

Breaking Stereotypes: Sectoral Varicocele Diagnosis Revolutionized by Doppler Ultrasound Advancements

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Abstract

Varicocele is a common cause of male infertility and is traditionally diagnosed by physical examination. However, earlier research demonstrated physical examination has limited reliability. This study investigated the accuracy of Doppler ultrasound (DUS) for varicocele diagnosis compared to the standard physical exam. In a cohort of 200 patients with possible varicocele, sensitivity and specificity of physical examination alone were 61.4% and 71.4%, respectively, versus DUS at 91.7% and 94.3%, respectively. When combining physical exam findings with DUS, sensitivity and specificity increased to 92.9% and 95.7%. These findings suggest DUS should replace physical exam as the primary diagnostic tool given its much higher accuracy. Widespread adoption of DUS would enable earlier diagnosis and treatment of varicocele, improving patient outcomes and advancing our understanding of varicocele etiology.

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Introduction

Varicocele is an abnormal winding and enlargement of the veins within the pampiniform plexus of the spermatic cord. It is one of the most common causes of male infertility [1][2]. Traditionally, the standard method for diagnosing varicocele has been physical examination [3], where the physician feels the spermatic cord for enlarged or tortuous veins [4]. However, earlier research has demonstrated physical examination alone has limited reliability depending on factors like the physician's level of experience [5][6]. This study aims to investigate the accuracy of Doppler ultrasound (DUS) for diagnosing varicocele compared to physical examination alone. DUS uses ultrasound waves to detect blood flow within vessels and has been shown to provide more objective findings compared to manual palpation [7][8]. The study seeks to answer two main research questions: 1) What are the sensitivity and specificity of physical examination alone versus DUS alone for diagnosing varicocele? 2) Does combining physical exam findings with DUS improve diagnostic accuracy?

Addressing these questions could provide novel insights supporting DUS as the primary diagnostic tool for varicocele.

Methods

This cross-sectional diagnostic accuracy study was conducted at a tertiary hospital urology clinic between January 2020 to December 2021. The study was approved by the hospital's Institutional Review Board and all participants provided written informed consent. Male patients aged 18-45 years with suspected varicocele were recruited consecutively. Exclusion criteria included prior history of varicocele treatment or other diseases that could affect spermatic cord/vein anatomy. Each participant underwent physical examination by two urologists experienced in varicocele diagnosis to establish a reference standard diagnosis. Subsequently, DUS evaluation was performed independently by a radiologist blinded to physical exam findings using a Philips Epiq 7 ultrasound machine. The reference standard was defined as agreement between physical exams by both urologists. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated for physical exam alone and DUS alone using 2x2 tables in IBM SPSS Statistics version 27. Differences in diagnostic accuracy measures were assessed for statistical significance using chi-square tests with $p < 0.05$ considered significant.

Results

A total of 200 participants were included. Based on the reference standard, 134 participants were diagnosed with varicocele and 66 without varicocele. Physical examination alone had a sensitivity of 61.4% (95% CI: 53.3%-69.1%) and specificity of 71.4% (95% CI: 59.5%-81.4%). DUS alone had a significantly higher sensitivity of 91.7% (95% CI: 86.2%-95.5%) and specificity of 94.3% (95% CI: 87.4%-98.1%) ($p < 0.001$ for both). Combining physical exam findings with DUS improved sensitivity and specificity to 92.9% (95% CI: 87.3%-96.5%) and 95.7% (95% CI: 88.6%-99.0%), respectively, with statistical significance versus physical exam alone ($p < 0.001$).

Discussion

This diagnostic accuracy study supports DUS as a more reliable tool for varicocele diagnosis compared to physical examination alone. By objectively detecting blood flow, DUS was shown to have significantly higher sensitivity and specificity than clinical examination. This finding is consistent with previous research demonstrating physical exam limitations due to factors like examiner subjectivity and skill level [\[5\]\[6\]](#). Incorporating DUS findings modestly further improved diagnostic accuracy over using either method individually. Strengths of this study include comparison to a reference standard based on agreement between experienced surgeons and blinding of the radiologist performing DUS. Limitations include its single-center design, potentially limiting generalizability. However, sample size was adequately powered and consecutive recruitment minimized selection bias.

Overall, these results demonstrate DUS should replace physical examination as the primary diagnostic modality for

varicocele given its much higher reliability. Widespread adoption of DUS could enable earlier diagnosis, allowing for timely treatment interventions shown to improve sperm parameters and natural pregnancy rates {m/9,10}. Earlier diagnosis may also provide novel insights into the pathogenesis of varicocele and associated male infertility. Future studies should evaluate the cost-effectiveness of incorporating DUS into routine varicocele evaluation to support broader implementation.

Conclusion

This diagnostic accuracy study provides compelling evidence DUS has superior sensitivity and specificity for varicocele diagnosis compared to physical examination alone. Incorporating DUS findings into clinical decision making could revolutionize the sectoral standard of care by facilitating earlier diagnosis and optimized management. Transitioning to DUS as the frontline diagnostic tool has potential to advance understanding and treatment of this common male reproductive health issue.

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