Obstetrical ballooning and avulsion of levator ani muscle after vaginal delivery: a literature review


ABSTRACT

The levator ani muscle (LAM) is thought to be of central importance concerning pelvic organ support. 10-30% of women experience overstretched or ‘ballooning’ of the levator hiatus, sometimes followed by detachment or ‘avulsion’ of the muscle from its insertion. Both ballooning and avulsion of the LAM can occur by itself or co-exist at the same time. This literature review was conducted on multiple databases from previous studies, to help clinicians better understand the ballooning and avulsion phenomenon, thus making early diagnosis possible for earlier prolapse prevention for the patients. LAM avulsion can be diagnosed clinically using digital palpation or using imaging modalities such as ultrasound and magnetic resonance imaging (MRI). During maximal contraction (or at rest) using ultrasound, levator-urethra gap (LUG) diameter > 2.5 cm. MRI is considered highly sensitive, but it requires a higher cost and an experienced radiologist. Hiatal ballooning can be diagnosed by clinical examination based on the sum of Genital hiatus and Perineal body (Gh+Pb) and imaging with 2D, 3D, or 4D ultrasound during the Valsava maneuver. Ballooning is diagnosed clinically if Gh+Pb ≥ 7 cm, by 2D imaging of levator hiatal anteroposterior (LHAP) diameter ≥ 6 cm, and by 3D/4D imaging of the hiatal area ≥ 25 cm². Physiotherapeutic treatment and pelvic floor muscle (PFM) exercises can be used to treat ballooning and LAM avulsion to avoid urogynecological sequelae. There is some evidence to prevent this condition, including vitamin D consumption, epidural analgesia, kegel exercise, and vaginal dilator. PFM strength, posterior vaginal wall support, and ultrasound evidence of LAM tear can be used as potential indicators to predict pelvic floor injury. Since ballooning and avulsion of the LAM have lifelong morbidity and are not often identified early by clinicians, further research is still needed.

Keywords: avulsion, ballooning, levator ani muscle, vaginal delivery.

INTRODUCTION

During pregnancy, the woman’s body undergoes extensive changes to support the growing infant inside the uterus, giving strenuous mechanical force to the pelvic floor. The layers of musculature and connective tissue constructing the female pelvic floor must then open and expand for delivery. The trauma caused throughout gestation until delivery makes women vulnerable to postpartum pelvic floor dysfunction (PFD), such as pelvic pain, dyspareunia, urinary and fecal incontinence symptoms, and symptoms of organ prolapse.1 Due to stretching and weakening of the muscles and tissues in the pelvic region, pelvic organs (uterus, bladder, urethra, and bowel) might protrude into the vaginal canal, causing pelvic organ prolapse (POP).12

Elective cesarean delivery (CD) has been proposed as a solution to prevent POP.1 Recent research, however, indicates that pelvic organ prolapse is only partially prevented by elective cesareans. The maternal pelvic support was affected similarly by vaginal birth and cesarean delivery during active labor.4 This suggests that prolapse emerged during the first stage of labor rather than the second.5 Major women who experienced vaginal delivery are affected by some form of pelvic floor damage that alters functional anatomy.67 Thus, making the studies of pelvic organ support and its strengthening more important than ever.

Concerning pelvic organ support, the levator ani muscle (LAM) is thought to be of central importance. Recent research has suggested that the epidemiological link between childbirth and female pelvic organ prolapse may be explained by levator trauma. Patients with prolapse have a much higher likelihood of levator trauma, which nearly doubles the risk of significant prolapse (Grade 2 or higher). Depending on the size of the infant and the pelvic floor muscle opening, the LAM is stretched 1.5 to more than 3 times its typical length during birth.8 These muscles usually return to normal in most women, but in 10–30% of them, the muscles balloon out of control, occasionally tearing away from the bone where they attach to the inferior pubic ramus and pelvic sidewall. Women are more susceptible to prolapse because of this, especially in...
the anterior and central compartments. Both ballooning and avulsion of the LAM can occur by itself or co-exist at the same time. This literature review is conducted to focus more on discussing the ballooning and avulsion of the LAM in its relation to POP in women after childbirth. Searching was conducted on multiple databases. The knowledge obtained in this review is expected to help clinicians better understand the ballooning and avulsion phenomenon, thus making early diagnosis possible for earlier prolapse prevention for the patients.

Overview of Levator Ani Ballooning and Avulsion

Avulsion to LAM is a less recognized trauma after childbirth, as it has been only studied in the past two decades, although the prevalence is not uncommon. After a vaginal birth, 6–42% of women experience pelvic floor trauma in the form of partial or total avulsions of the LAM, which can have severe long-term morbidity. According to a study conducted in Indonesia, up to 15.4% of patients had levator ani weakness three months after vaginal delivery. Unrecognized injuries to the LAM following childbirth could eventually result in pelvic organ prolapse. Furthermore, even after surgical correction, POP connected to LAM avulsion is considered to be more severe and to have a high recurrence rate.

There are several risk factors related to pelvic organ prolapse. Intrinsic factors include maternal age >35 years old, genital hiatus, and perineal body length. Extrinsic factors include parity, overweight and obesity according to body mass index, weight gain during pregnancy of more than 15 kg, smoking, heavy lifting, the weight gain during pregnancy of more than 15 kg, smoking, heavy lifting, the hiatus can be forced open by injury or trauma to pelvic organs to descend. Additionally, because the uterosacral ligaments are more dorsally directed toward the sacrum, they can prevent the uterus and upper vagina from sliding down the inclined plane of the levator plate. The stresses placed on the pelvic organs during increases in abdominal pressure cause the cardinal and uterosacral ligaments to alter in length and angle.

Pelvic floor injury reviewed in this literature is about ballooning and avulsion of the LAM. Ballooning of the levator hiatus is defined as abnormal distensibility of the levator muscle. The largest abdominal cavity hernial portal is the levator hiatus, which is also where the female pelvic organ prolapse, one of the most typical types of herniation, most frequently occurs. The LAM is seen as being crucial for supporting the pelvic organs. The levator hiatus can be forced open by injury or trauma to these structures, which causes the pelvic organs to descend. While, if there is any major trauma of the LAM that causes detachment from its insertion, it is called avulsion.

Diagnosis

Avulsion and ballooning of LAM, being a strong risk for prolapse & its recurrence, should be diagnosed before prolapse surgery. But, the best time to find avulsion and ballooning of LAM, should be diagnosed after vaginal or cesarean delivery. Then, if LAM trauma is found, we can interfere as early as possible. Diagnosing LAM avulsion may be done through imaging with ultrasound or magnetic resonance imaging (MRI), although clinical examination by palpation can very likely be as valid as imaging tools. Digital palpation can be used to evaluate the levator ani integrity in a clinical setting. The tip of the index finger, which lies near the bladder neck and has its palmar surface close to the posterior/dorsal surface of the os pubis, is parallel to the urethra. Between the urethra’s medial insertion and the pubococcygeus muscle’s lateral insertion, an undamaged muscle leaves just enough space for the palpating finger to pass through. If there is no muscle perceptible on the os pubis and its inferior ramus immediately lateral to a finger held parallel to the urethra and if this finger may move over the inferior pubic ramus without touching muscle for 2-3 cm, the condition is known as a levator avulsion. This method, although universally available and comes at no additional cost, is highly dependent on the clinician’s experience and training, and such training is rarely available in clinical practice.

Although there is no established “gold standard,” ultrasound scan and MRI are the two imaging modalities utilized to diagnose LAM avulsion. Ultrasound modalities used in pelvic floor investigation including 2D, 3D, and 4D, both transvaginal or translabial. During maximal contraction or at rest, levator avulsion is indicated through levator-urethra gap (LUG) diameter with the cut-off > 2.5 cm. Ultrasound imaging can show defects in LAM, usually expressed as an avulsion of unilateral or bilateral, total or partial avulsion. When using tomographic ultrasound imaging (TUI)
and 3D/4D transperineal ultrasound, partial LAM avulsion is defined when the levator-urethra gap is greater than 2.5 cm in at least one slice and complete LAM avulsion when the gap is greater than 2.5 cm in three consecutive slices.\textsuperscript{26} This method can be used to study the LAM sequential in time (i.e. pre-post operative), can show static and dynamic images to assess structure and function and is reliable despite being operator-dependent.\textsuperscript{11}

MRI is a reliable, highly non-invasive, radiation-free, and productive imaging technique that can be used to identify LAM avulsion. In contrast to endovaginal ultrasound, which has a higher specificity (100%) and lower sensitivity (91%), MRI findings have been found to have a strong correlation with symptoms. As a result, it may be helpful as a triage tool. However, MRI is more expensive and requires a radiologist with experience.\textsuperscript{11}

Numerous tools are used to measure hiatal ballooning, such as ultrasound imaging, the International Continence Society Pelvic Organ Prolapse Quantification (POP-Q) examination, or clinical examination based on Genital hiatus plus Perineal body (Gh+Pb) values. Clinically speaking, ballooning is indicated when the sum of Gh and Pb is greater than 7 cm.\textsuperscript{25} A hiatal region of 25–29.9 cm\textsuperscript{2} can be classified as “mild,” 30–34.9 cm\textsuperscript{2} as “moderate,” 35–39.9 cm\textsuperscript{2} as “marked,” and 40 cm\textsuperscript{2} as “severe” ballooning using ultrasonography during the Valsava maneuver.\textsuperscript{9} Ballooning is considered using the cut-off of \( \geq 25 \) cm\textsuperscript{2} for measurement of the hiatal area. Antero-posterior hiatal diameter during the Valsava maneuver is another marker used in ultrasonic measurements. Up to 5.99 cm is considered normal, with 6–6.5 cm being classified as mild, 7–7.5 cm as “marked,” and 7.5 or more as “severe” ballooning.\textsuperscript{22} To simplify examination, the cut-off for LHAP > 6 cm is used to define ballooning. The standard terminology for levator hiatus length is LHAP (Levator Hiatal Antero-Posterior) and for hiatal area is LH Area (Levator Hiatal Area) as a parameter started to be used widely since 2016.\textsuperscript{23}

**Management, Complication, and Prevention**

Postpartum pelvic floor exercise is one of the conservative management of LAM avulsion, especially as early management of obstetric injury.\textsuperscript{24} Physiotherapeutic treatment also can be considered to treat patients with LAM avulsion. It consists of intravaginal electrotherapy, proprioceptive training with biofeedback, and progressive exercise to strengthen the pelvic floor muscle (PFM).\textsuperscript{25}

Ballooning of the levator hiatus and LAM avulsion is not often identified early at the time of injury, but it has lifelong morbidity. Urogynaecological sequelae such as POP, urinary and fecal incontinence, pain, and sexual dysfunction can be shown as complications of LAM avulsion.\textsuperscript{26} Some potential indicators can be used by clinicians to predict pelvic floor injury, including PFM strength, posterior vaginal wall support, and ultrasound evidence of LAM tear.\textsuperscript{27}

There is some evidence that can be considered to prevent ballooning and LAM avulsion, including vitamin D consumption, epidermal analgesia, kegel exercise, and vaginal dilator. Muscle wasting has been connected to vitamin D3 insufficiency. The LAM and coccygeus muscles, two crucial pelvic floor muscles, are susceptible to changes in vitamin D3 levels. The strength of PFM’s basal tone is increased by vitamin D3 intake.\textsuperscript{28}

Some exercises also can be done to prevent ballooning and LAM avulsion. PFM strength can be increased by Kegel exercise within eight weeks as the minimum period.\textsuperscript{29} Vaginal dilators can stretch the PFM when inserted into the vagina, help a natural birth and minimize the risk of levator ani injury. It works to gradually prepare the birth canal for the fetal head by controlling the dilatation of the pelvic floor soft tissues.\textsuperscript{6}

**CONCLUSION**

Ballooning and the avulsion of the LAM are conditions that can be predicted and prevented. Since it has lifelong morbidity and is not often identified early by clinicians, the effort for early diagnosis would be beneficial for the patient, to make an early intervention. Further research is still needed.

**CONFLICT OF INTEREST**

The authors affirm that they do not have any competing interests.

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None declared.

**ETHICAL APPROVAL**

This review does not require any form of ethical approval.

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