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COMPARING THE ACCURACY OF CONVENTIONAL US AND DOPPLER PLANIMETRY IN THE DETERMINATION OF BLADDER VOLUME IN POSTPARTUM WOMEN

Hypothesis / aims of study

Estimation of bladder volume by conventional 2D ultrasound (CUS) or 3D Doppler planimetry (DP) has replaced urinary catheterisation in many clinical settings including urology, neuro-urology, geriatrics and rehabilitative medicine. Nevertheless, urinary catheterisation (UC) remains the 'gold standard' as it gives the absolute volume, but is invasive and carries the risk of urinary infection. Voiding dysfunction is a common postpartum problem and unrecognised may lead to long-term lower urinary tract sequelae. While US evaluation is preferable in this setting there are several factors that interfere with the accurate assessment of bladder volume using US based techniques. With advances in ultrasound technology DP has been advocated as an accurate, user friendly, minimally invasive technique for the evaluation of postpartum residuals. There is paucity of clinical data however, to support this statement. The aim of this study was therefore to compare the accuracy of CUS versus DP for the assessment of postpartum bladder volume using in-out UC to determine the true volume.

Study design, materials and methods

50 postpartum women with an in-dwelling catheter were recruited day 1-2 postpartum. Prior to catheter removal a spigot was inserted for about an hour to allow accumulation of a reasonable volume of urine in the bladder. Bladder volume was first assessed by CUS using a 3.5MHz curvilinear transducer (UroSonic™ scanner, Mediwatch, UK). Measurements were taken in three planes corresponding to the axes of the bladder, to calculate bladder volume. The bladder volume was then assessed by DP (BladderScan™ BV3000, Diagnostic Ultrasound, USA). The scan-head was applied suprapubically, two fingerbreadths above the superior margin of the pubis symphysis, or at the Pfannenstiel incision, and directed towards the sacrum. Six readings were taken. The BladderScan™ BVI 3000 rotary 2MHz transducer captured twelve cross-sectional planes at 15degree increments to construct a 3D bladder model before computed its volume. The bladder was then emptied immediately by manual aspiration with a 60ml bladder washout syringe. The uterine volume was then calculated to evaluate its role as a confounding factor, using three axes (longitudinal, anteroposterior and transverse). The transverse distance between the two anterior superior iliac spines and the hip circumference at the level of the ASIS were also measured. Data was analysed according to the method of estimation: CUS1 - using formula L x T x AP x 0.52 (Griffiths 1986), CUS2 - using formula 4/3 x pi xT x AP^2 x 1.23 (UroSonic™ scanner), CUS3 (formula modified from Hendrikx), mean and maximum DP volume (DPV), derived from six BladderScan™ estimates.

Results

Of the 50 women recruited 62% had undergone emergency caesarean section (CS), 22% elective CS, 10% ventouse, 4% forceps and 2% normal vaginal delivery. Mean age was 30.6 yrs(R17-42) and mean parity 1(R1-3). The mean time interval between delivery and catheter removal was 1395mins(R352-4441). The mean uterine volume (estimated by 0.5 x volume of parallelogram) was 1055cm^3(R468-1954). The mean true bladder volume (TVol) at UC was 252mls(R13-950). Logarithmic transformation of data was necessary as the volume measurements were not distributed normally. The volumes estimated by the CUS and DP were correlated with the Tvol, and the test reliability was ascertained by the intraclass correlation coefficient. CUS1 correlated better with the TVol ($r=0.7800$, $P<0.001$) compared to CUS3 ($r=0.7762$, $P<0.001$), CUS2 ($r=0.7223$, $P<0.001$) or DPVmean ($r=0.4230$, $P<0.001$) and DPVmax ($r=0.3226$, $P=0.0119$). The mean error of each reading (DPVol – TVol) was (-)25ml [(SD+/-175), R(-)623-(+)421] and the mean percentage error was 73% (SD+/-210, R(-)92-(+)1200). The DP technique tended to over-estimate with smaller bladder volumes but accuracy improved with larger bladder volumes. The internal consistency summarised by the Guttman split half coefficient was $r=0.7324$. No correlation was found between the percentage

error and either the abdominal girth or uterine size, although as the latter increased, the percentage error tended to increase as well (Pearson's r=0.491, P<0.001).

Interpretation of results

Urinary catheterisation remains the 'gold standard' for evaluating postpartum residual bladder volume. CUS performed better than the DP. The most consistent formula was CUS1. The reliability of the CUS technique is affected by the irregular bladder shape, and the difficulty in defining the actual bladder edge (because of either pelvic adiposity or postpartum bladder wall oedema). Maternal abdominal adiposity may also be a confounding factor as it rendered it difficult to accurately delineate the bladder edge. The DP technique failed to address the CUS weaknesses. The reduced suprapubic-abdomen angle from the increased thickness of the abdominal wall made it difficult to place the scan-head optimally, thereby affecting bladder localization by the DP.

Concluding message

We failed to validate the use of Doppler planimetry (by the BladderScan™ BV3000) for the assessment of postpartum urinary volume. Although bladder volume assessment using CUS was more comparable, the need for training limits its routine use by allied health professionals.