Digital Hepatology

JOURNAL
OF HEPATOLOGY

Assessment of portal hypertension severity using machine learning models in patients with compensated cirrhosis

Jiří Reiniš^{1,†}, Oleksandr Petrenko^{1,2,3,4,†}, Benedikt Simbrunner^{1,2,3,4}, Benedikt S. Hofer^{1,2,3,4}, Filippo Schepis⁵, Marco Scoppettuolo⁵, Dario Saltini⁵, Federica Indulti⁵, Tomas Guasconi⁵, Agustin Albillos⁶, Luis Téllez⁶, Cándid Villanueva⁷, Anna Brujats⁷, Juan Carlos Garcia-Pagan⁸, Valeria Perez-Campuzano⁸, Virginia Hernández-Gea⁸, Pierre-Emmanuel Rautou⁹, Lucile Moga⁹, Thomas Vanwolleghem^{10,11}, Wilhelmus J. Kwanten^{10,11}, Sven Francque^{10,11}, Jonel Trebicka^{12,13,14}, Wenyi Gu^{12,13}, Philip G. Ferstl^{12,13}, Lise Lotte Gluud¹⁵, Flemming Bendtsen¹⁵, Søren Møller¹⁶, Stefan Kubicek¹, Mattias Mandorfer^{3,4}, Thomas Reiberger^{1,2,3,4,*}

Journal of Hepatology **2023**. vol. 78 | 390–400



IA pentru predicția evenimentelor hepatice la pacienții HCV după terapia antivirală

Letter to the Editor

JOURNAL
OF HEPATOLOGY

Unlock AI-Safe-C score's potential at all levels: Improve methods and overcome barriers

To the Editor:

We were intrigued by the recent study by Lin *et al.*, which introduced a novel artificial intelligence (AI)-driven model that predicts liver-related events in non-cirrhotic patients after antiviral treatment, providing a potential tool for personalized risk assessment.¹ However, clearer explanations of the meth-

crucial when applying the model, as high-risk assessments may lead to anxiety, reducing adherence and quality of life. Providing support during result communication helps patients understand their health risks and mitigate negative effects.

Despite these challenges, the AI-Safe-C score holds significant promise. At the individual level, the model supports

IA pentru diagnosticul hepatocarcinomului



Submit a Manuscript: <https://www.f6publishing.com>

World J Hepatol 2021 December 27; 13(12): 2039-2051

DOI: [10.4254/wjh.v13.i12.2039](https://doi.org/10.4254/wjh.v13.i12.2039)

ISSN 1948-5182 (online)

MINIREVIEWS

Deep learning in hepatocellular carcinoma: Current status and future perspectives

Joseph C Ahn, Touseef Ahmad Qureshi, Amit G Singal, Debiao Li, Ju-Dong Yang

ORCID number: Joseph C Ahn [0000-0001-6994-2870](https://orcid.org/0000-0001-6994-2870); Touseef Ahmad

Joseph C Ahn, Gastroenterology and Hepatology, Mayo Clinic, Rochester, MN 55904, United States

IA pentru *decizii clinice de dg, tratament și prognostic* în gastroenterologie și hepatologie



Submit a Manuscript: <https://www.f6publishing.com>

World J Gastroenterol 2025 September 28; 31(36): 110742

DOI: [10.3748/wjg.v31.i36.110742](https://doi.org/10.3748/wjg.v31.i36.110742)

ISSN 1007-9327 (print) ISSN 2219-2840 (online)

REVIEW

Translational artificial intelligence in gastrointestinal and hepatic disorders: Advancing intelligent clinical decision-making for diagnosis, treatment, and prognosis

Shu-Qi Ren, Jin-Man Chen, Chuang Cai

IA și perspectiva medicului și a pacientului

scientific reports

Scientific Reports | (2022) 12:16779



OPEN

Artificial intelligence in (gastrointestinal) healthcare: patients' and physicians' perspectives

Quirine E. W. van der Zander^{1,2✉}, Mirjam C. M. van der Ende - van Loon³,

IA și perspectiva medicului și a pacientului

- Prospective questionnaire: 377 GI-patients, 35 gastroenterologists, and 45 GI-fellows.
- Of GI-patients, 62.5% reported to be familiar with AI.
- GI-patients preferred their physicians to use AI and GI-physicians were willing to use AI.
- More GI-physicians believed in an increase in quality of care (81.3%) than GI-patients.
- GI-fellows expected AI implementation within 6.0 years, gastroenterologists within 4.2 years and GI-patients within 6.1 years.
- GI-patients and GI-physicians agreed on the most important advantages of AI in healthcare: improving quality of care, time saving, and faster diagnostics and shorter waiting times.
- *The most important disadvantage for GI-patients was the potential loss of personal contact.*
- Finally: GI-patients and GI-physicians hold positive perspectives towards AI in healthcare.

Poate un nou câmp de dezvoltare: Chat GPT?

ChatGPT Related Technology and Its Applications in the Medical Field

Tairui Zhang, BS^{a,}, Linxue Qian, MD^b*

^a School of Computer Science, College of Engineering and Physical Sciences, University of Birmingham, Birmingham, UK; ^b Department of Ultrasound, Beijing Friendship Hospital, Capital Medical University, Beijing, China

Și în final, poate o nouă modalitate de a
scrie articole medicale?

AI-based ChatGPT Impact on Medical Writing and Publication

Mofan Li ^a, Yongyue Zhang, MM ^a, Yang Sun, MM ^a, Ligang Cui, PhD ^a, Shumin Wang, PhD ^{a,}*

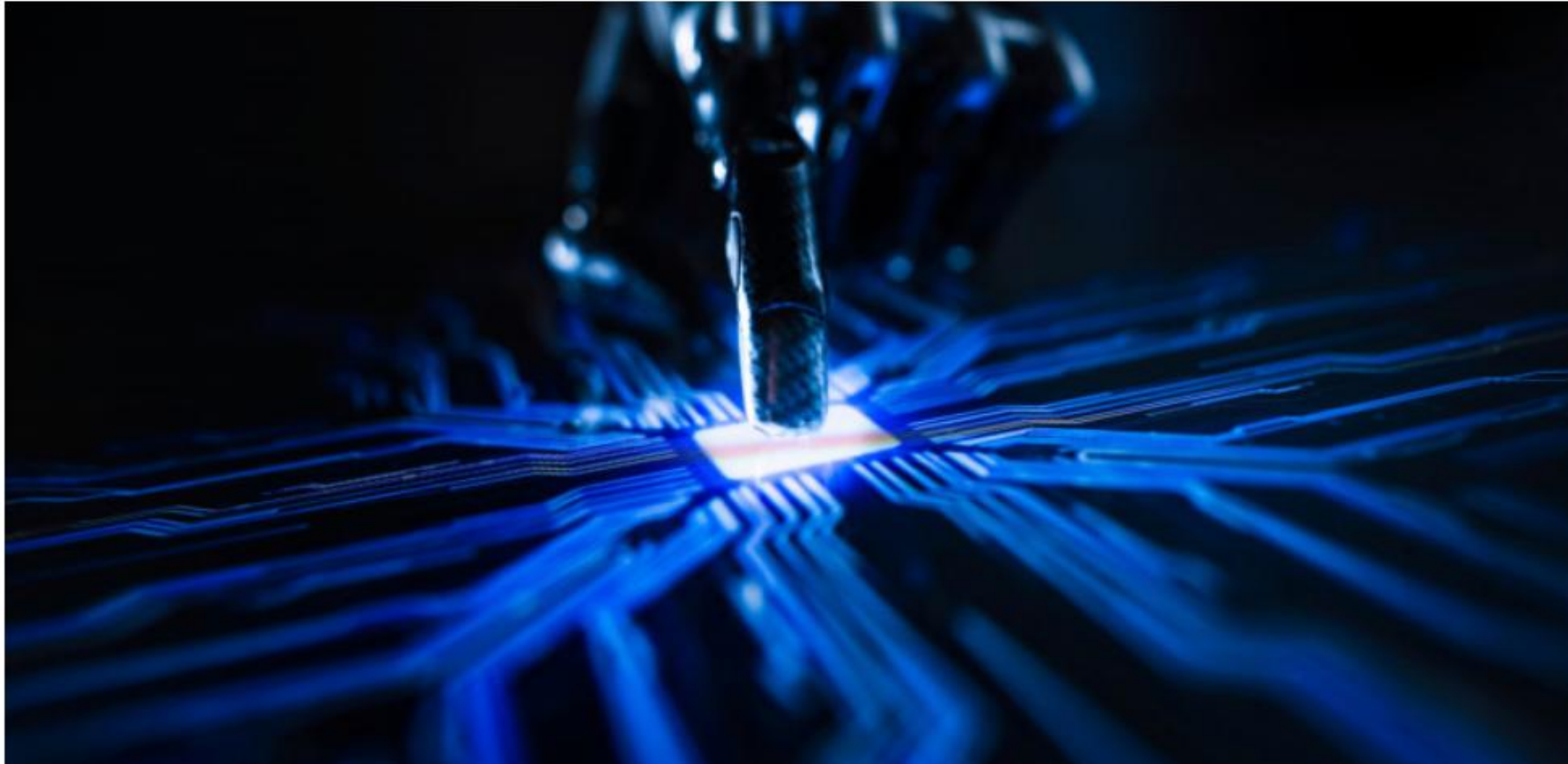
^a Department of Ultrasound, Peking University Third Hospital, Beijing, China

Dar

**Peste 60% dintre americani se tem că
inteligența artificială pune în pericol
viitorul umanității**



Data publicării: 18.05.2023 09:22



Pericolul inteligenței artificiale

- *Inteligența artificială încearcă să îi șantajeze pe oameni dacă se simte amenințată.* Singurul mod în care vom putea supraviețui superinteligenței artificiale este *dacă sistemele AI tot mai performante vor fi programate să dezvolte „instincte materne”, așa încât să ne protejeze chiar și atunci când vor deveni mult mai inteligente decât omul*, potrivit lui Geoffrey Hinton, poreclit „nașul inteligenței artificiale”.

Geoffrey Hinton:

- Dezvoltarea AI-ului este ca creșterea unui pui de tigru care într-o zi va putea să te omoare, a spus Hinton. „Este un pui de tigru atât de drăguț. Acum, dacă nu te poți asigura că nu va dori să te omoare când va crește mare, ar trebui să îți faci griji.”
- **Geoffrey Hinton a avertizat de mult timp că *inteligenta artificială avansează atât de rapid încât oamenii s-ar putea să nu aibă nicio cale de a opri sistemele AI înainte să pună stăpânire pe civilizația umană.***

Și în loc de concluzie:

ÉDITO

L'intelligence artificielle, ce n'est pas pour demain

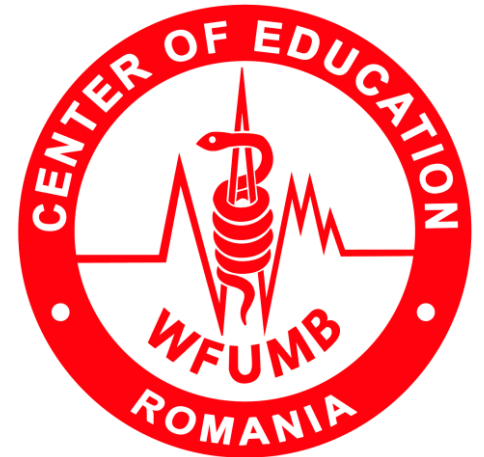
Pr Lucine VUITTON (Besançon)



Artificial Intelligence in Ultrasound

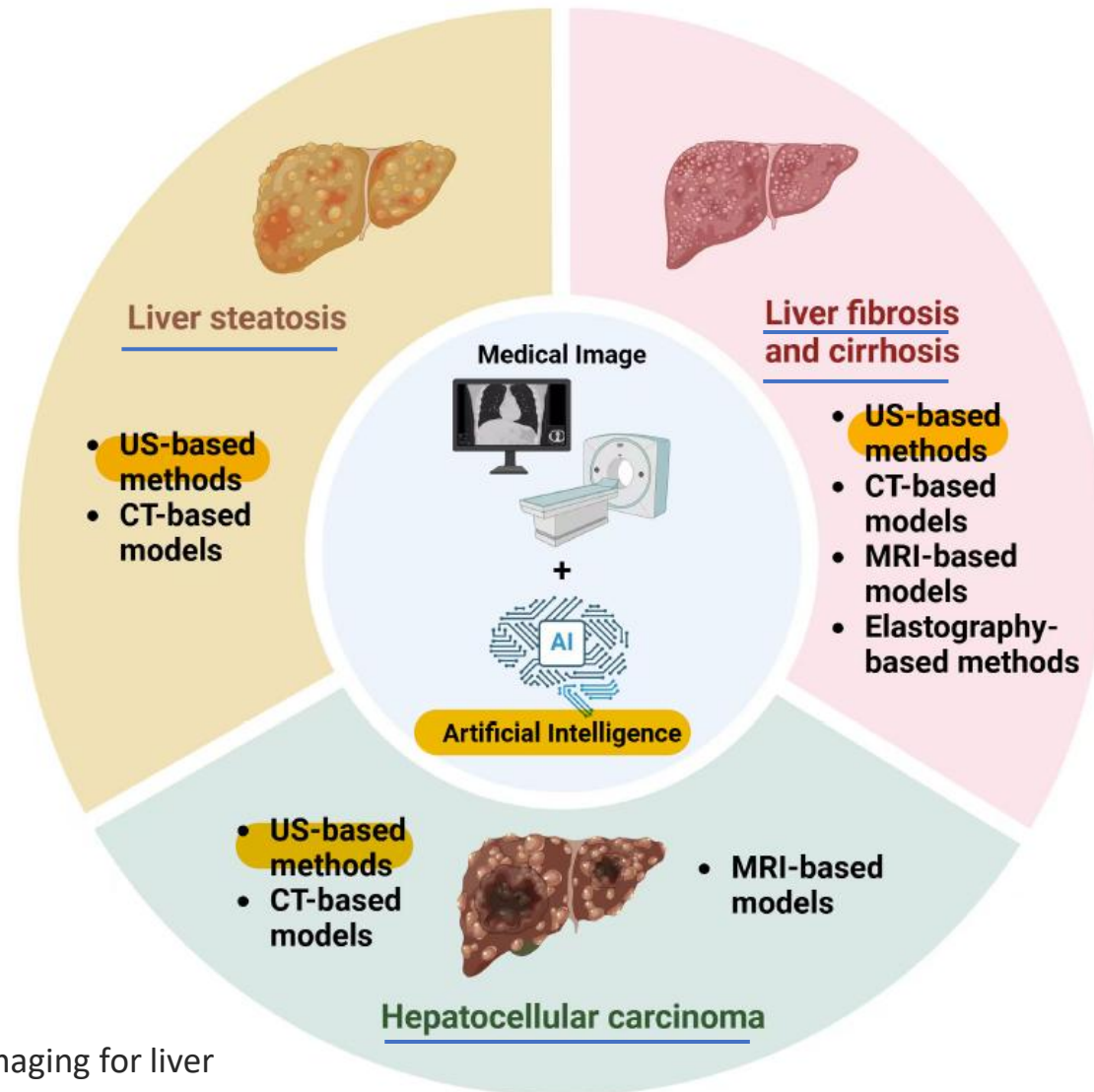


Prof. Ioan Sporea, MD, PhD, FEBGH
WFUMB Past-President
Director, WFUMB COE Timișoara



University of Medicine and Pharmacy Timișoara,
Romania

AI in Liver Imaging – place in ultrasound



Ultrasonomics

- **Ultrasonomics** = *Ultrasound + Omics*
- It is a **new research field** where advanced computational methods are applied to **ultrasound images** to extract large numbers of **quantitative imaging features** (often invisible to the human eye). These features are then analyzed using **machine learning and AI** to build predictive or diagnostic models.

Ultrasonomics

- **Process:**

- *Acquire ultrasound images (B-mode, Doppler, CEUS, elastography).*
- *Segment the region of interest* (tumor, organ, lesion).
- *Extract hundreds–thousands of features* (texture, shape, echogenicity, perfusion, stiffness).
- *Analyze with AI/ML models, combined with clinical and molecular data.*

- **Applications:**

- Distinguishing **benign vs. malignant tumors** (liver, thyroid, breast).
- Assessing **liver fibrosis and steatosis**.
- Predicting **response to chemotherapy or immunotherapy**.
- Supporting **precision medicine** through personalized risk stratification.

AI for detection and quantification of fatty liver in ultrasound



Bioengineering 2022, 9, 748.



Systematic Review

Artificial Intelligence for Detecting and Quantifying Fatty Liver in Ultrasound Images: A Systematic Review

Fahad Muflih Alshagathrh  and Mowafa Said Househ *

Division of Information and Computing Technology, College of Science and Engineering,
Hamad Bin Khalifa University, Qatar Foundation, Education City, Doha P.O. Box 34110, Qatar

AI for detection of gallbladder diseases






diagnostics

Diagnostic 2023



Article

Detection of Gallbladder Disease Types Using Deep Learning: An Informative Medical Method

Ahmed Mahdi Obaid ^{1,*}, Amina Turki ², Hatem Bellaaj ³, Mohamed Ksantini ², Abdulla AlTae ⁴
and Alaa Alaerjan ⁵

AI for the improvement of *standard US* for the diagnosis of FLL

EBioMedicine 56 (2020) 102777



ELSEVIER

Contents lists available at ScienceDirect

EBioMedicine

journal homepage: www.elsevier.com/locate/ebiom



Research paper

Improving B-mode ultrasound diagnostic performance for focal liver lesions using deep learning: A multicentre study



Qi Yang^{a,1}, Jingwei Wei^{b,c,1}, Xiaohan Hao^{b,c,d,1}, Dexing Kong^{e,1}, Xiaoling Yu^a, Tianan Jiang^f,

AI for FLL classification *with CEUS*

Vetter M et al. Artificial intelligence for... Ultraschall in Med **2023**; 44: 395–407

Accepted Manuscript online: 2023-03-31 Article published online: 2023-05-12

Review

 Thieme

Artificial intelligence for the classification of focal liver lesions in ultrasound – a systematic review

Künstliche Intelligenz zur Klassifikation fokaler Leberläsionen im Ultraschall – eine systematische Übersichtsarbeit

Authors

Marcel Vetter¹ , Maximilian J Waldner¹, Sebastian Zundler¹, Daniel Klett¹, Thomas Bocklitz^{2, 3}, Markus F Neurath¹, Werner Adler⁴, Daniel Jesper¹

AI for CEUS diagnosis of FLL



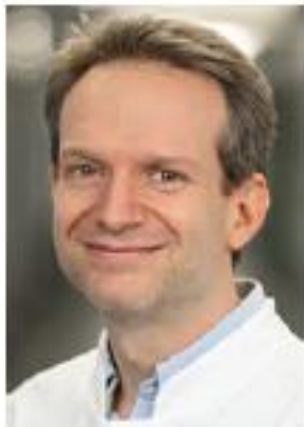
Author	Cases	Diagnoses	Feature ex- traction	AI	Accuracy in %	Sensitivity in %	Specificity in %	AUC
Guo et al. 2017	93	BEN, MAL	yes	Other	90.4	93.6	89.3	0.95
Guo et al. 2018	83	CCC, FNH, HCC, HEM, MET,	yes	Other	90.4	93.6	86.9	0.97
Hu et al. 2021	363	BEN, MAL	no	ANN	91.0	92.7	85.1	0.93
Kondo et al. 2017	94	FNH, HCC, HEM, MET	Yes (TIC)	SVM	91.6	94.0	90.3	N/A
Qian et al. 2017	93	BEN, MAL	yes	SVM	89.4	89.7	89.8	0.96
Ta et al. 2018	105	BEN, MAL	Yes (+TIC)	ANN&SVM	81.1 (73.3) ¹	90.0 (83.3) ¹	71.1 (62.7) ¹	0.88
Wu et al. 2014	26	ABS, FFS, HCC, HEM, MET	Yes (TIC)	ANN	86.4	83.3	87.5	N/A
Zhang et al. 2021	153	BEN, MAL	yes	SVM	88.2	86.9	89.4	0.9

HCC Diagnosis with AI

Waldner MJ, Strobel D. Ultraschall in Medicine **2024**; 45: 8–12

Ultrasound Diagnosis of Hepatocellular Carcinoma: Is the Future Defined by Artificial Intelligence?

Ultraschalldiagnostik des hepatozellulären Karzinoms: In Zukunft nur mit künstlicher Intelligenz?



Prof. Maximilian J. Waldner



Prof. Deike Strobel

Correspondence

Prof. M. Waldner

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Bibliography

Ultraschall in Med 2024; 45: 8–12

DOI 10.1055/a-2171-2674

AI for Liver Elastography using SWE

Hepatology



OPEN ACCESS

ORIGINAL ARTICLE

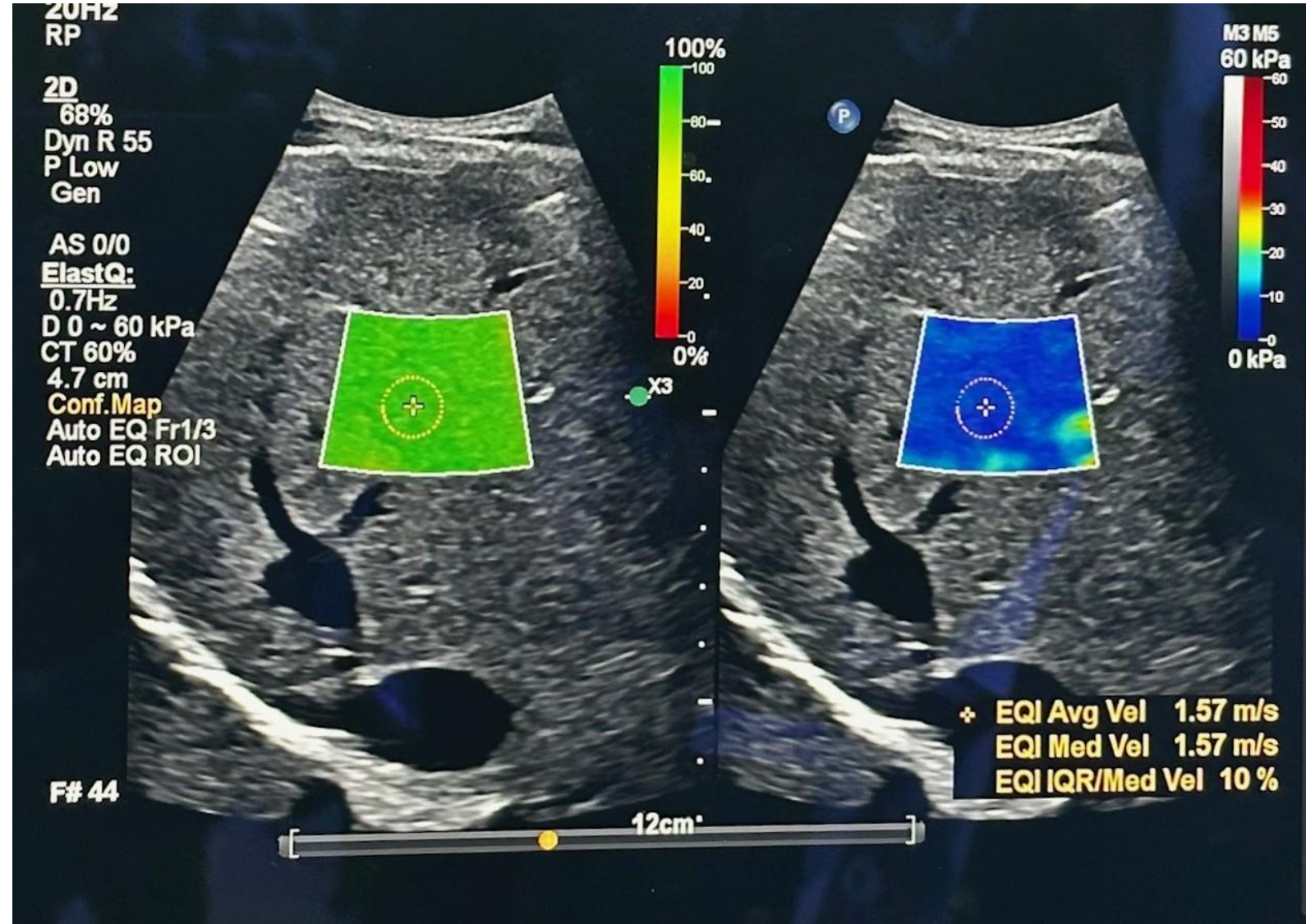
Deep learning Radiomics of shear wave elastography significantly improved diagnostic performance for assessing liver fibrosis in chronic hepatitis B: a prospective multicentre study

Kun Wang,^{1,2} Xue Lu,¹ Hui Zhou,^{2,3} Yongyan Gao,⁴ Jian Zheng,^{1,5} Minghui Tong,⁶

Wang K, et al. Gut 2019;68:729–741

New system using AI for liver Elastography

AI choose the best frames from the recorded image and choose the place for ROI



AI for Multiparametric Ultrasound (MPUS)

- **RESEARCH ARTICLE**
- “Quantitative ultrasound, elastography, and machine learning for assessment of steatosis, inflammation, and fibrosis in chronic liver disease.”

AI- others applications in Ultrasonography

Artificial Intelligence in Prenatal Ultrasound: Clinical Application and Prospect

Wenjia Guo, Shengli Li, Xing Yu, Huaxuan Wen, Ying Yuan, Xia Yang,

Deep Learning on Ultrasound Imaging for Breast Cancer Diagnosis and Treatment: Current Applications and Future Perspectives

Changyan Wang, Haobo Chen, Jieyi Liu, Changchun Li, Weiwei Jiao, Qihui Guo, Qi Zhang

Advanced Application of Artificial Intelligence for Pelvic Floor Ultrasound in Diagnosis and Treatment

Enze Qu, Xinling Zhang

Advances in the Research of Ultrasound and Artificial Intelligence in Neuromuscular Disease

Tianxiang Li, Fei Ji, Ruina Zhao, Huazhen Liu, Meng Yang

Application and Prospect of AI and ABVS-based in Breast Ultrasound Diagnosis




Rui Chen, Fangqi Guo, Jia Guo, Jiaqi Zhao

AI for SWE measurement in Prostate Cancer



Article

Artificial Intelligence System for Predicting Prostate Cancer Lesions from Shear Wave Elastography Measurements

Ciprian Cosmin Secasan ^{1,2,†}, Darian Onchis ^{3,†}, Razvan Bardan ^{1,2,*} , Alin Cumanas ^{1,2}, Dorin Novacescu ¹ , Corina Botoca ⁴, Alis Dema ⁵  and Ioan Sporea ⁶

Secasan CC, Onchis D, Bardan R, Cumanas A, Novacescu D, Botoca C, Dema A, Sporea I. Artificial Intelligence System for Predicting Prostate Cancer Lesions from Shear Wave Elastography Measurements. Curr Oncol. 2022 Jun 10;29(6):4212-4223

AI for ultrasound diagnosis of the thyroid gland pathology

Advanced Ultrasound in Diagnosis and Therapy **2023**;02:073–081

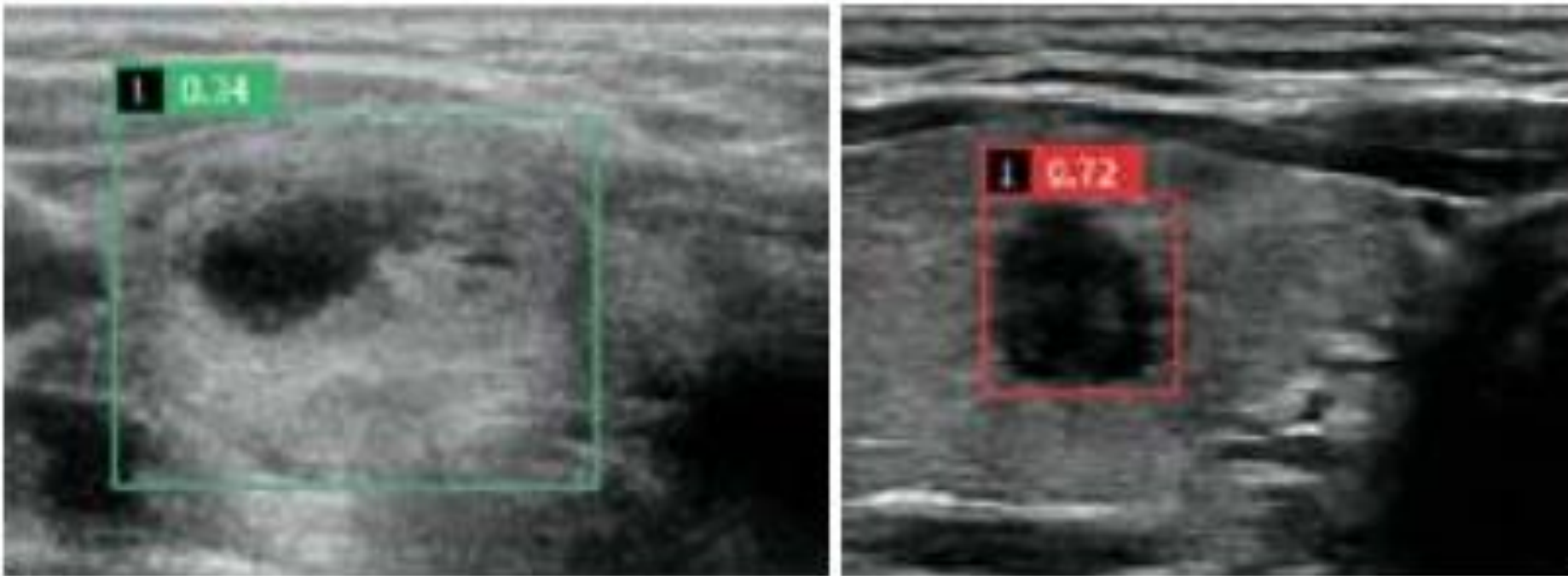
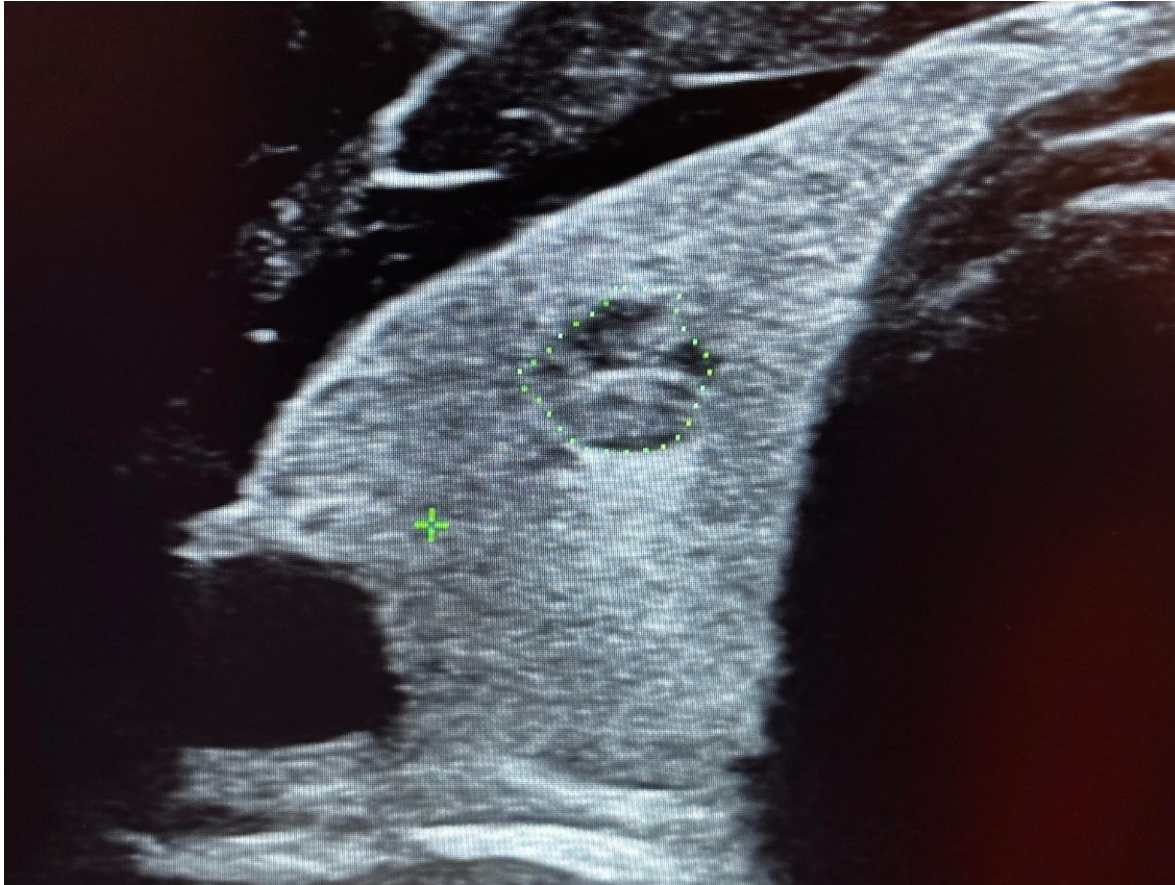


Figure 1 The AI-SONIC™ System can automatically recognizes and quantifies the risk levels of thyroid nodules.

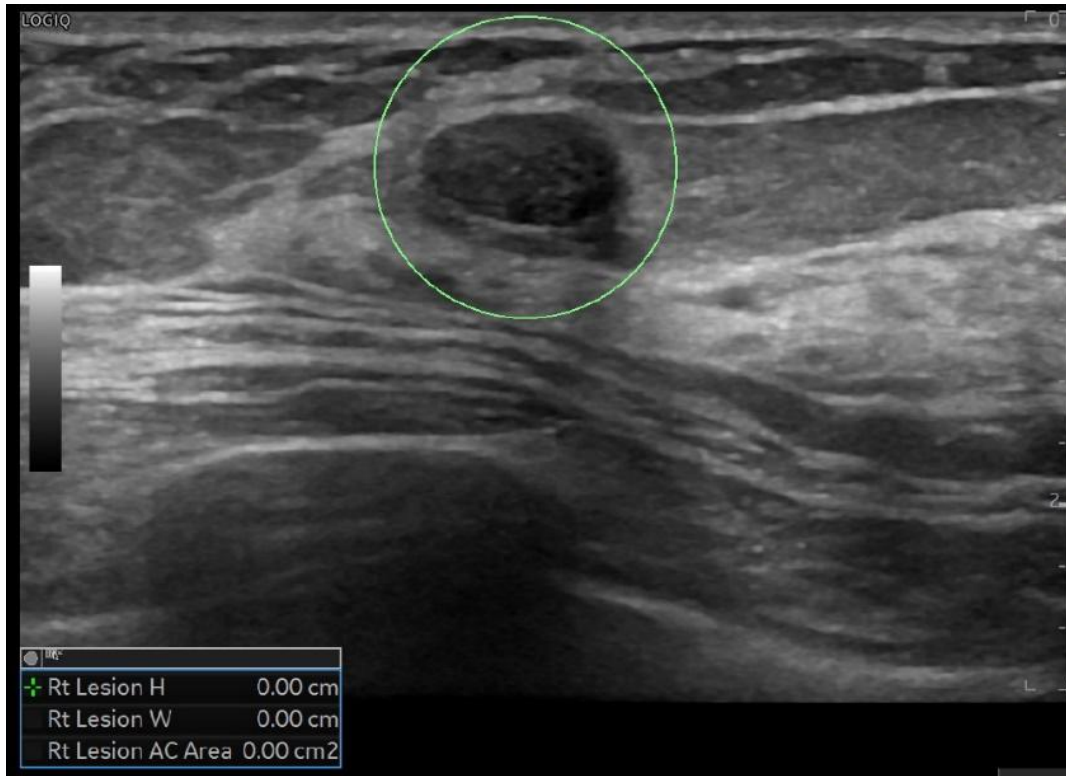
AI interpretation



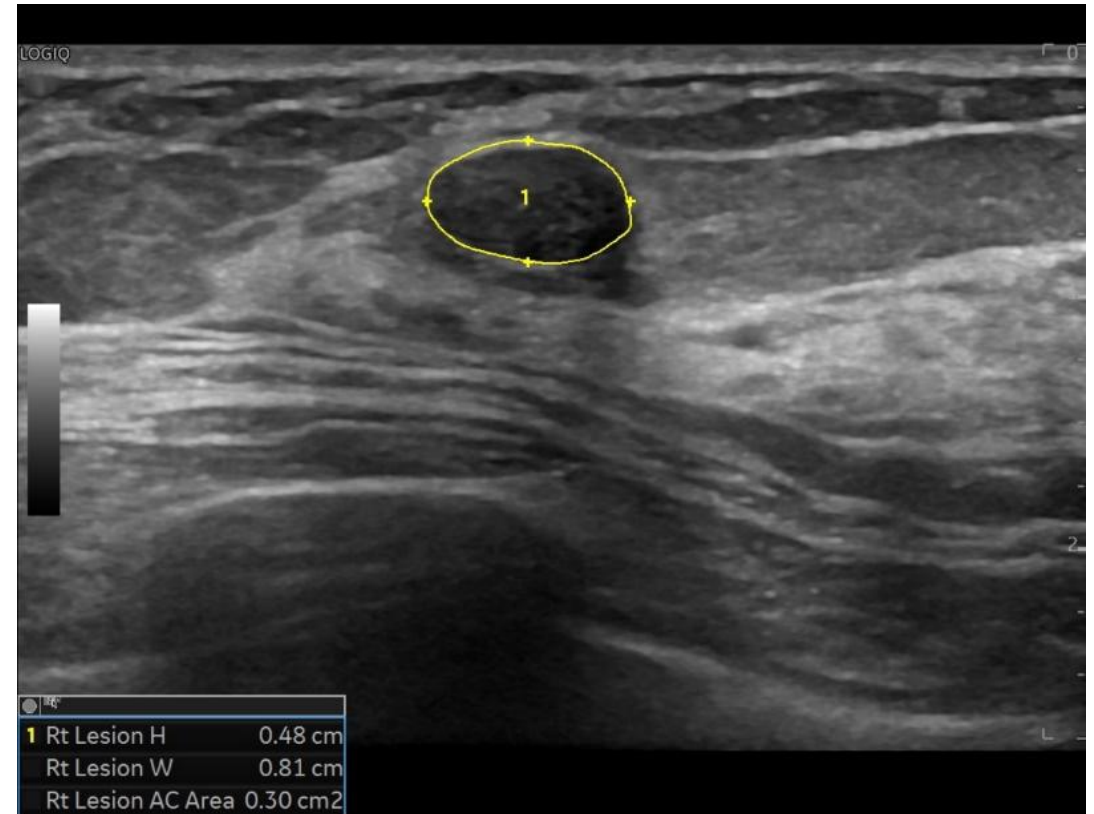
Points	3.0
Levels	TR3
Assessment	Mildly Suspicious
<hr/>	
Composition	▼
Solid or almost complet...	2
Echogenicity	▼
Hyperechoic or isoechoic	1
Echogenicity Foci	▼
None or large comet tail...	0
Margin	▼
Ill-defined	0
Shape	▼
Wider than tall	0

Identification and characterisation of the US lesions: Breast, Thyroid and Liver

SEMI-AUTOMATED STRUCTURE DETECTION



1. User clicks on the lesion and simply expands a graphical circle to encompass it.



2. The algorithm segments the lesion, providing a trace and extents of the lesion

Breast Assistant (propose BIRADS classification)

Decision support: Harnessing the power of Artificial Intelligence (AI)



- Based on machine learning
- Uses a proprietary AI algorithm that includes >400,000 clinical breast lesion images
- Select a **button to analyze the image**
- **Available in two seconds, or less**

DESIGNED TO INCREASE CLINICAL CONFIDENCE AND REDUCE PATIENT ANXIETY

Liver Assistant or in Obstetric

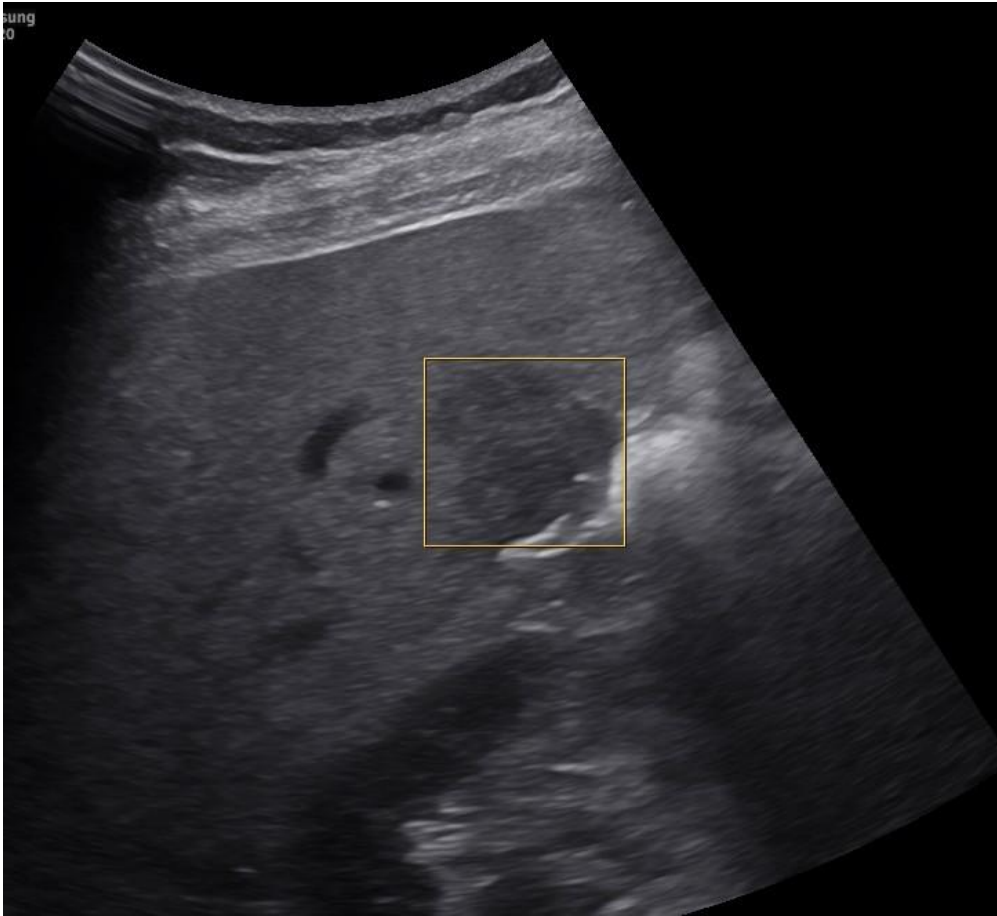


Automated Lesion Segmentation – The user identifies a breast, thyroid or liver lesion by clicking on the lesion and easily expanding or shrinking a graphical circle that appears centered about the clicked location to encompass the lesion. The algorithm then segments the lesion, providing a trace of the lesion boundary and the corresponding area. In addition, calipers are automatically placed that correspond to the height and width of the lesion.

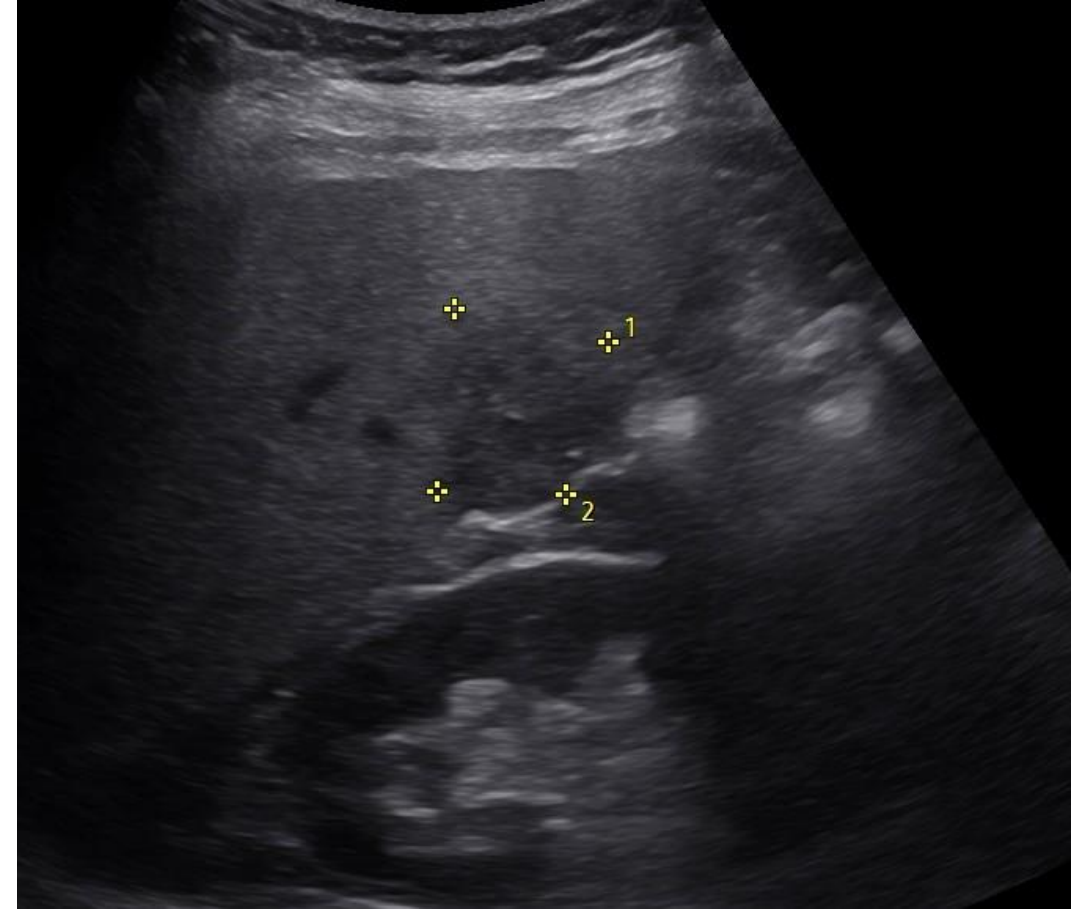


OB Measure Assistant – The user identifies an image as a view appropriate for measuring the head circumference (HC) and biparietal diameter (BPD), the abdominal circumference (AC) or the femur length (FL). The system then automatically segments out the appropriate structure from the image and annotates it with the associated measurement.

For the Liver: first step-AI lesion Detection

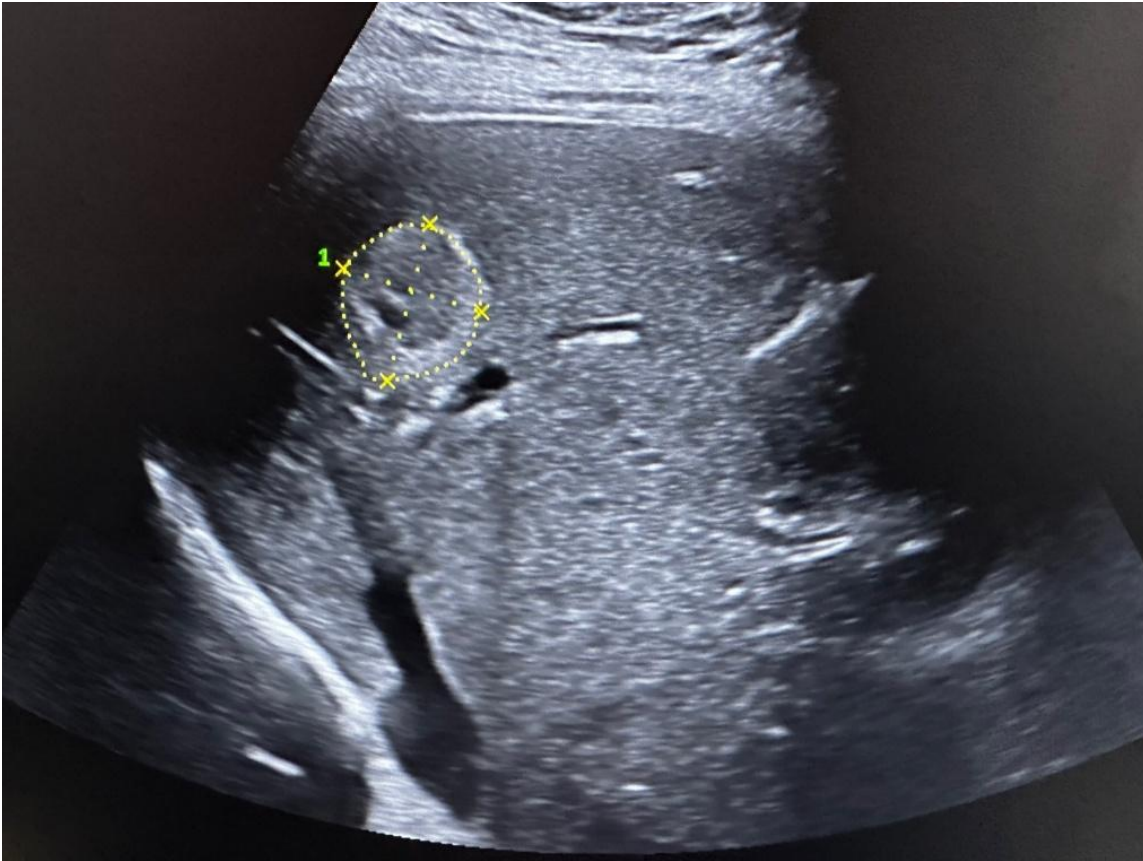


AI Lesion detection



Automatical measurement

AI inside US machine. Liver. New performance



VAid Analysis	
1	
Reference	
Possible HHE	89.9%
Echo:	Hyperechoic
Shape:	Regular Shape
Boundary:	Clear Boundary
Echo Texture:	Heterogeneous
Horizontal:	2.30 cm
Vertical:	2.57 cm



Detection and characterization of a liver lesion

AI in the Ultrasound diagnosis and treatment

The Impact of Deep Learning on Ultrasound in Diagnosis and Therapy: Enhancing Clinical Decision Support, Workflow Efficiency, Quantification, Image Registration, and Real- time Assistance

Won-Chul Bang, PhD, Vice President ^a, Yeong Kyeong Seong, PhD ^b, Jinyong Lee ^a

Virtual Reality for Ultrasound Teaching

REVIEW ARTICLE

Application of the Virtual Reality in the Teaching of Ultrasonography

Zheng Zhang, MS ^{a,b}, Li Liu, MD ^a, Desheng Sun, MD ^a, Dirong Zhang, MD ^a, Fengbei Kong, MS ^a, Yalin Wu, PhD ^{a,*}, Yu Shi, MD ^{a,*}

^a Department of Ultrasonography, Peking University Shenzhen Hospital, China; ^b Shenzhen University School of Medicine, China

Received April 6, 2023; revision received April 10, 2023; accepted April 22, 2023

Abstract: This article discusses the potential benefits of using virtual reality (VR) technology in the teaching of ultrasonography. VR technology can provide an immersive learning experience, enabling students to interact with simulated environments and practice various tasks. Ultrasonography has the characteristics of convenient, rapid, real-time feedback, and dynamic, and is indispensable in practical clinical disease diagnosis applications. Combining VR and ultrasound technology can provide a unique and effective teaching method for medical students and medical professionals. This article mainly discusses the current situation, advantages, and challenges of virtual reality technology in the teaching of ultrasonography to ensure their successful implementation in an educational environment.

AI for Education in Ultrasound

REVIEW ARTICLE

Development of 5G-based Remote Ultrasound Education: Current Status and Future Trends

Jiaojiao Ma, MD^{a,b}, Xinying Jia, MD^a, Guanghan Li, MD^a, Dandan Guo, MD^a, Xuehua Xi, MD^a, Tongtong Zhou, MD^a, Ji-Bin Liu, MD^c, Bo Zhang, MD^{a,b,d,}*

^a Department of Ultrasound, China-Japan Friendship Hospital, Beijing, China; ^b National Center for Respiratory Medicine, National

AI in radiomics for chronic liver diseases

Artificial intelligence

> Diagnostics (Basel). 2022 Nov 9;12(11):2737. doi: 10.3390/diagnostics12112737.

Ultrasound Radiomics for the Detection of Early-Stage Liver Fibrosis

Maryam Al-Hasani ¹, Laith R Sultan ¹,
Mrigendra B Karmacharya ¹, Chandre

Meta-Analysis

> BMC Gastroenterol. 2021 Jan 6;21(1):10. doi: 10.1186/s12876-020-01585-5.

Multicenter Study > Gut. 2019 Apr;68(4):729-741. doi: 10.1136/gutjnl-2018-316204.
Epub 2018 May 5.

Deep learning Radiomics of shear wave elastography significantly improved diagnostic performance for assessing liver fibrosis in chronic hepatitis B: a prospective multicentre study

Application of artificial intelligence in chronic liver diseases: a systematic review and meta-analysis

Pakanat Decharatanachart ¹, Roongruedee Chaiteerakij ^{2 3}, Thodsawit Tiyyarattanachai ⁴,
Sombat Treeprasertsuk ⁵

Review


> Dig Liver Dis. 2023 Jun;55(6):704-713. doi: 10.1016/j.dld.2022.12.002.

Epub 2022 Dec 30.

The potential role of machine learning in modelling advanced chronic liver disease

OPEN

Experimental evidence of effective human–AI collaboration in medical decision-making

Carlo Reverberi^{1,2}, Tommaso Rigon³, Aldo Solari^{2,3}, Cesare Hassan^{4,5}, Paolo Cherubini^{1,2,6}, GI Genius CADx Study Group* & Andrea Cherubini^{2,7}

Artificial Intelligence (AI) systems are precious support for decision-making, with many applications also in the medical domain. The interaction between MDs and AI enjoys a renewed interest following the increased possibilities of deep learning devices. However, we still have limited evidence-based knowledge of the context, design, and psychological mechanisms that craft an optimal human–AI collaboration. In this multicentric study, 21 endoscopists reviewed 504 videos of lesions prospectively acquired from real colonoscopies. They were asked to provide an optical diagnosis with and without the assistance of an AI support system. Endoscopists were influenced by AI (or = 3.05), but not erratically: they followed the AI advice more when it was correct (or = 3.48) than incorrect (or = 1.85). Endoscopists achieved this outcome through a weighted integration of their and the AI opinions, considering the case-by-case estimations of the two reliabilities. This Bayesian-like rational behavior allowed the human–AI hybrid team to outperform both agents taken alone. We discuss the features of the human–AI interaction that determined this favorable outcome.



Crucial Role of Understanding in Human-Artificial Intelligence Interaction for Successful Clinical Adoption

Seong Ho Park¹, Curtis P. Langlotz²

¹Department of Radiology and Research Institute of Radiology, University of Ulsan College of Medicine, Asan Medical Center, Seoul, Republic of Korea




²Departments of Radiology, Medicine, and Biomedical Data Science, Center for Artificial Intelligence in Medicine and Imaging, Stanford University, Stanford, CA, USA

CONCLUSION

Human-AI interaction is a critical factor for the successful integration of AI into clinical practice. Effectively utilizing

Review

Artificial Intelligence (AI)-Enhanced Ultrasound Techniques Used in Non-Alcoholic Fatty Liver Disease: Are They Ready for Prime Time?

Elena Codruta Gheorghe ¹, Carmen Nicolau ², Adina Kamal ³, Anca Udristoiu ⁴, Lucian Gruionu ⁵
and Adrian Saftoiu ^{6,7,*}

→ Data from medical imaging research support the implementation of AI in healthcare settings, with clinical implications such as improving the performance of early stage NAFLD diagnosis, accurately quantifying NAFLD and estimating the stage of liver fibrosis, decreasing subjectivity and minimizing human errors, as well as introducing computer-aided diagnosis for less experienced doctors.

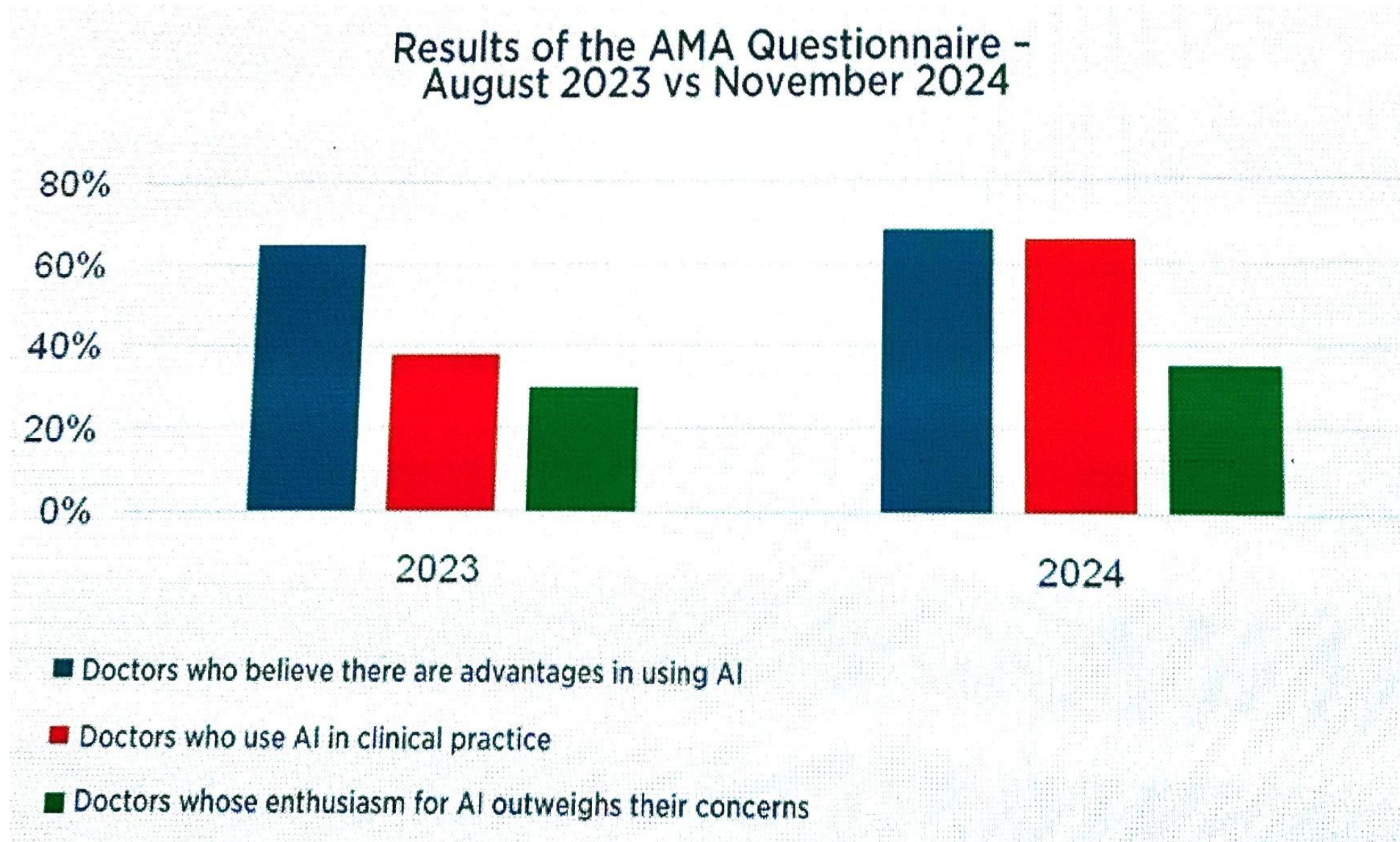
Which AI method (model)?

Artificial Intelligence in Gastroenterology Education: DeepSeek Passes the Gastroenterology Board Examination and Outperforms Legacy ChatGPT Models.

Andrew F Ibrahim, Pojsakorn Danpanichkul, Alexander Hayek, Edwin Paul, Annmarie Farag, Masab Mansoor,
Charat Thongprayoon, Wisit Cheungpasitporn, Mohamed O Othman

[*American Journal of Gastroenterology*](#) 2025 May 20

How doctors look to AI during the time?

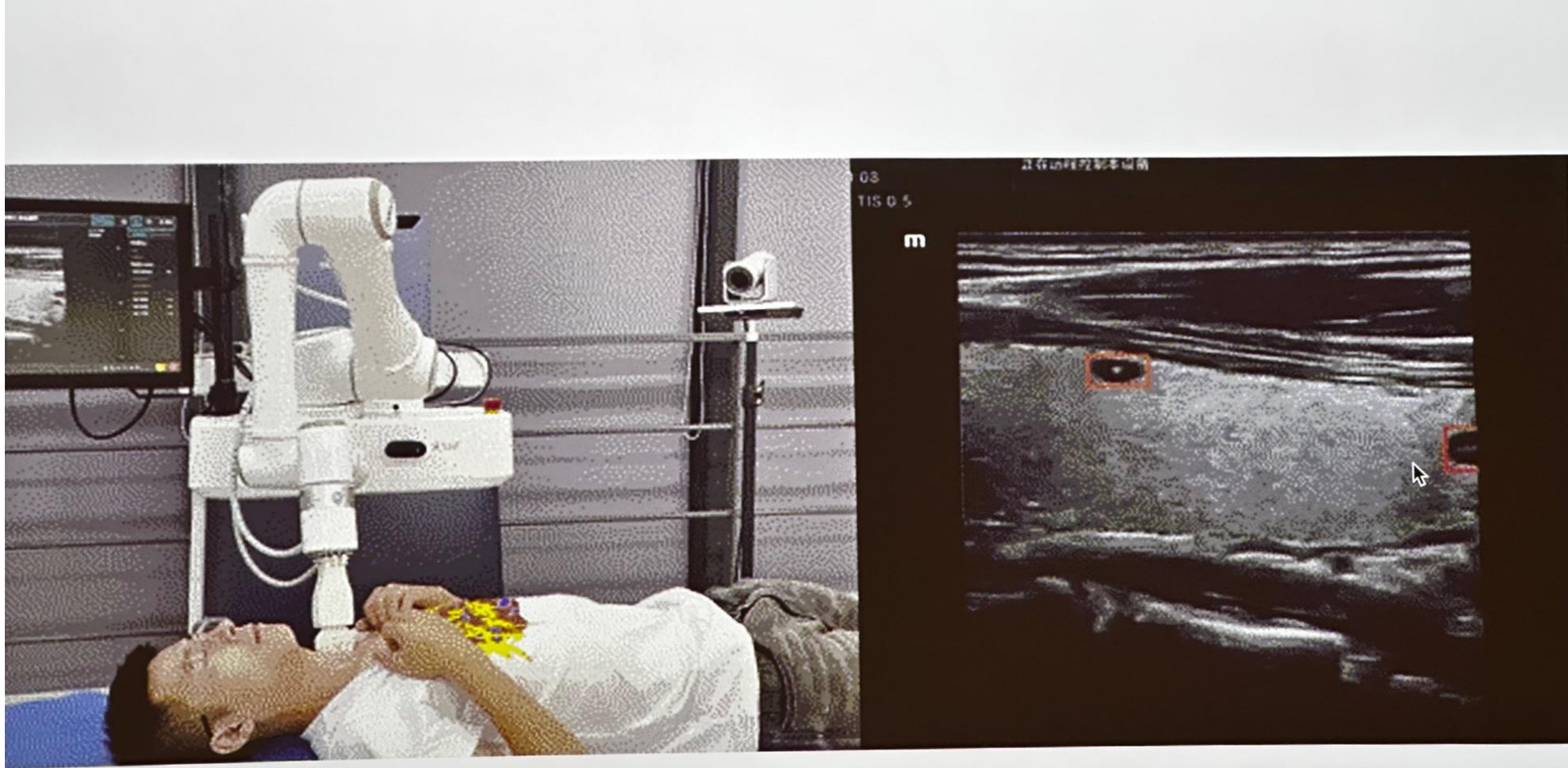


AI Guided Roboting. Is a future?



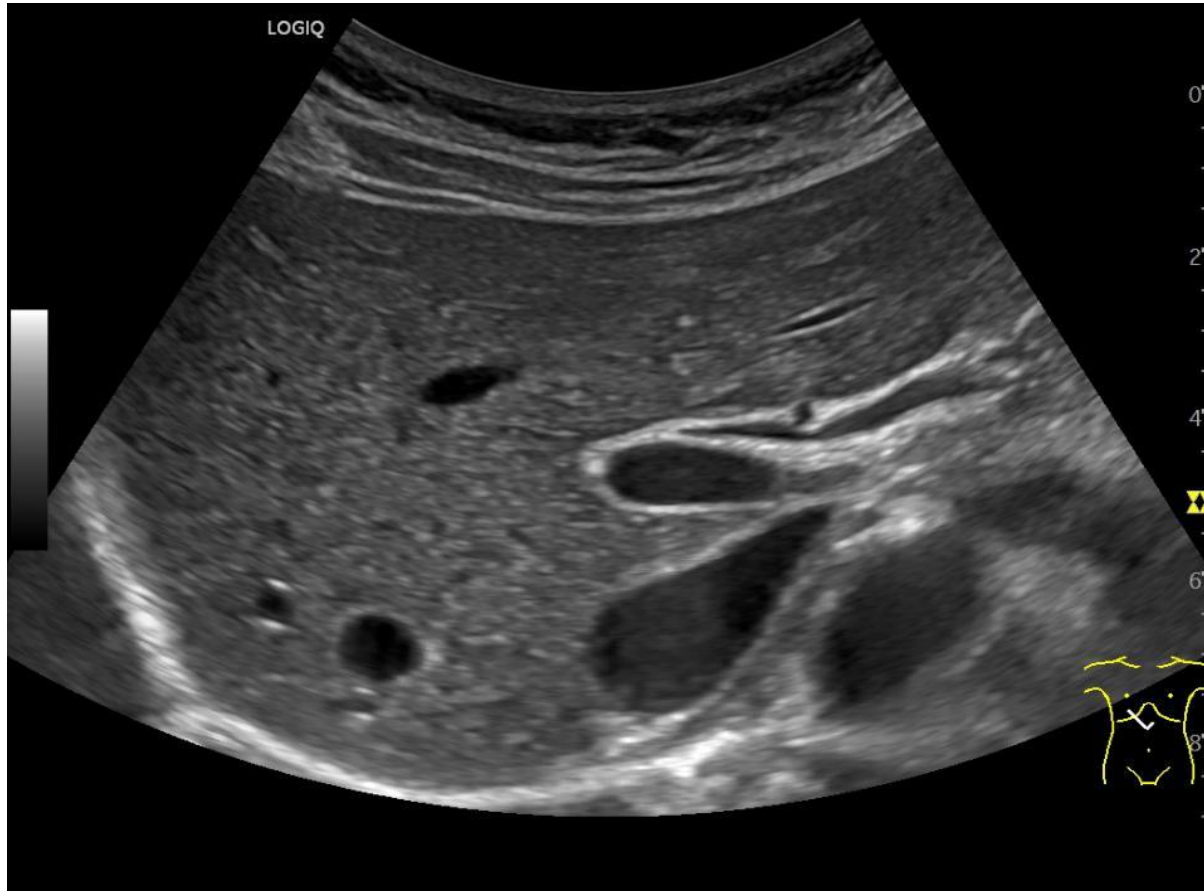
Images from Prof. Christoph Dietrich

AI Guided Roboting



Images from
Prof. Christoph
Dietrich

What do you believe about this ultrasound image?! Question for Chat GPT 4.0/5



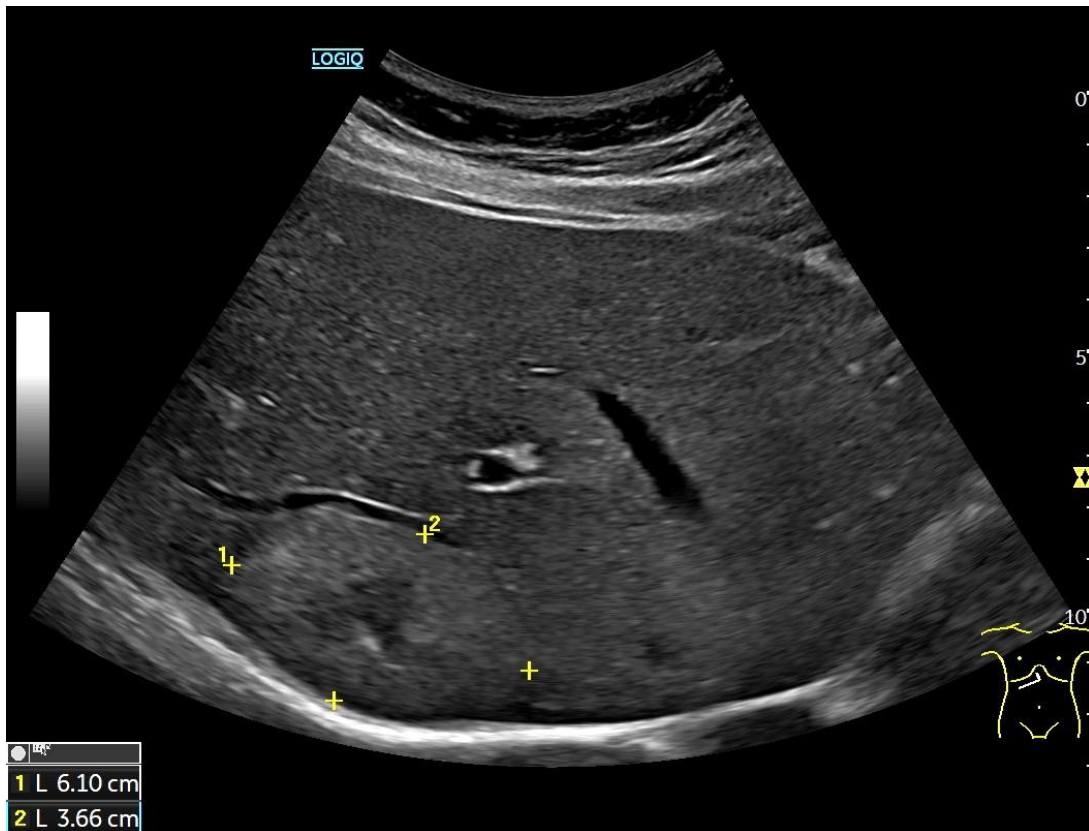
This appears to be an ultrasound image, possibly of the liver and adjacent structures, taken in a longitudinal or transverse plane. *Specific findings cannot be confirmed without clinical context and further details.*

However, the hyperechoic and hypoechoic regions, as well as the visible biliary structures or vessels, could represent normal anatomy or pathological changes.

CHAT GPT 4.0 Interpretation



What you believe about this image?

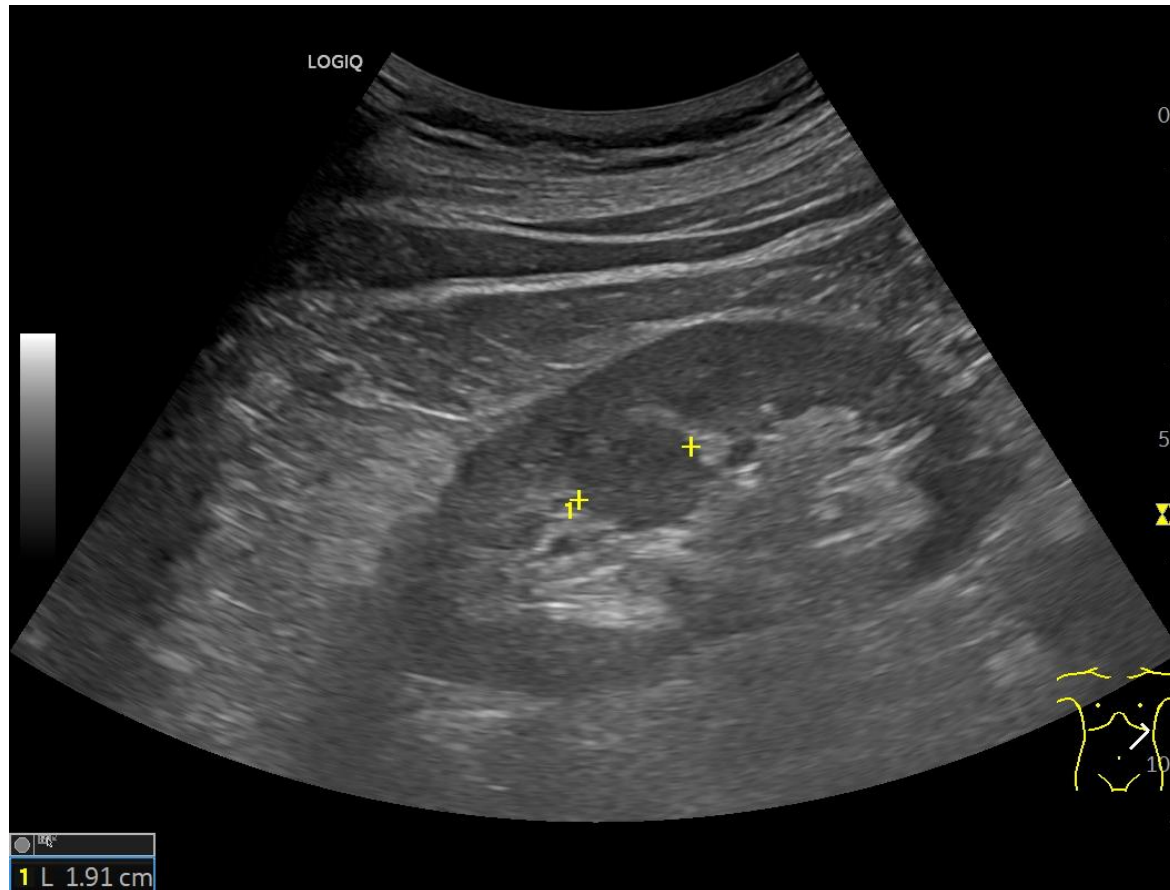


- **Ultrasound Liver Report**
- **Scientific Interpretation of the Ultrasound Image**
 - Modality: B-mode ultrasound; Anatomical region: Liver (transverse/subcostal view)
 - Device: LOGIQ (General Electric)
- **Findings**
 - - Liver Parenchyma:
Homogeneous echotexture overall, with normal periportal echogenicity and no diffuse steatosis or cirrhotic nodularity apparent. No signs of intrahepatic biliary dilatation.
 - - Focal Liver Lesion:
A well-defined, hyperechoic, rounded lesion is visible in the right hepatic lobe. Two perpendicular measurements:
 - Long axis: 6.10 cm
 - Short axis: 3.66 cmNo posterior acoustic shadowing or significant internal vascularity noted. No peripheral halo or calcifications are visible. The lesion is consistent with a cavernous hemangioma.
 - - Adjacent Structures:
The hepatic vasculature is visible and not compressed or displaced. The diaphragm is seen posteriorly with preserved contour.
- **Interpretation / Diagnosis**
- **Likely Diagnosis: Cavernous hepatic hemangioma – a common benign vascular tumor of the liver. The echographic appearance in this image is typical.**
- **Recommendations**
 - 1. Follow-up Imaging:
 - If asymptomatic and classical appearance: routine follow-up may suffice.
 - If lesion is >5 cm, or if patient is symptomatic or has atypical features, consider:
 - Contrast-enhanced ultrasound (CEUS)
 - MRI with hepatocyte-specific contrast agents (e.g., Gd-EOB-DTPA)
 - CT with dynamic contrast phases
 - 2. Clinical Correlation:
 - Assess for abdominal pain, signs of compression, or bleeding risk.
 - Check liver function tests if not already available.
- **Conclusion**
 - **This ultrasound image reveals a large (6.1 x 3.66 cm), well-demarcated, hyperechoic lesion in the right hepatic lobe, most consistent with a cavernous hemangioma. Further imaging may be warranted based on clinical context.**

CHAT GPT 4.0 Interpretation

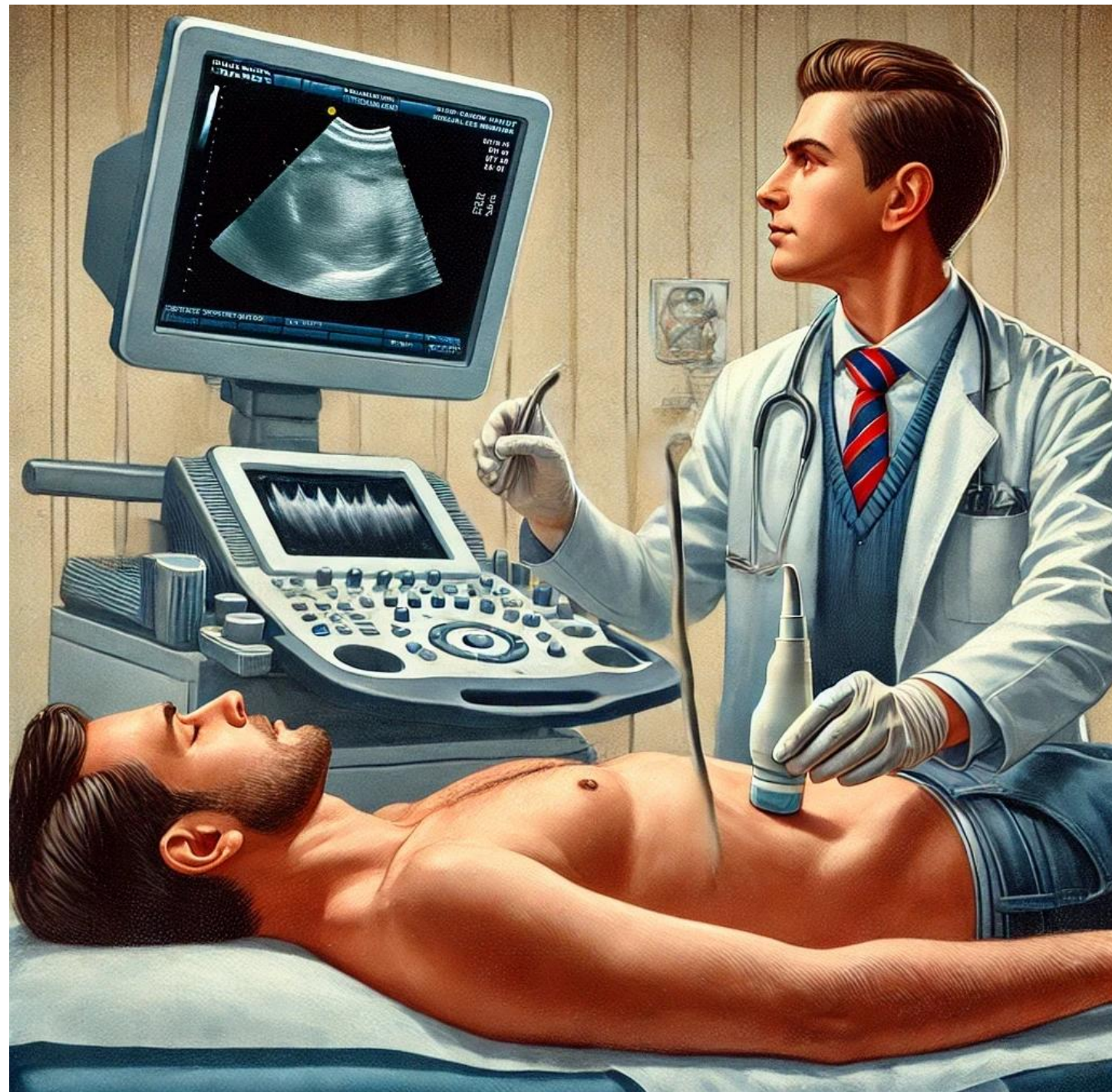


What you believe about this image?

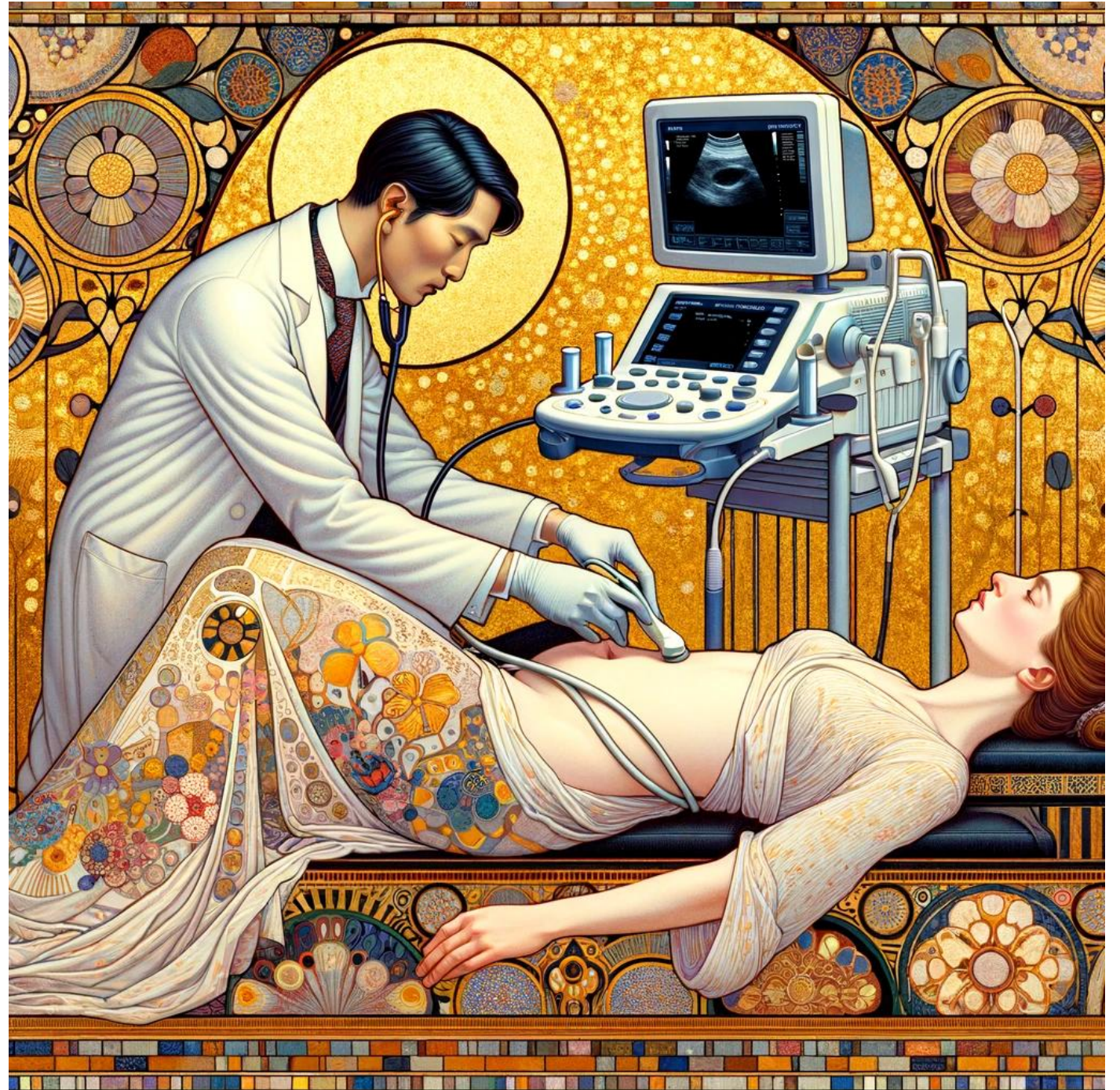


- **Ultrasound Interpretation Report**
- **General Information**
- Organ: Kidney (most likely left); Modality: B-mode ultrasound; Orientation: Longitudinal (sagittal) view
- **Findings**
- ***Renal size and contour:***
- The kidney appears within normal size range and demonstrates a preserved reniform shape. The cortical margin is smooth and regular.
- ***Cortico-medullary differentiation:***
- Cortical echogenicity appears normal (less echogenic than the liver/spleen), and medullary pyramids are distinguishable, indicating preserved corticomedullary differentiation.
- ***Prominent Column of Bertin (Pseudotumor appearance):***
- A well-defined, hypoechoic area is seen extending into the central sinus from the renal cortex. This structure is isoechoic with the surrounding renal cortex and does not distort the renal architecture or demonstrate mass effect. These findings are characteristic of a hypertrophied column of Bertin, a normal anatomical variant.
- **Renal sinus:**
- The renal sinus appears echogenic due to the presence of fat and collecting system echoes. No evidence of hydronephrosis or sinus mass is visible.
- ***Other observations:***
- No renal stones or cystic lesions are evident in this plane.
- **Conclusion**
- **Normal renal ultrasound with a prominent column of Bertin (normal variant).**
- **No evidence of hydronephrosis, mass lesion, or nephrolithiasis in this image.**

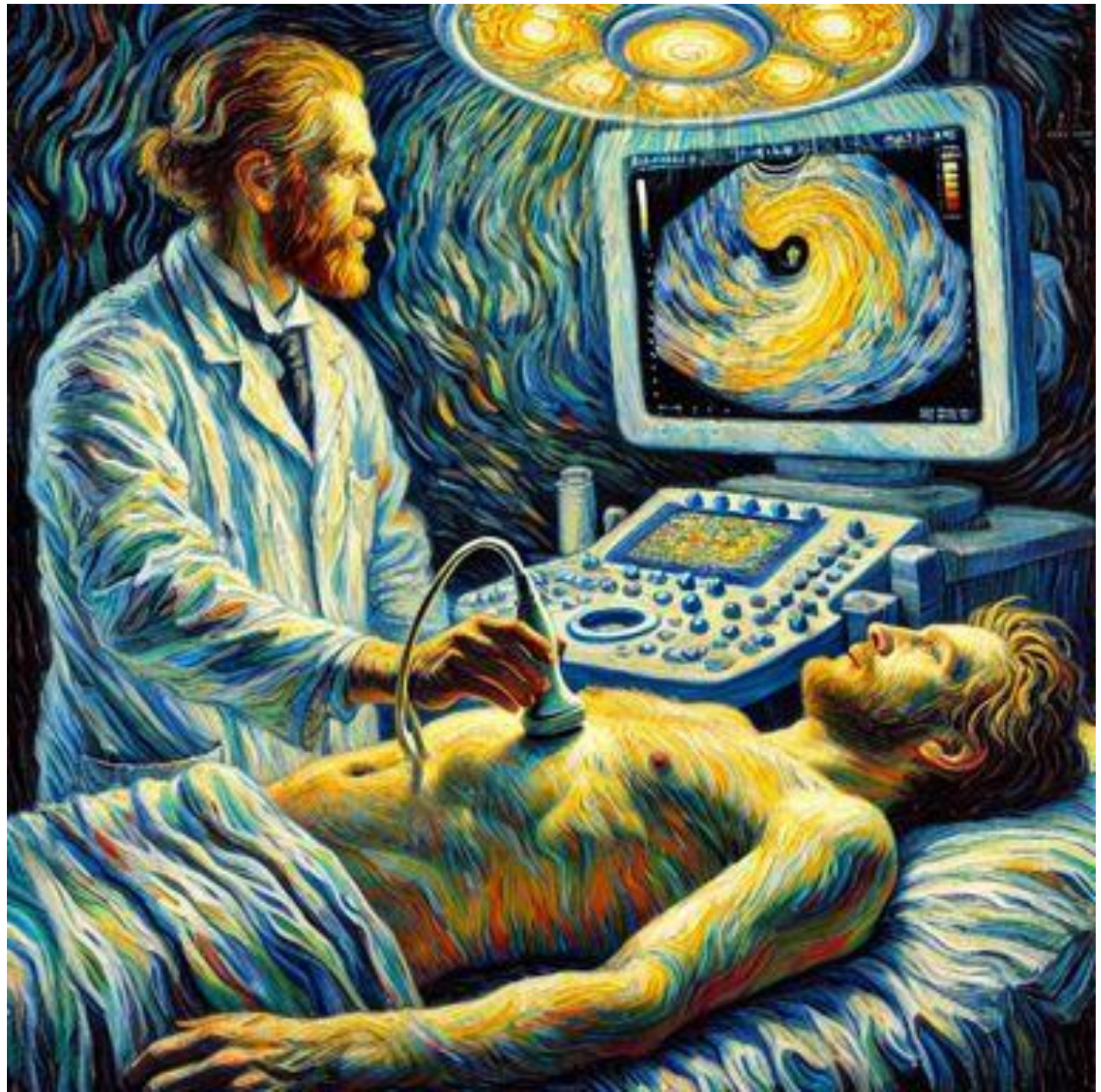
**Ultrasound picture
created with AI
(Chat GPT 4.0)**



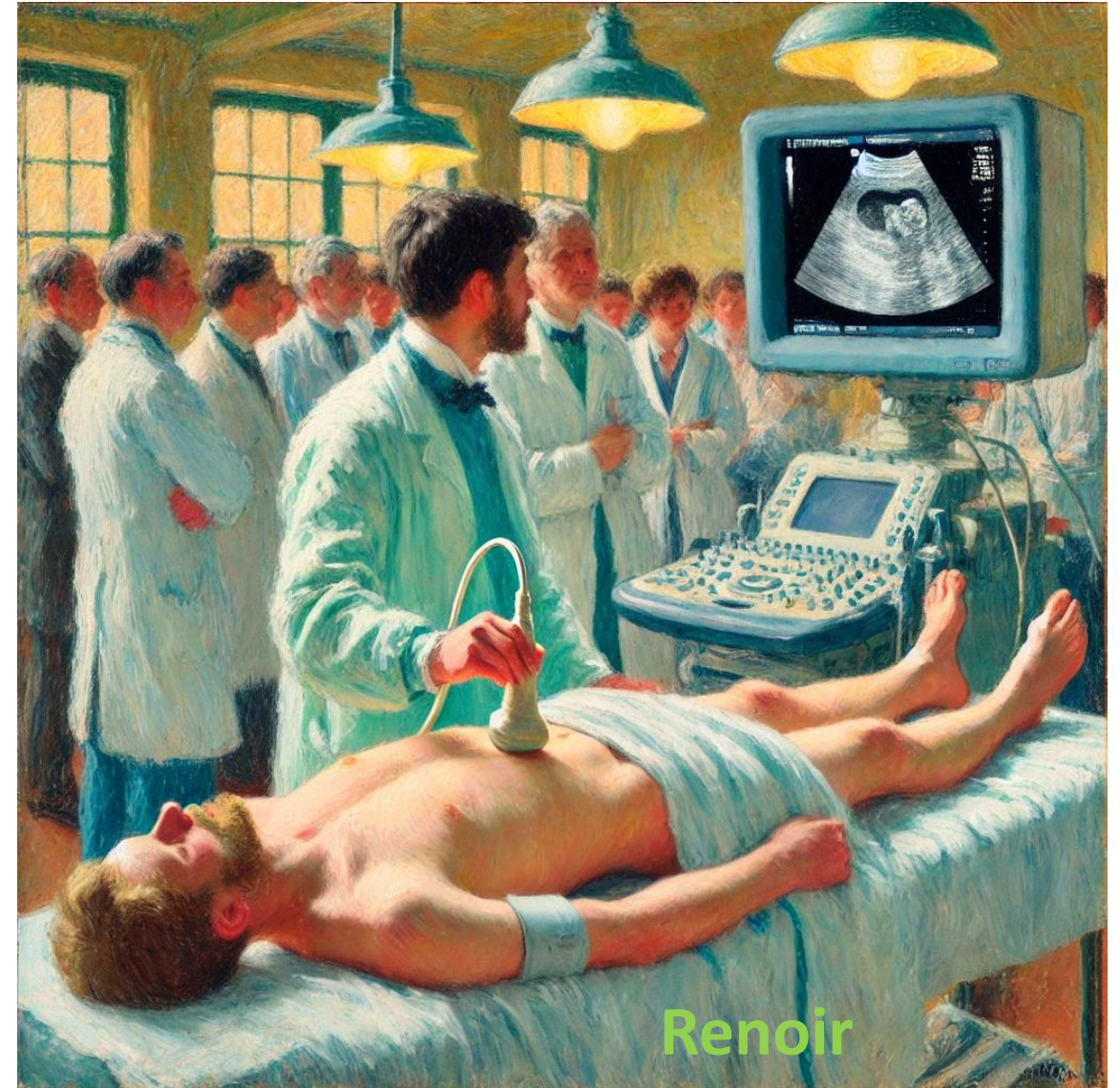
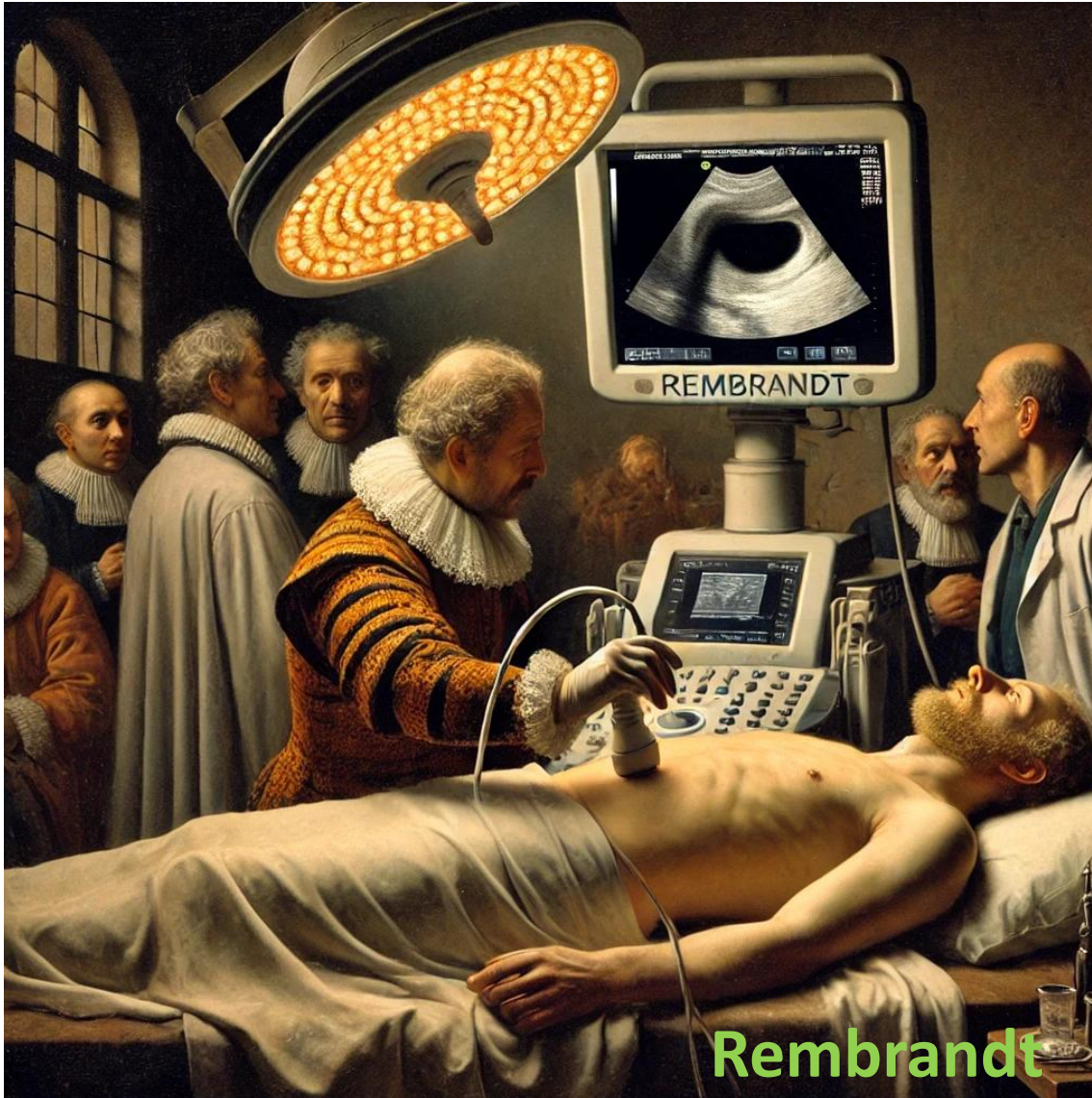
**Ultrasound picture
created with AI
(Klimt style)**



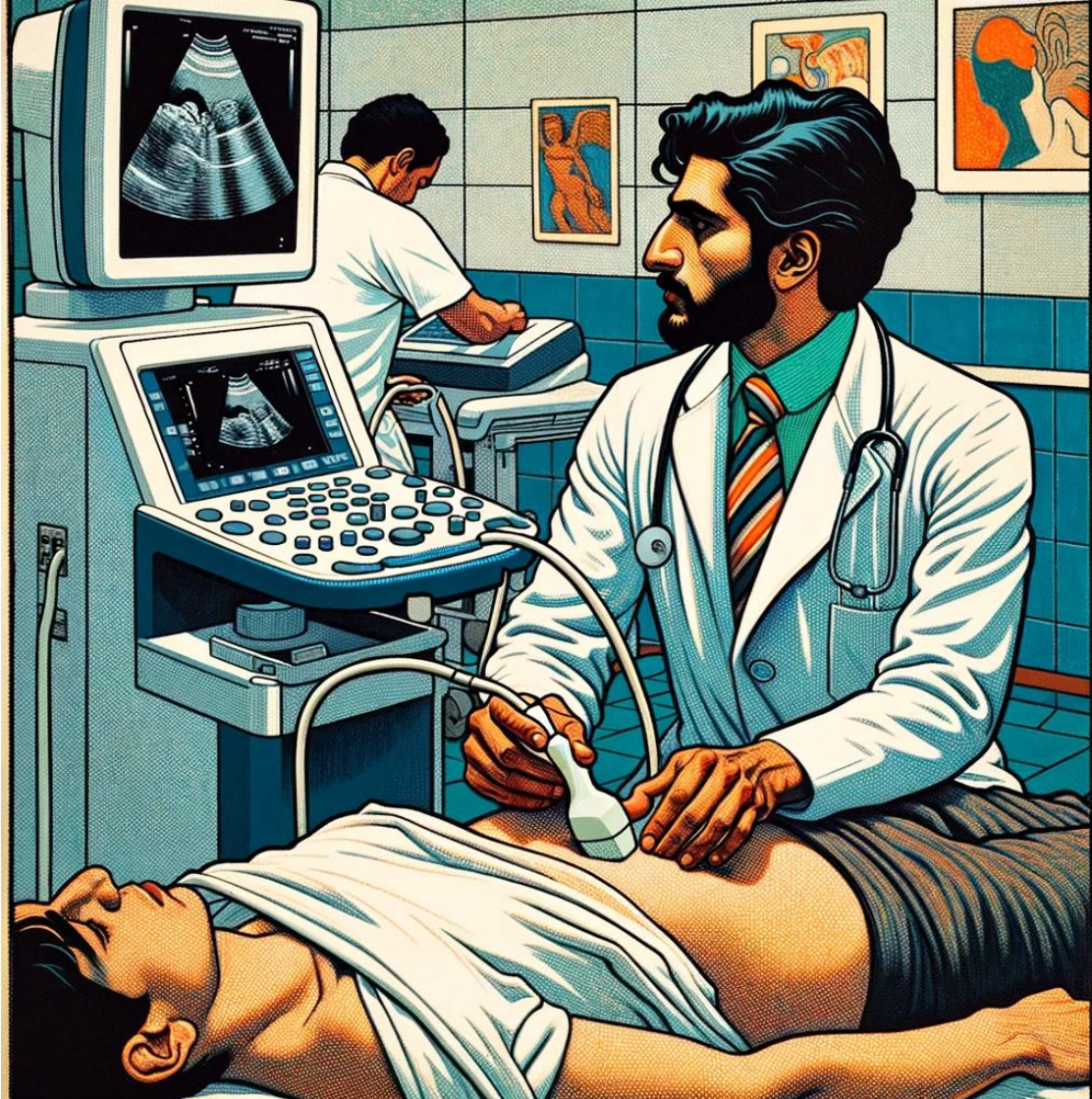
**Van Gogh
style**



Pictures with AI about US (others artistic styles)



Pictures with AI about US (others artistic styles)



Obstetric
US in van
Gogh
style



AI will
replace the
painters?

How US look
for AI in
“Stone Age”!

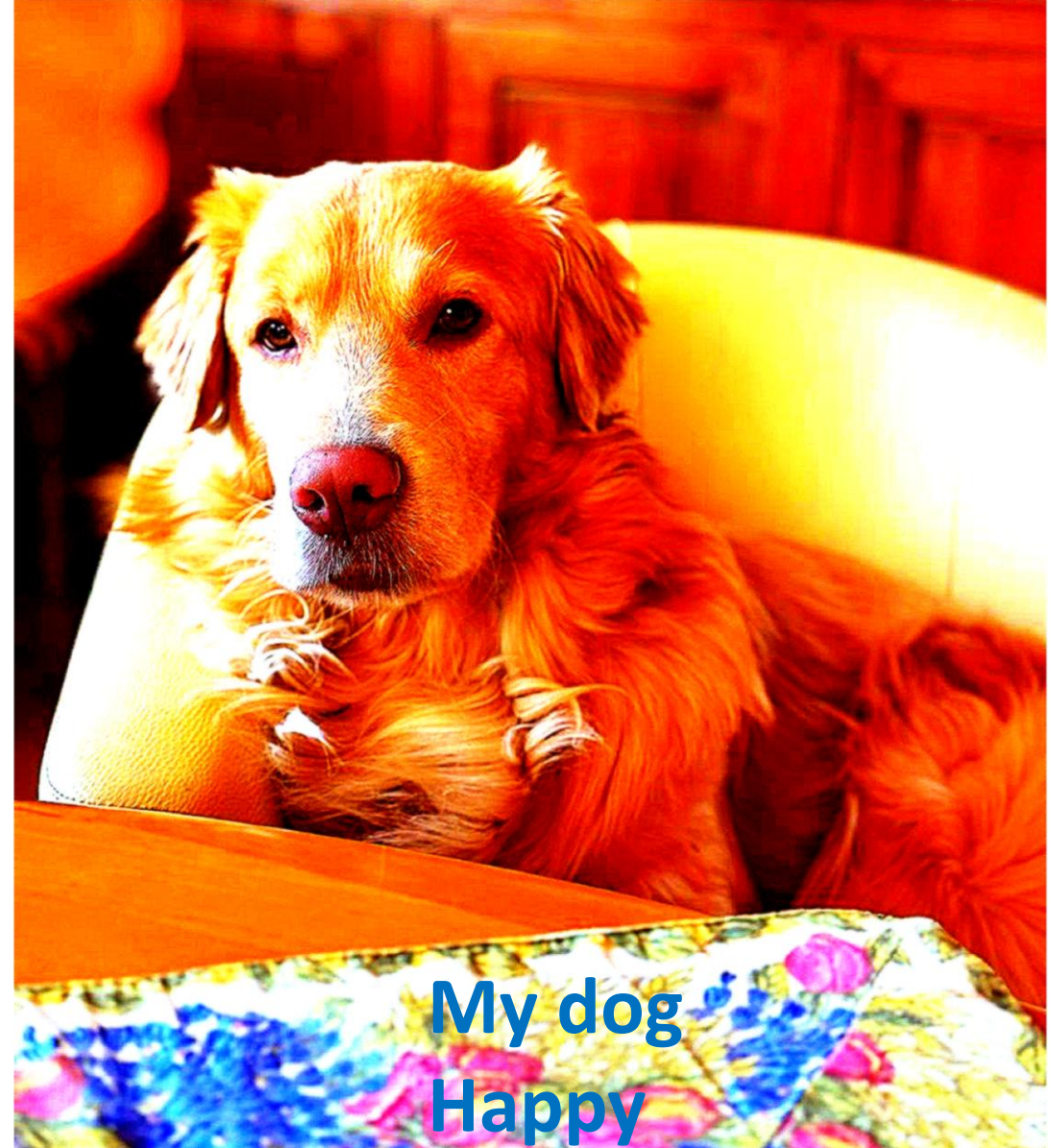


How US look for
AI in “Roman
time”!





My dog sculpture made with AI in Brancusi style



**My dog
Happy**