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Ultrasound abdominal phantom - A possible training tool for radiographers and medical imaging students

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Authors:

J. Pinheiro, L. P. V. Ribeiro

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Learning objectives

Simulation-based learning (SBL) is extensively utilized in healthcare education to offer students a safe environment for practicing clinical scenarios without risking patient safety. Simulation plays a crucial role in training, assessment, and research across fields such as aviation, nuclear power, and the military, and is poised to become a mandatory aspect of health professional education. It is essential for developing medical skills, guiding learners from novice to expert. Studies have demonstrated that simulation models enhance proficiency and success rates in ultrasound-guided procedures. In this context,...

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Background

A qualitative, exploratory, descriptive and contextual approach was employed to conduct this research study. Twenty exams (n=20) were performed with the phantom (Kyoto Kagaku Ultrasound Examination Training Phantom"ABDFAN") [fig]1[/fig] and multiple imagens were obtained in several planes and accoustic windows to test echogenicity, measuremetns of organs and main vessels were also performed and then compared to abdominal exams with real people [fig]2[/fig]. Radiographers were given a pre-test including written and practical skills diagnosis of phantom pathologies, a short vídeo and practice time with the phantoms...

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Findings and procedure details

After didactic and hands-on training with phantoms [fig]6[/fig], radiographers demonstrated an increase in knowledge, skills and preparedness for diagnosing real patients with abdominal pathologies in several acoustic windows and anatomical surface locations [table]1[/table] and [table]2[/table]. Overall, the phantoms allowed an unrestricted opportunity to practice and refine their technique Training Videos Playlist.1 - US Liver Axial Plane with lesions Training Phantom2 - US Liver Left and Kidney Axial Plane with lesions Training Phantom3 - US Liver Left and Kidney Axial Plane with lesions Training Phantom4 -...

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Conclusion

Thematic analysis identified three key themes: (1) Enhancing preparedness for the clinical environment, (2) Limitations of the tissue-equivalent phantom, and (3) Suggestions for improving simulation. Although students provided positive feedback and appreciated the simulation tool, they also pointed out its limitations, including the unrealistic representation of real patient scanning conditions.Overall, the phantom ultrasound scans resembled human images and were successful in training AI models. Tissue phantoms are critical that can accelerate the widespread use of ultrasound imaging for emergency triage or walk in patients.Using ultrasound...

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Personal information and conflict of interest

J. Pinheiro: Nothing to disclose L. P. V. Ribeiro: Nothing to disclose

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References

Filippou, P., Odisho, A., Ramaswamy, K., Usawachintachit, M., Hu, W., Li, J., & Chi, T. (2016). Using an abdominal phantom to teach urology residentes ultrasound-guided percutaneous needle placement.International braz j urol : official journal of the Brazilian Society of Urology,42(4), 717–726. https://doi.org/10.1590/S1677-5538.IBJU.2015.0481Hernandez-Torres Sofia I. , Bedolla Carlos , Berard David , Snider Eric J. 2023 An extended focused assessment with sonography in trauma ultrasound tissue-mimicking phantom for developing automated diagnostic technologies. Frontiers in Bioengineering and Biotechnology. 11. https://www.frontiersin.org/journals/bioengineering-and-biotechnology/articles/10.3389/fbioe.2023.1244616 DOI 10.3389/fbioe.2023.1244616McKinley, H. J., Jones, I., LaRochelle,...

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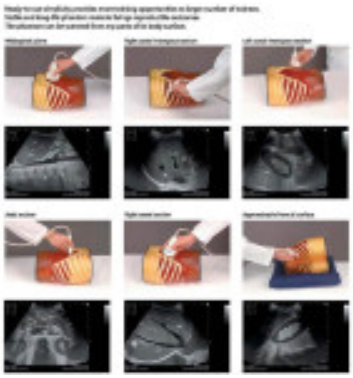

Fig 1: *Kyoto Kagaku Ultrasound Examination Training Phantom "ABDFAN"*

Fig 2: *Examples of US planes acquired*

Fig 3: *Example of Training*

Fig 4: *Training Session*

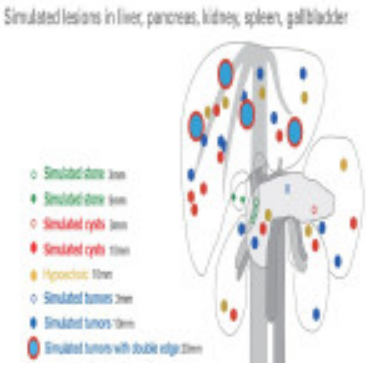

Fig 5: *Simulated Pathologies*

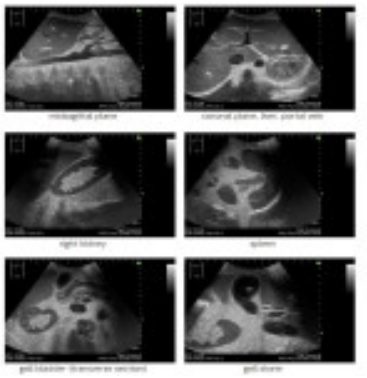

Fig 6: *Anatomical structures and pathologies found in the phantom*

Anatomical Structures	On Phantom (n=80) %	On Students (n=40) %	Pearson*	P
Liver	100	100	0.98	0.08
Liver segmental anatomy	87	73	0.88	0.48
Liver portal and hepatic venous systems,	88	84	0.80	0.45
Liver ligamentum teres and ligamentum venosum	89	78	0.79	0.42
Biliary tract (gallbladder)	100	100	0.99	0.08
Biliary cystic duct,	95	88	0.89	0.48
Biliary tract (intrahepatic and extrahepatic bile ducts)	92	78	0.91	0.48

*p <0.05

Table 1: *Results on identification of anatomical structures between groups.*

Pathologies	On Phantom (n=40) %
Hepatic lesions (cysts and solid),	88
Gallbladder and bile duct stones,	85
Pancreatic tumors (one involving the portal vein),	75
Splenic lesions,	78
Both kidney lesions, and left adrenal tumor.	78

Table 2: *Results on identification of pathologies in the Phantom*