

Prolapse assessment supine and standing: do we need different cutoffs for “significant prolapse”?

Nuria-Laia Rodríguez-Mias^{1,2} · Nishamini Subramaniam² · Talia Friedman² · Ka Lai Shek² · Hans Peter Dietz²

Received: 31 January 2017 / Accepted: 10 April 2017 / Published online: 25 April 2017
© The International Urogynecological Association 2017

Abstract

Introduction and hypothesis Translabial ultrasound (TLUS) has shown good correlations between clinical examination and imaging findings in the supine position, and limits of normality have been described. This is not the case for imaging in the standing position. This study was designed to test the hypothesis that different cutoff values are required for imaging in the standing position.

Methods This was a retrospective study carried out in a tertiary urogynecological unit in women presenting with symptoms of lower urinary tract and pelvic floor dysfunction between August 2013 and December 2015. All women underwent a standardized interview, 4D TLUS and a POP-Q assessment. Organ descent on ultrasound was measured relative to the postero-inferior margin of the symphysis pubis (SP) on maximal Valsalva in the supine and standing positions. Receiver operator characteristic (ROC) statistics were used to determine optimal cutoffs for “normal” pelvic organ support.

Results We assessed 243 data sets. Mean patient age was 57 years. Prolapse symptoms were reported by 59.2%, and POP of stage ≥ 2 was found in 82.3%. On analysing imaging data sets obtained in the standing position, we obtained similar cutoff values to those established previously for supine imaging, using ROC statistics. The levator hiatus distended significantly more on Valsalva in the standing position compared

with supine, and on ROC analysis we identified a new optimal cutoff of 29 cm².

Conclusions Established cutoffs for supine imaging of organ descent are suitable for imaging in the standing position. Hiatal distensibility may require a higher cutoff of 29 cm².

Keywords Cystocele · Female pelvic organ prolapse · Hiatal area · Rectocele · Ultrasound · Uterine prolapse

Introduction

The clinical assessment of female pelvic organ prolapse (POP) involves observation of organ descent during a Valsalva manoeuvre according to a standardised method, the Pelvic Organ Prolapse Quantification (POP-Q) [1]. For practical reasons the patient is assessed in the supine position, even though it is generally accepted that organ support is more adequately tested in the standing position [2]. Some authors have claimed that poor associations between symptoms of prolapse and clinical findings may be because the latter are obtained supine rather than standing [3].

Translabial ultrasound (TLUS) is an alternative method to the clinical assessment of prolapse. Pelvic organ descent evaluated on ultrasound has shown good correlations with symptoms of prolapse and standardised prolapse quantification (POP-Q) [4–6], with ultrasound organ descent quantified against the inferior symphyseal margin [7]. For technical reasons, assessment in the standing position is easier than on clinical examination, and this is sometimes necessary when patients are unable to perform a proper Valsalva manoeuvre [8].

To help to define whether a certain degree of POP is clinically relevant, cutoffs for significant pelvic organ descent on the basis of prolapse symptoms have been defined. Descent of the bladder to ≥ 10 mm, the rectum to ≥ 15 mm below the

✉ Nuria-Laia Rodríguez-Mias
nuromi@gmail.com

¹ Department of Obstetrics and Gynecology, Hospital Universitari Vall d’Hebrón, Universidad Autónoma de Barcelona, Passeig de la Vall d’Hebrón, 119–129, 08035 Barcelona, Spain

² Department of Obstetrics and Gynecology, Sydney Medical School Nepean, University of Sydney, Penrith, Australia

symphysis pubis (SP) and the cervix descending to ≥ 15 mm above the SP have been proposed as cutoffs for the diagnosis of significant prolapse on the basis of ROC statistics [4, 9]. The levator hiatus on Valsalva is deemed to be normal if <25 cm² on Valsalva, both on the basis of data in young nulliparous women and on the basis of ROC statistics in symptomatic women [8].

However, it is likely that established cutoffs for “normal pelvic organ support” on imaging may have to be modified for imaging in the standing position. In other words, a given degree of organ descent measured on imaging may be “abnormal” in the supine, but “normal” in the standing position.

The relationship between organ descent and symptoms of prolapse may depend on the position in which the examination is carried out. Several studies have been published regarding the influence of the patient’s posture on pelvic floor ultrasound parameters [10–13], but such studies have been limited to bladder descent, without attempting to define “normality”, that is, the optimal cutoff for the identification of the degree of organ descent that is likely to lead to symptoms of prolapse. The aim of this study was to determine whether established cutoff values for supine imaging of organ descent are equally valid for imaging performed in the standing position.

Materials and methods

We retrospectively analysed the data of 243 women seen in a tertiary urogynecological unit for symptoms of lower urinary tract and/or pelvic floor dysfunction during two separate time periods, from August 2013 to February 2014 and between October and December 2015. All patients underwent a standardised interview, which included questions regarding urinary incontinence, prolapse, voiding dysfunction, frequency, nocturia, obstructed defecation, anal incontinence, recurrent urinary tract infections and pad use. Lifestyle impact was quantified with the help of a visual analogue scale (VAS) used for the main symptoms. A clinical examination was then performed using the International Continence Society Pelvic Organ Prolapse Quantification (ICS POP-Q) [1] system, in addition to a 3D/4D TLUS in supine and standing positions using a GE Kretz Voluson 730 Expert system (GE Medical Systems, Zipf, Austria) as previously described [14]. The patient was standing upright, with the operator kneeling to the side of the patient and holding the transducer to her perineum. The order of assessment (supine or standing first) was changed every 50 patients. The person performing ultrasound data acquisition was blinded to the patient’s history, but not to clinical findings. The person performing post-processing analysis of stored ultrasound volume data sets obtained in the standing position was blinded against history and all clinical findings. A test–retest series for all ultrasound parameters was conducted before analysis and showed good interobserver

agreement. The main outcome measure was “symptoms of prolapse”, which was ascertained using standardised questions and defined as a “sensation of a lump or bulge” and/or a “dragging sensation in the vagina”.

Offline analysis of stored ultrasound volumes obtained in the standing position was performed at a later date and blinded against all other data, on a desktop personal computer using the proprietary software 4D View v 10 (GE Kretz Ultrasound, Zipf, Austria). Ultrasound measurements of pelvic organ descent (cystocele, uterine descent, descent of the rectal ampulla) were performed against a horizontal line placed through the inferior symphyseal margin, giving the maximal caudal position on Valsalva, without any reference to position at rest. On ultrasound, prolapse below the SP is given a negative reading, while the ICS POP-Q returns positive measurements. Hence, bladder descent to 5 cm below the SP (–5 cm) is equivalent to approximately $Ba = +3$ [7]. Hiatal area on Valsalva was measured in rendered volumes, as previously described [15]. All measurements were performed on volume data sets obtained on maximal Valsalva in the supine and standing positions. Levator avulsion was diagnosed on multi-slice or tomographic imaging as previously described [16].

Two-sample t test was used to test the association between pelvic organ descent on TLUS and symptoms of POP; $p < 0.05$ was considered significant. Using symptoms of prolapse (i.e., the sensation of a vaginal lump or bulge or a dragging sensation) as the outcome parameter to be predicted, cutoffs for “abnormal” pelvic organ descent were determined using ROC statistics, aiming for optimal sensitivity and specificity. Our null hypothesis was: “Translabial ultrasound imaging in the standing position does not require different cutoffs for the definition of ‘normal pelvic organ descent (that is, descent unlikely to lead to symptoms of prolapse) compared to imaging in the supine position”. Statistical analysis was undertaken using SPSS v.20 (SPSS, Inc., Chicago, IL, USA). This study was approved by the institutional Human Research Ethics Committee (Reference No: 14–022).

Results

Two hundred and forty-three women were assessed during the study period; 5 were excluded because of missing TLUS volume data sets, leaving 238 patients for analysis. Mean patient age was 57 years (range 17–89, SD 13.8), mean parity was 3 (range 0–8, SD 1.5), and in 21.9% ($n = 39$) there was a history of forceps delivery. Seventy-nine patients (33%) reported a previous hysterectomy by any route. Mean BMI was 29 kg/m² (range 16–53, SD 6.3) and 58.4% ($n = 139$) were menopausal. Among 238 patients, 70.2% ($n = 125$) complained of stress urinary incontinence, and 66.8% ($n = 119$) of urge urinary incontinence. Prolapse symptoms were reported by 59.2% ($n = 141$).

On examination, clinically significant prolapse (i.e. POP-Q stage ≥ 2 in the anterior and posterior compartments or POP-Q stage ≥ 1 in the central compartment) [5] was found in 82.3% ($n = 196$). Levator avulsion was diagnosed by tomographic ultrasound in 36.1% ($n = 86$). On TLUS, offline analysis of volumes obtained on maximal Valsalva in the standing position, the bladder neck descended on average to 11.5 mm below the SP, that is, to -11.5 mm (range $+ 5.6$ to -28); mean uterine descent was to 9.7 mm above the SP, that is, to $+9.7$ mm (range $+ 25.5$ to -6.1) and mean rectal ampulla descent to -15.8 mm (range $- 1.7$ to -29.8). Mean levator hiatal area was 32.3 (range 24.6 to 40) cm^2 . Volume data obtained in the supine position were not evaluated for this study.

Table 1 shows the association between symptoms of prolapse and POP measurements on Valsalva in the standing position. Uterine descent measurements were obtained in the 159 women who had not previously undergone a hysterectomy. Symptoms of prolapse were significantly associated with cystocele (-11.5 mm vs 0.5 mm; $p < 0.001$), uterine descent (9.7 mm vs 15.3 mm; $p = 0.005$), rectal ampulla descent (-15.8 mm vs -10.9 mm; $p = 0.009$), and levator hiatal area (32.3 mm vs 26.8 mm; $p < 0.001$).

Using ROC statistics (see Fig. 1) we established optimal cutoffs of -10 mm (i.e. 10 mm below the SP) for bladder descent, $+15$ mm (i.e. 15 mm above the SP) for uterus descent, -15 mm (i.e. 15 mm below the SP) for rectal ampulla descent and 29 cm^2 for levator hiatal area. The area under the curve (AUC) obtained was 0.698, 0.593, 0.635 and 0.706 for cystocele, uterine descent, rectal ampulla descent and levator hiatal area respectively. Similar results were obtained when

ROC statistics were repeated after excluding women who reported previous incontinence and/or prolapse surgery.

Hence, our null hypothesis for organ descent could not be disproven. Measurements obtained in the standing position can be assessed using established definitions of normality. However, this is not the case for hiatal distension. A hiatal area on Valsalva of 29 cm^2 was found to be the optimal cutoff when imaging is performed in the standing position.

Discussion

In this study, we attempted to determine whether cutoffs for “normal pelvic organ support” previously defined for the supine position [4, 9] need to be modified if imaging is performed with the patient standing. This does not seem to be the case. Although all organs descend slightly further, that is, to a lower position, in the standing patient, this effect is too small to alter ROC statistics for the definition of optimal cutoffs. Hence, established cutoffs for organ descent can be used on imaging data obtained in the standing position. This is not the case for hiatal dimensions for which a higher cutoff of 29 cm^2 may be more appropriate.

Imaging and clinical assessment for POP are almost universally performed with the patient supine for reasons of practicality and expediency, although it has been postulated that the standing position may offer a more accurate assessment of pelvic organ support because prolapse symptoms are generally only perceived when the patient is standing [17].

There are limited data on the assessment of pelvic organ support in the standing position, as this posture can be quite

Table 1 The association between measurements on standing Valsalva and symptoms of female pelvic organ prolapse

TLUS measurements on standing Valsalva	Symptoms of prolapse		OR (95% CI) <i>p</i> value	AUC
	Mean (SD) cm			
	Yes	No		
Cystocele (mm)	-11.5 (17.1)	0.5 (13.27)	0.95 (0.93–0.97) <0.001	0.70
Uterine descent (mm) ^a	9.7 (15.86)	15.3 (13.82)	0.97 (0.958–0.99) 0.005	0.59
Rectal ampulla (mm)	-15.8 (14.08)	-10.9 (13.43)	0.97 (0.95–0.99) 0.009	0.64
Hiatal Area (cm^2)	32.3 (7.72)	26.8 (6.79)	1.11 (1.06–1.16) <0.001	0.71

Analysed using univariate binary logistic regression test and ROC curve. Results and data expressed as mean (SD), odds ratio (95% CI) and area under the curve (AUC)

^a Analysis performed on 159 women who had not undergone hysterectomy

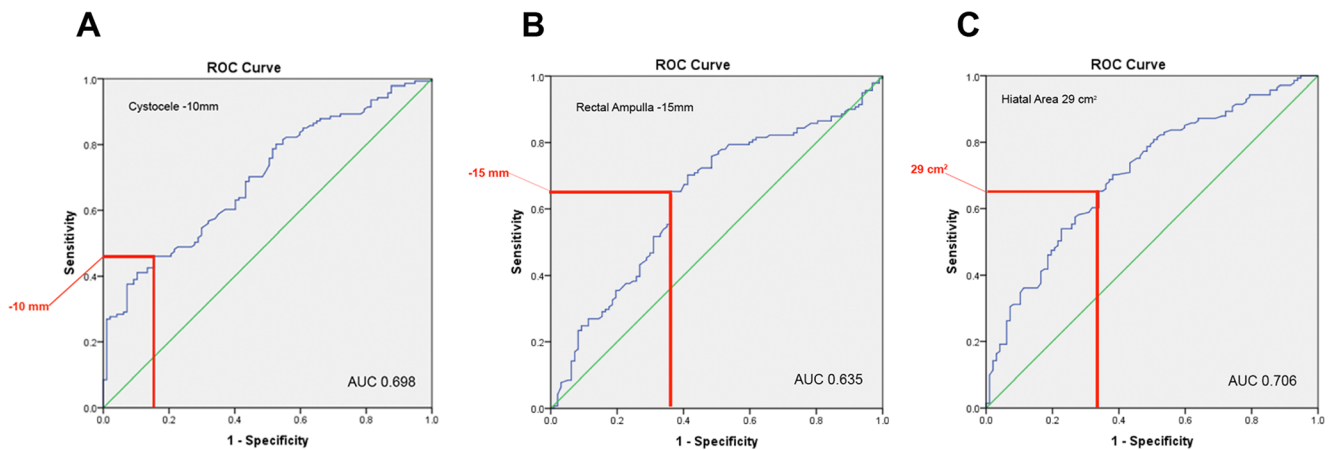


Fig. 1 Receiver operating characteristic (ROC) curves showing the association between symptoms of prolapse and organ descent (**a** bladder, **b** uterus, **c** rectal ampulla). AUC area under the curve

awkward for both the patient and the physician, and it needs special skills to obtain precise measurements. Some authors have reported significantly greater organ descent in the standing position [17–19], whereas others have found the opposite [20]. Some of the differences between those studies may be due to power issues and definitions, as it is highly likely that organs would descend further once gravity adds to the loads placed on supportive tissues. More importantly, it appears that neither author attempted to define “normal” organ support, that is, organ support that is unlikely to lead to symptoms of prolapse.

This is an issue that some of the authors of this current study have been interested in for many years. In the past, we have defined optimal cutoffs, that is, values that can be utilised as a definition of the limits of “normal pelvic organ support”, both on imaging [4, 21] and on clinical examination [22]. These were defined on POP-Q as Ba and Bp at -0.5 , C at -5 on, and bladder at 10 mm below the SP, uterus at 15 mm above the SP and rectal ampulla at 15 mm below the SP on ultrasound imaging. However, it is understood that all those values apply to assessment in the supine position, which is why we carried out this study.

In our study population, it appears that established cutoffs for supine imaging of the descent of the bladder and rectal ampulla are suitable when performing imaging in the standing position. A supine Valsalva seems highly effective in that the additional load generated by imaging in the standing position does not seem to greatly increase organ descent. This is not the case for hiatal distensibility, for which we propose a higher cutoff when determined in the standing position. We hypothesize that this may be because muscle biomechanical properties can be confounded by cortical activity, resulting in more optimal distension when loaded in the standing position.

There are several strengths of this study that should be considered. It was conducted using a 4D ultrasound system based on a highly reproducible ultrasound methodology in a

large data set and with a standardised technique. Real-time ultrasound assessment of prolapse allows the observation and exclusion of a number of confounders such as bladder filling [22] and levator co-activation. The storing of cine loops of volume data sets allows an evaluation that is fully blinded against symptoms and clinical characteristics. On the other hand, there are some weaknesses that should be acknowledged. This is a retrospective study based on symptomatic patients referred to a tertiary urogynecological unit, and most of them were of Caucasian origin. Hence, our results may not be representative of other jurisdictions and/or the general population. It might also be argued that the use of validated questionnaires may have been preferable to a physician-directed interview. In addition, previously defined cutoffs for “significant prolapse” were established in a different population, although performed in the same clinic and in women with similar demographic characteristics.

In conclusion, it appears that established cutoffs for supine imaging of organ descent are suitable for the analysis of imaging performed in the standing patient. Assessment in the standing person does not yield substantially altered diagnostic performance. Hence, we agree with Swift et al. [20] in that an optimal supine Valsalva effort should be sufficient to result in maximal or near-maximal organ descent. In our view, assessment in the standing position can be limited to those patients in whom a supine examination is clearly sub-optimal because of poor effort or levator co-activation, or in whom there is a substantial discrepancy between symptoms and clinical findings.

Compliance with ethical standards

Conflicts of interest H.P. Dietz has received unrestricted educational grants from GE Medical. The remaining authors declare that they have no conflicts of interest.

References

- Bump RC, Mattiasson A, Bo K, Brubaker LP, DeLancey JO, Klarskov P, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol.* 1996;175(1):10–7.
- Barber MD, Cundiff GW, Weidner AC, Coates KW, Bump RC, Addison WA. Accuracy of clinical assessment of paravaginal defects in women with anterior vaginal wall prolapse. *Am J Obstet Gynecol.* 1999;181(1):87–90.
- Shull BL, Hurt G, Laycock J, Palmtag H, Yong Y, Zubieta R. Physical examination. Abrams L, Cardozo S, Khouryand AW, editors. *Incontinence. 2nd International Consultation on Incontinence, Paris, 1–3 July 2001.* Plymouth: Health Publications; 2002. p. 373–388.
- Dietz HP, Lekskulchai O. Ultrasound assessment of pelvic organ prolapse: the relationship between prolapse severity and symptoms. *Ultrasound Obstet Gynecol.* 2007;29(6):688–91.
- Dietz H, Kamisan Atan I, And AS. The association between ICS POPQ coordinates and translabial ultrasound findings. *Ultrasound Obstet Gynecol.* 2016;47(3):363–8.
- Dietz HP, Mann KP. What is clinically relevant prolapse? An attempt at defining cutoffs for the clinical assessment of pelvic organ descent. *Int Urogynecol J.* 2014;25(4):451–5.
- Dietz HP, Haylen BT, Broome J. Ultrasound in the quantification of female pelvic organ prolapse. *Ultrasound Obstet Gynecol.* 2001;18(5):511–4.
- Dietz HP. Pelvic floor ultrasound in prolapse: what's in it for the surgeon? *Int Urogynecol J.* 2011;22(10):1221–32.
- Shek KL, Dietz HP. What is abnormal uterine descent on translabial ultrasound? *Int Urogynecol J.* 2015;26(12):1783–7.
- Mouritsen L, Bach P. Ultrasonic evaluation of bladder neck position and mobility: the influence of urethral catheter, bladder volume, and body position. *Neurourol Urodyn.* 1994;13(6):637–46.
- Schaer GN, Koechli OR, Schuessler B, Halley U. Perineal ultrasound: determination of reliable examination procedures. *Ultrasound Obstet Gynecol.* 1996;7(5):347–52.
- Dietz HP, Clarke B. The influence of posture on perineal ultrasound imaging parameters. *Int Urogynecol J.* 2001;12(2):104–6.
- Peng Q, Jones R, Shishido K, Constantinou CE. Ultrasound evaluation of dynamic responses of female pelvic floor muscles. *Ultrasound Med Biol.* 2007;33(3):342–52.
- Dietz HP. Ultrasound imaging of the pelvic floor. II. Three-dimensional or volume imaging. *Ultrasound Obstet Gynecol.* 2004;23(6):615–25.
- Dietz HP, Wong V, Shek KL. A simplified method for determining hiatal biometry. *Aust N Z J Obstet Gynaecol.* 2011;51(6):540–3.
- Dietz HP, Bernardo MJ, Kirby A, Shek KL. Minimal criteria for the diagnosis of avulsion of the puborectalis muscle by tomographic ultrasound. *Int Urogynecol J.* 2011;22(6):699–704.
- Barber MD, Lambers A, Visco AG, Bump RC. Effect of patient position on clinical evaluation of pelvic organ prolapse. *Obstet Gynecol.* 2000;96(1):18–22.
- Visco AG, Wei JT, McClure LA, Handa VL, Nygaard IE, Pelvic Floor Disorders Network. Effects of examination technique modifications on pelvic organ prolapse quantification (POP-Q) results. *Int Urogynecol J.* 2003;14(2):136–40.
- Silva WA, Kleeman S, Segal J, Pauls R, Woods SE, Karram MM. Effects of a full bladder and patient positioning on pelvic organ prolapse assessment. *Obstet Gynecol.* 2004;104(1):37–41.
- Swift SE, Herring M. Comparison of pelvic organ prolapse in the dorsal lithotomy compared with the standing position. *Obstet Gynecol.* 1998;91(6):961–4.
- Dietz HP, Wilson PD. The influence of bladder volume on the position and mobility of the urethrovesical junction. *Int Urogynecol J.* 1999;10(1):3–6.
- Ornö AK, Dietz HP. Levator co-activation is a significant confounder of pelvic organ descent on Valsalva maneuver. *Ultrasound Obstet Gynecol.* 2007;30(3):346–50.