

盆底超声及相关新技术评估盆底肌收缩功能的临床价值

谢川博¹, 满琴²

¹自贡市妇幼保健院超声影像科, 四川 自贡

²自贡市妇幼保健院产前诊断中心, 四川 自贡

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摘要

盆底功能障碍(FPDF)是产后女性一种常见的疾病, 对生活质量有负面影响, 包括尿失禁、便失禁及性障碍等多种临床表现。由于盆底是人体中最复杂的区域之一, 仅通过病史采集和体格检查很难做出有效的评估, 为了进行准确的诊断, 不同的成像方式一直在使用, 包括磁共振成像(MRI)和计算机断层扫描(CT); 如今, 随着超声技术的不断发展, 盆底超声已成为盆底成像的最佳选择之一, 特别是在该种成像模式基础上发展而来的一系列新的超声检查方法, 对于盆底肌收缩功能的临床分析十分有价值。本文旨在介绍盆底成像中新兴的超声技术, 包括容积渲染、融合成像、运动跟踪和彩色矢量映射及超声盆底测压及弹性成像等。

关键词

盆底超声, 盆底功能障碍, 盆底收缩功能

The Clinical Value of Pelvic Floor Ultrasound and Related New Technologies in Evaluating Pelvic Floor Muscle Contraction Function

Chuanbo Xie¹, Qin Man²

¹Department of Ultrasound Medicine, Zigong Hospital of Women and Children Health Care, Zigong Sichuan

²Prenatal Diagnosis Center, Zigong Hospital of Women and Children Health Care, Zigong Sichuan

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Abstract

Pelvic floor dysfunction (FPFD) is a common disorder in postpartum women that negatively affects quality of life, including multiple clinical manifestations such as urinary incontinence, fecal incontinence, and sexual disturbances. Since the pelvic floor is one of the most complex regions in the human body, it is difficult to make an effective assessment through history taking and physical examination alone. To make an accurate diagnosis, different imaging modalities have been used, including magnetic resonance imaging (MRI) and computed tomography (CT); nowadays, with the continuous development of ultrasound technology, pelvic floor ultrasound has become one of the best choices for pelvic floor imaging, especially a series of new ultrasound developed on the basis of this imaging mode. The examination method is very valuable for the clinical analysis of pelvic floor muscle contraction function. This article aims to introduce emerging ultrasound techniques in pelvic floor imaging, including volume rendering, fusion imaging, motion tracking and color vector mapping, ultrasound pelvic floor manometry and elastography.

Keywords

Pelvic Floor Ultrasound, Pelvic Floor Dysfunction, Pelvic Floor Contraction Function

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1. 引言

女性骨盆是具有不同作用的器官和组织的复合体, 它由骨盆带、子宫, 膀胱和直肠共同构成。骨盆底是由肌肉、韧带和骨骼组成的复合体, 并具有不同的功能, 包括排尿、排便和阴道分娩等。骨盆底可以划分三个盆腔: 前盆腔, 由下泌尿系统和阴道的前部组成, 中盆腔由子宫、子宫颈和顶端阴道组成, 后盆腔由直肠、肛门和阴道的后部组成。盆底功能障碍(female pelvic floor dysfunction, FPFD)是包括盆腔器官脱垂、尿失禁、便失禁及性障碍等常见于产后女性的疾病, 患病率随着年龄和体重的增加而升高, 在 50 岁以上女性中约有一半受此病困扰, 并对其生活质量及身心健康产生重大影响[1] [2] [3]。仅进行病史询问和体格检查并不足以准确评估 FPFD, 盆底影像学检查对于准确诊断盆底功能障碍机制和评估受累结构至关重要。几种成像方式可用于盆底评估, 包括透视、磁共振(magnetic resonance imaging, MRI)、计算机断层扫描(computed tomography, CT)和盆底超声[4] [5]。如今, 盆底三维超声已发展成为一种研究盆底功能解剖学的热门方式, 能更有效地评估盆底肌收缩功能, 并为临床提供骨盆底三个盆腔的动态可视化图像[6]。在本文中, 我们将对盆底三维超声检查及相关的新技术在 FPFD 及评估盆底肌收缩功能方面做一综述。

2. 盆底超声

盆底超声是一个包含多种技术的术语, 这里我们主要对盆底三维超声进行讨论。该超声检查方式是将探头放置在患者会阴部位, 使用高频声波提供盆腔肌肉和相关结构的可视化, 以产生盆腔内部的立体三维图像[7]。随着计算机技术的发展使得在盆底超声中使用更先进的技术成为可能, 包括: 容积渲染、融合成像、运动跟踪和彩色矢量映射及超声盆底测压等, 辅助用于对尿道、肛提肌、阴道旁支架、脱垂、盆底重建和尿失禁植入物可视化进行成像[8] [9] [10]。

3. 容积渲染

容积渲染是一种三维超声数据可视化技术, 通过医学成像技术生成的数据进行三维重建, 以产生更详细的盆底解剖结构图形, 为诊断提供更多的空间信息和可视化的三维解剖结构, 允许更容易地对盆底复杂形状的解剖结构进行观察和分析[11]。此外, 该技术提供了获得矢状切面、横切面、冠状切面和任何所需切面图像的机会。通过任意旋转图像, 使超声医生能够在任何切面上直接对距离、面积、角度和体积等进行测量, 为定量分析盆底肌收缩功能提供了可能[12]。在 Egorov 等人[13]的研究中, 容积渲染已被用于研究 42 名未产妇和 54 名盆腔器官脱垂妇女的骨盆底, 将提肌裂隙面积、提肌裂隙前后直径、提肌裂隙左右径 3 个指标为参考, 观察两组患者提肌裂孔、耻骨、直肠和盆腔器官的大小和位置。盆腔脱垂组的提肌间隙被证明具有更大的前后径(7.4 cm vs 4.5 cm), 更高的球形度(0.91 vs 0.65), 并且其轴线偏离骨盆底(47° vs 22°)。

4. 融合成像

融合成像是一种融合了两种不同成像方式的技术。实时盆底三维超声检查通常与其它成像技术融合, 如 CT、MRI 和正电子发射断层扫描(positron emission computed tomography, PET)。这种方式能够弥补一种方法的缺陷, 并保持另一种方法的优点: 它允许直接比较病变, 更精确地监测介入手术并提高诊断信心[14]。例如, 在 Egorov 等人[15]的研究报道, 证实了阴道触觉成像和盆底三维超声图像融合的成像性能和临床价值, 使女性骨盆底的生物力学表征成为可能。触觉成像可直接作用于盆底软组织, 将触觉转化为数字图像信息提供了女性骨盆底的生物力学映射, 这些信息参数主要包括: 盆底组织的体积、形态、杨氏模量、剪切波弹性值及流动性等, 以量化组织弹性, 盆腔支撑和盆腔肌肉功能。它允许高分辨率的压力映射, 并评估阴道内盆底肌的力量, 以帮助临床对盆底肌收缩功能的进行分析。

5. 运动跟踪和彩色矢量映射

运动跟踪是评估组织和器官生物力学特性的一种方式, 它可以帮助了解盆腔器官、肌肉、韧带和结缔组织之间复杂的功能相互作用。彩色矢量映射是对于运动的不同可视化技术, 包括: 基于颜色的可视化、基于位移矢量的长度值和基于矢量的可视化, 其中箭头表示移动物质的长度和空间方向。它们可为盆底提供定量测量及分析, 例如骨盆底肌肉的位移、速度、加速度、运动、轨迹和拉伤等。在 Peng 等人[16]的研究中, 为 22 名无症状女性和 9 名患有压力性尿失禁的女性使用分析肛直角骨盆底肌肉的动力学参数, 研究发现两者之间的动力学参数差异具有统计学意义。此外, Lucente 等人[17]研究表明, 运动跟踪和彩色矢量映射可用于评估术前和术后压力性尿失禁女性阴道内盆底肌收缩功能。

6. 超声盆底测压

超声盆底测压是在盆底三维超声的基础上结合通过压力计测量阴道内盆底肌收缩期间产生的压力变化情况来反应骨盆底肌肉的状态, 较高的压力区域用红色表示, 较低的压力区域用蓝色表示, 对于评估女性盆底肌收缩功能非常有用[18]。有关研究表明[19], 将盆底测压与超声成像相结合, 可在盆底肌肉的三维超声图像上标记出阴道高压区并分析其静态和动态特性, 可以更好地研究骨盆底肌肉并能对其收缩功能进行评估。

7. 弹性成像

超声弹性成像是一种很有前途的成像技术, 用于确定需要定量分析的 FPDF 患者的盆底肌群软硬度。该技术可以量化组织的弹性和硬度, 并且可用于评估骨盆底生物力学。Zhong 等人[20]将弹性成像用于评

估 Valsalva 运动前后盆腔器官脱垂 I/II 期患者的盆底肌收缩功能以及产后盆底的肛提肌撕脱损伤进行定量分析。Abe-Takahashi 等人[4]运用盆底超声结合实时弹性成像比较间质性膀胱炎(IC)、膀胱疼痛综合征(BPS)患者和健康女性之间的骨盆底肌肉弹性差异性。通过这项技术,他们表明 IC 和 BPS 患者在静息状态下盆底肌的弹性值及盆底收缩功能比健康女性显著降低。

8. 展望

女性骨盆底是人体最复杂的区域之一,正确诊断特定的盆底疾病并非易事。盆底超声成像为骨盆底区域的分析提供了一种非常有效的方法,这得益于容积渲染、融合成像、运动跟踪和彩色矢量映射及超声盆底测压等超声技术的创新。未来随着更多盆底超声技术的发展,能够对构成骨盆底的器官、肌肉、结缔组织及 FPDF 提供更深入的信息,更好地为临床诊断和治疗提供帮助。

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