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ORIGINAL ARTICLE

Temporal latency between pelvic floor trauma and presentation for prolapse surgery: a retrospective observational study

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Abstract
Introduction and hypothesis Levator avulsion is an etiological factor for female pelvic organ prolapse (POP) and generally occurs during a first vaginal birth. However, most women with POP present decades later. This study aimed to estimate latency between pelvic floor trauma and presentation for POP surgery.
Methods This was a retrospective observational study in a tertiary urogynecological unit to which 354 patients presented for evaluation prior to prolapse surgery between June 2011 and December 2012. All underwent an interview, clinical assessment [International Continence Society Pelvic Organ Prolapse Quantification score (ICS POPQ) and 4D translabial ultrasound (US). Postprocessing analysis of US volumes was blinded against clinical data. The main outcome measure was temporal latency between first vaginal birth and prolapse presentation in women with levator avulsion.
Results Three hundred and fifty-four patients presented with symptoms of prolapse, of whom 115 (32 %) were found to have an avulsion of the levator ani muscle. Of these, 30 patients were excluded due to previous prolapse surgery, leaving 85, all of whom showed significant prolapse on US and/or clinical staging. Mean latency between first vaginal delivery and presentation was 33.5 (3–66.3) years. There were no associations between latency and potential predictors, except for maternal age at first birth, which was associated with shorter latency ($r=-0.45$, $P<0.001$). There was a trend toward shorter latency after forceps delivery ($P=0.09$).
Conclusions Average latency between first birth and presentation for prolapse surgery in women with avulsion was 33.5 (3–66) years. Maternal age at first vaginal birth and possibly forceps delivery were associated with shorter time to presentation.

Keywords Birth trauma · Levator ani · Pelvic organ prolapse · Ultrasound

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Introduction

Female pelvic organ prolapse (POP) is a significant burden on women. It affects more than half of all women to some degree, and the lifetime risk of undergoing surgery for the condition may reach 20 % [1]. The condition commonly presents with a sensation of vaginal fullness, heaviness, or dragging. The patient may notice a vaginal or uterine protrusion, and POP may be associated with bladder, bowel, and sexual dysfunction [1, 2].

The exact etiology of POP is yet to be determined. Factors that have been associated with POP include obesity, age, delivery mode, race, chronic increased intra-abdominal pressure, ageing, and menopause [2–4]. There is strong evidence to support the role of trauma during vaginal childbirth as a contributing factor to the development of the disorder [2, 5]. In particular, avulsion of the levator ani muscle has been identified as a major contributing factor [6–9] and commonly occurs during the first vaginal delivery [10, 11], yet women often do

not present with prolapse symptoms until decades after this traumatic event. Very little is currently known about the nature or reasons for this delay. The "ship-in-the-dock" theory hypothesized by DeLancey provides a possible explanation for the extended time period between the initial traumatic event and presentation of the disorder [12].

The aim of this study was to determine the range and the average latency period between trauma to pelvic organ support structures resulting from vaginal childbirth and presentation for prolapse surgery. We used avulsion as the only evidence of childbirth-related trauma that has unequivocally been linked to POP in order to maximize the probability of those women suffering from childbirth-related—rather than congenital or otherwise acquired—prolapse. The study also sought to determine whether the mean latency period was extended or shortened by various factors, such as maternal body mass index (BMI), age, and the use of forceps during delivery.

Methods

This was a retrospective observational study using data sets of 354 women seen between June 2011 and December 2012 at a tertiary urogynecological unit for urodynamic assessment as part of their workup prior to planned prolapse surgery. Symptoms of POP were defined as "a dragging sensation in the vagina" and/or "the sensation of a lump or bulge in the vagina" ascertained by standardized, nonvalidated interview by the senior author. Each patient was asked to score the bother of prolapse symptoms using a visual analog scale (VAS) from 0 to 10. Clinical assessment for POP was performed using the International Continence Society (ICS) Pelvic Organ Prolapse Quantification (POP-Q) grading system. All patients underwent 3D/4D translabial pelvic floor ultrasound (US) using a GE Kretz Voluson 730 Expert system with 8–4-MHz curved array volume transducer (GE Medical Systems, Zipf, Austria). Data was obtained with the patients lying supine after bladder emptying. Volumes were acquired at rest, upon Valsalva, and upon pelvic floor muscle contraction using methods previously described [13]. At least three US volumes were acquired on Valsalva maneuvers. The one with the greatest pelvic organ descent was used for analysis. Significant clinical prolapse was defined as International Continence Society (ICS) POP-Q stage 2 or greater. Significant prolapse on US was defined as a cystocele 10 mm or more below a horizontal reference line placed through the inferoposterior symphyseal margin; uterine descent or enterocele to or below the same reference line, and/or descent of the rectal ampulla to 15 mm or greater below [14]. Levator avulsion was diagnosed using tomographic US imaging, as previously described [15] (Fig. 1).

US data sets were analyzed offline using the proprietary software GE Kretz 4D View version 10.0, blinded to all clinical data. Statistical analysis was performed using MINI TAB v.13 (Minitab Inc., State College, PA, USA) after testing for normality (Kolmogorov–Smirnov testing). Patients with previous prolapse and/or anti-incontinence surgery were excluded, as the latency in those women would have to be calculated as the time interval between the birth of their first child and presentation for their first surgical

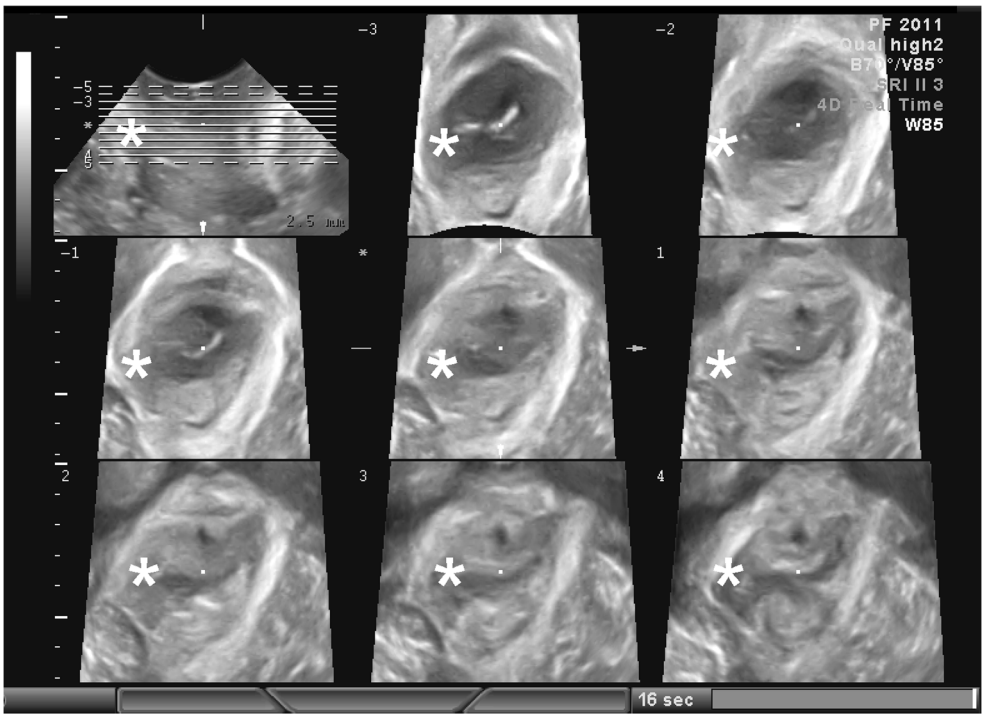

Fig. 1 Complete unilateral avulsion (*) in 45-year-old patient with symptomatic three-compartment prolapse 17 years after first vaginal delivery

intervention. This study was approved by the local human research ethics committee (NBMLHD HREC ref. 12–71). Due to the retrospective and low-risk nature of this study, we were not required to obtain patient consent. As this was a sample of convenience without power calculations, this may be regarded as a pilot study.

We used Pearson correlations and two-sample Student's *t* test to test associations between latency period and potential influencing factors, including maternal BMI, age at first delivery, genital hiatus and perineal body measurements on Valsalva, the use of forceps during delivery, and the subjective severity of bother.

Results

Six hundred eighty-one patients were assessed between June 2011 and December 2012. Of these, 354 (52 %) presented with symptoms of prolapse, with a mean rating of bother of 5.8/10 [2.8 standard deviation (SD)]. One hundred and fifteen (32 %) of those were found to have a full avulsion of the levator ani muscle: 70 were unilateral; 45 were bilateral. There were 43 women with avulsion who did not present with a symptomatic prolapse and hence were not included in the analysis. All 115 women with avulsion and symptoms of prolapse were shown to have significant prolapse on US and/or ICS POP-Q staging. Of the 115, 30 had a history of surgery for urinary incontinence or prolapse and were therefore excluded from analysis, leaving 85 in the study. The following analysis pertains to these 85 women.

Mean age was 58 years (range 29–85; SD13), mean BMI was 27 (SD 5.2), and mean bother was 6/10. Eighty-three (98 %) were vaginally parous. Of the remaining two patients, one had been delivered by cesarean section after a failed forceps, and one was reported to be vaginally nulliparous. Mean vaginal parity was 2.8. Mean age at first vaginal delivery was 25 years (range 17–39; SD4.9). Forty-one (48 %) had a history of forceps delivery. Fifty-six (66 %) complained of stress urinary incontinence (SUI), 56 of urge incontinence (UUI) (66 %), and 33 of voiding dysfunction (39 %). On clinical examination, 84 women had significant prolapse. Cystoceles presented in 76, uterine prolapse in 25, enterocele in six, and rectocele in 61. Mean measurement of genital hiatus and perineal body (Gh + Pb) was 9.18 cm (SD 1.18). Significant prolapse on US was noted in 75 patients. Mean bladder descent was −19.2 mm (range 37.7 to −50.2 mm; minus signifies position below the symphyseal reference line), uterine descent 3.33 mm (35.9 to −51.1 mm), and rectal descent −12.6 mm (23.1 to −46.1 mm). Mean hiatal area on Valsalva was 38.2 cm^2 (SD8.75).

Mean latency between first vaginal delivery and presentation was 33.5 years (range 3–66.3 years, SD14), and this data was normally distributed. There were no significant associations between latency and BMI (P=0.64), severity of bother (P=0.68), or Gh + Pb measurement on Valsalva (P= 0.91). There was a trend toward shortened latency after forceps delivery (31.9 vs. 36.4 years, P=0.09). Higher maternal age at first delivery was strongly associated with a shorter latency (r=−0.45, P<0.001). There was no difference in latency between women with uni- and bitaleral avulsion, and associations with higher maternal age and forceps delivery were virtually identical for both groups. We also tested for latency in women without avulsion, and again, both mean latency (32.9 years) and associations with forceps (31.7 vs 34.9 years, P=0.13) and higher maternal age at first birth (r=−0.479, P<0.001) were very similar.

Discussion

Main findings

This study shows that the average latency period between the first vaginal birth and presentation with POP in women diagnosed with levator avulsion in this population was 33.5 years. However, we found a great variation between individuals in that the latency period ranged from 3 to 66 years. Of factors that could potentially influence the latency to presentation with POP, there was no effect of BMI, Gh + Pb measurement, or increased bother of POP. Forceps delivery had a trend towards shorter latency. There was also an interesting association between maternal age at first delivery and latency: the older a mother was at her first vaginal delivery, the shorter the latency period.

While we were principally interested in women with avulsion (as avulsion provides clear evidence of traumatic childbirth), the observed associations between latency and maternal age/forceps delivery also held true for women without avulsion, suggesting that delivery-related trauma also plays a role in those without levator tears, either due to hiatal overdistension, partial muscle tears, or fascial and neurological trauma.

Strengths and limitations

The primary strength of this study is that it is, to our knowledge, the first to investigate the time interval between traumatic delivery and presentation for prolapse surgery. However, the study is limited by its retrospective design. A prospective longitudinal study following up women after childbirth would be less subject to possible bias but would be at risk of high levels of loss to follow-up due to the long latency between childbirth and prolapse development. It should also be considered that the study estimated latency between first vaginal birth and time of presentation for surgery, instead of time to onset of POP or POP symptoms, and may therefore be

confounded by factors such as the individual's cultural beliefs and attitudes and ease of access to healthcare.

However, it is difficult to determine the exact timing of POP onset from patient history due to recall bias affecting retrospective estimates made by patients. Due to the likely gradual onset of the disorder, this would be difficult and is likely to be unreliable and biased. To circumvent this problem, we chose to use the time of presentation instead of time of onset in this study. Our results must therefore be interpreted with the knowledge that the latency period between trauma and POP onset will be different from the latency period between trauma and presentation with POP. Another issue is that women with prolapse also frequently exhibit other symptoms, such as urinary incontinence or voiding dysfunction, and our study design did not allow us to determine the contribution of different symptoms to the patient's eventual decision to present. In addition, some women with avulsion are likely to never develop or present with prolapse, which would suggest that our results may systematically underestimate mean or median latency. Other women develop prolapse without any signs of levator trauma, suggesting a different etiology not covered by this study. Many women with prolapse, whether with or without evidence of avulsion, require only conservative treatment, and such patients are not included in this study. Finally, the index assessment occurred in a tertiary urogynecological unit in preparation for prolapse surgery. It is highly likely that some (albeit likely a small proportion) of the latency described by us was caused by delays in subspecialist referral, waiting lists, and periods of conservative management.

Interpretation

It has long been recognized that there is an extended latency between trauma caused by vaginal birth and the time of presentation with POP. However, the length of this latency period has not been well studied. Understanding this period and the potential factors that may influence the timing of presentation may help with patient communication and education. It may also contribute to the body of knowledge regarding the condition's natural progress or course.

While we found an average latency of 33.5 years between first vaginal birth and presentation, it is interesting to note that there was a great interindividual variation of between 3 and 66 years. The development of POP is considered to be multifactorial [3]. The wide range of the latency period is consistent with this hypothesis. If multiple factors influence development of the disorder, then there are more variables that can affect the timing of presentation, thereby resulting in a greater variation in the latency period.

We observed an interesting association between maternal age at first delivery and the latency of presentation. The older a mother was at her first vaginal delivery, the shorter the latency period. The observation may be explained in several different ways. In more recent times, there is a trend for women to have their first child at an increasingly older age. Consequently, women who are older when they have their first delivery are more likely to have had their first delivery relatively recently. Those with a longer latency period from this group may not have had enough time to present, thus skewing the data. It may also be that there is a bias caused by generational attitudes and willingness to seek medical care. Young women, who are more likely to have their first delivery at an older age may be more willing to seek medical care and may present at an early stage of the disorder, thus shortening the latency period. However, this finding might not necessarily be the result of bias. It may be that a reduced latency period is an indicator of the increase in severity of trauma experienced by those having their first vaginal birth at an older age, which is consistent with studies showing higher maternal age being a risk factor for avulsion [16]. Furthermore, there was a trend toward a shortened latency period in women with a history of forceps delivery, which is shown to result in greater rates of pelvic floor trauma [17–20]. It is plausible that the trend may reflect a greater degree of trauma caused by forceps, which could be muscular, fascial, and/or neurovascular in nature.

Conclusion

The average latency period between the first vaginal birth and presentation with POP in women diagnosed with levator avulsion in this population was 33.5 years. This latency period ranged from 3 to 66.3 years. Increased maternal age was associated with a shorter latency period; however, it is unclear whether this is due to bias or indicative of a greater degree of trauma. There was a trend toward shortened latency after forceps delivery.

Conflict of interest H.P. Dietz received unrestricted educational grants from GE Medical. K.L. Shek received an unrestricted educational grant from GE Medical. Vanessa Thomas and R. Guzmán Rojas have no conflict of interest to declare.

Details of ethics approval The study was approved by the Human Research Ethics Committee of Nepean Blue Mountains Health District (NBMLHD 12-71)

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RGR: Access of reliability series; data analysis and Interpretation; drafting the article; and final approval of the version to be published.

HPD: Conception and design; data analysis and interpretation; drafting and critically revising the article for important intellectual content; and final approval of the version to be published.

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