IMR Press

Review

Risk factors for obstetric anal sphincter injuries during vaginal delivery: can we reduce the burden?

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DOI:10.31083/j.ceog4806201

Submitted: 13 August 2021 Revised: 7 September 2021 Accepted: 21 October 2021 Published: 15 December 2021

Background: Third- and fourth-degree perineal tears are associated with significant discomfort and impact on women's quality of life after labor. We reviewed the literature on risk factors for obstetric anal sphincter injuries (OASIS), focusing on modifiable risk factors for OASIS to help obstetricians prevent them. *Methods*: We searched MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Scopus using key search terms. We selected clinical studies, systematic reviews, and meta-analyses in English investigating antepartum and intrapartum factors associated with OASIS. Three researchers independently selected studies and documented outcomes. *Results*: We identified forty-two relevant articles for inclusion. Among antepartum factors, primiparity, neonatal birth weight, and ethnicity were associated with a higher risk of OASIS. Instrumental delivery, midline episiotomy, duration of the second stage of labor, persistent occiput posterior position, and labor augmentation were those intrapartum factors reported associated with OASIS. *Conclusions*: Multiple ante- and intrapartum factors are associated with a higher risk of OASIS. The actual modifiable factor is episiotomy during the second stage of labor. However, literature reporting episiotomy associated with a reduction in OASIS prevalence during instrumental delivery is limited. These results may help obstetricians recognize women at higher risk of developing severe perineal tears and recommend further investigation on the role of episiotomy in an operative delivery.

Keywords

Obstetric anal sphincter injury; OASIS; Perineal tears; Obstetric trauma; Episiotomy

1. Introduction

Perineal tears are caused by the straining of the pelvic floor structure during vaginal delivery. As severity concerns, they are classified into four levels which reflect the involved anatomic structures [1]. Third-and fourth-degree lacerations are known as severe obstetric anal sphincter injuries (OASIS), and they include injuries that involve the anal sphincter only (third-degree) and those extending to the anal mucosa (fourth-degree).

The incidence of OASIS represents a maternal wellbeing indicator, and it should not exceed 5% of all perineal tears in labor [2]. In the United States, the rate of third-degree laceration is 3.3%, and of fourth-degree laceration is 1.1% [3]. However, almost 20% of OASIS are estimated to be missed and thus unrepaired during the postpartum period with associated long-term complications [4].

OASIS results in short-term morbidity such as pain, infection, hemorrhage [5], and long-term sequelae like dyspareunia and urinary and anal incontinence [6, 7]. Stool and flatus incontinence occurs in up to 50% of women after OASIS [8]. These morbidities profoundly impact women's psychological wellbeing and are associated with a high risk of postpartum depression in women with lower resilience [9]. Moreover, the associated surgical repair is at high risk of needlestick injury among obstetricians [10, 11]. Nevertheless, prevention strategies for severe perineal lacerations are still far from being established. Although it represents an essential topic for obstetricians, inadequate evidence is available in the literature due to the heterogeneity of studies' conclusions and the absence of randomized trials.

In this scenario, defining risk factors for perineal trauma after vaginal delivery would be helpful to identify women at risk for developing OASIS and find out possible preventive measures. Therefore, this review aims to analyze risk factors associated with OASIS and identify women at higher risk for severe perineal tears. This is of primary importance to help obstetricians understand how to reduce the incidence and impact of these events, particularly whether modifiable risk factors are identified.

2. Materials and methods

For this review, a comprehensive search of several databases was conducted from inception up to May 2021. The searched databases were MEDLINE, Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily, Ovid EMBASE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Scopus.

The research strategy included the combinations of the following medical terms: "perineal lacerations; perineal trauma; perineal tear; childbirth trauma; birth trauma; ob-

stetric trauma; obstetric anal sphincter injury; OASIS; third-degree tear; fourth-degree tear". We selected clinical studies, systematic reviews, and meta-analyses in English language investigating antepartum and intrapartum factors associated with OASIS. We selected studies and systematic reviews or meta-analyses of studies, including pregnant women who delivered vaginally and reporting data regarding the occurrence of OASIS and intra or antepartum factors associated with OASIS occurrence. No additional inclusion or exclusion criteria were used. No specific interventions were investigated.

We did not use a systematic approach in reporting results due to the heterogeneous and extensive amount of literature on this topic; therefore, we conducted a narrative review and reported the most relevant studies to provide the reader with a complete and synthetic overview of the risk factors for severe perineal tears to prevent perineal lesions during delivery. Data are presented as absolute numbers (percentage). No statistical analysis was performed.

3. Results

Forty-two articles have been selected for inclusion in the present review. From the included studies, we identified multiple modifiable and non-modifiable factors associated with OASIS.

3.1 Antenatal factors

Pergialiotis *et al.* [12] found that primiparous women have the highest rate of severe perineal lacerations (RR 1.59, [95% confidence interval (CI), 1.45–1.75]; $p < 0.001$). In a cohort of 2754 women, Smith *et al.* [13] reported an overall OASIS rate of 6.6% in nulliparous women and 2.7% in multiparous ones.

Asian women were reported to have a higher rate of severe perineal tears than Caucasian women. Extensive literature observed this association; however, the etiological factors are still unclear. Differences in pelvic floor anatomy and function between racial groups have been proposed as determinants of this higher susceptibility of women belonging to specific races [14, 15].

3.2 Intrapartum factors

Some authors found an increased rate of OASIS after births of macrosomic infants [16–19]. In a study of 3356 women who delivered infants with a birth weight greater than 4500 g, 4.4% of them suffered from severe perineal trauma. This rate was higher compared with women who had a non-macrosomic fetus [17]. Stotland *et al.* [18] included 146526 births and calculated the rate of fourth-degree lacerations: 1.5% when the neonatal birth weight was less than 4000 g, 2.8% when the neonatal weight was between 4000 g and 4499 g, 4.5% for neonatal birth weight below 4500 g, and 7% for infants who weighted 5000 g. Conversely, other authors did not find an association between severe perineal trauma and birth weight in macrosomic fetuses [20, 21]. A retrospective study on 34685 term singleton pregnancies, of which 2077 were characterized by a fetal birth weight greater than 4000 g, showed no difference in OASIS rate between macrosomic and non-macrosomic fetuses [20]. In a meta-analysis of 716031 patients, neonatal birth weight was significantly higher in women who developed severe perineal lacerations than in the control group. However, the mean difference was 163.71 g. The weight difference between the two groups was so slight that clinical relevance has been questioned. Therefore, the importance of fetal birth weight on the OASIS rate is still debated [12].

Mazouni *et al.* [22] observed no correlation between the obstetric maneuvers used to solve fetal shoulder dystocia (SD) and perineal lesions. Conversely, Gauthaman *et al.* [23] reported a higher risk of OASIS when internal maneuvers were used for SD management than those women who underwent eutocic vaginal birth (OR 2.18, [95% CI, 1.17–4.0]). This is particularly true when four or more maneuvers are used. In a multivariate analysis, internal maneuvers such as Woods' and the reverse Woods' screw maneuvers were found to be significant risk factors, while delivering the posterior fetal arm at first is not a risk factor for OASIS (OR 1.74, [95 % CI, 0.84–3.6]; $p = 0.135$) [23].

Several authors observed that the rate of third and fourth-degree perineal tears was associated with the length of the second labor stage [24, 25]. This is true for both nulliparous and multiparous women [26]. Ramm *et al.* [27], in a retrospective study, compared women whose second stage of labor lasted at least 180 minutes to those with the second stage of labor that lasted less than 60 minutes, describing a three times higher OASIS rate in the first group (adjusted OR 3.20, [95% CI, 2.62–3.89]). Consistently, labor augmentation is an independent risk factor for the development of severe lacerations (RR 1.46, [95% CI, 1.32–1.62]) [12, 28, 29].

Conversely, labor induction was not associated with severe perineal tears. The ARRIVE trial compared elective labor induction at 39 weeks in low-risk nulliparous women with expectant management. They demonstrated that induction results in a significantly lower frequency of cesarean delivery [30]. In a secondary analysis of the ARRIVE trial, the OASIS rate was similar between women with induced labor and those managed expectantly [31]. The same results were reported in a meta-analysis, showing that labor induction had no significant effect on the OASIS risk (RR 1.05, [95% CI, 0.97–1.15], 716031 women) [12].

Conflicting results have been reported regarding the association between the use of epidural analgesia and OASIS. Some studies suggested that it may protect against severe perineal tears [13]. Loewenberg-Weisband *et al.* [32], in the first analysis, found a significant association between the use of epidural analgesia and OASIS. However, after adjusting the results with the effects of parity, this association disappeared (OR 0.95, [95% CI, 0.69–1.29]). Still, other studies reported epidural analgesia as a risk factor for OASIS (RR 1.21, [95% CI 1.08–1.36], 716,031 women) [12].

Occiput posterior position at delivery is an independent risk factor for severe lacerations [33] and is associated with a significantly lower rate of spontaneous vaginal births [12,

34]. One possible explanation might be related to the fetal head's inability to flex onto the chest, resulting in an enlargement of the fetal head diameter at the pelvic outlet [35]. Moreover, occiput posterior position is associated with prolonged first and second stages of labor and increased medical interventions such as oxytocin augmentation and assisted delivery [34].

Episiotomy is a surgical procedure that consists of vaginal orifice enlargement by incising the perineum to facilitate fetal delivery. Its role as a preventive maneuver for OASIS or risk factors has become a highly debated topic in the last decade.

Episiotomy can be performed at the end of the second stage of labor when the perineum is seen as an obstacle to the completion of fetal birth [36]. Different types of incisions were described in the literature, such as the midline, mediolateral, modified-median, J-shaped, and lateral ones [37, 38]. However, the two most used incisions are the midline (median) and the mediolateral ones. The former is more frequently performed in the United States, while the latter is more used in Europe [38]. The literature agrees that midline episiotomy is associated with an increased risk of OASIS as compared with mediolateral episiotomy [12, 27], and International Guidelines, such as the American College of Obstetricians and Gynecologists (ACOG) and Royal College of Obstetricians and Gynecologists (RCOG), discourage its use and agree that mediolateral episiotomy may be preferable [39, 40].

In women undergoing a non-operative vaginal delivery, mediolateral episiotomy was assumed to be protective against severe perineal tears for a long time. Nevertheless, it is well demonstrated that routine use of episiotomy during eutocic spontaneous vaginal delivery is not justified in reducing perineal trauma [41, 42]. According to Cochrane database review, the selective use of episiotomy compared with the routine one resulted in a 30% decrease of severe perineal trauma (RR 0.70, [95% CI, 0.52–0.94]; 5375 women) [43]; this was only applicable to trials where the difference in episiotomy rates between the two groups was more than 30%. Moreover, in a meta-analysis of 2020, the authors demonstrated that mediolateral episiotomy tends to increase the risk of severe perineal lacerations. However, the overall effect does not reach statistical significance ($p = 0.08$) [12].

A different situation is the operative vaginal delivery, which has been recognized as a major risk factor for OASIS, particularly when other risk factors coexist [27]. In the literature, forceps for operative vaginal delivery was associated with an increased risk of OASIS [44]. Similarly, many studies reported even vacuum extraction as a significant risk factor for perineal trauma [12, 45]. However, Ramm *et al.* [27] included a cohort of 22822 vaginal deliveries reporting a 4–6 times higher OASIS rate among patients who underwent forceps-assisted deliveries than vacuum-assisted deliveries. For this and additional evidence, the actual contribution of vacuum-assisted delivery to OASIS risk is still debated. Indeed, the actual contribution of vacuum-assisted delivery to the occurrence of OASIS is challenging to estimate, as other determinants may confound its impact.

Levin *et al.* [46] analyzed the distribution of tear types in spontaneous vaginal births compared to vacuum-assisted deliveries. They evaluated 23272 vaginal deliveries of primiparous women. The univariate analysis reported a higher OASIS rate in the vacuum delivery group (2.3%) than the spontaneous vaginal births group (1.7%). However, when multivariate regression analysis was performed, vacuum-assisted delivery was not independently associated with an increased risk of OASIS. In addition, in the vacuum-assisted delivery group, aspects like maternal age >35 years old, weight gain during gestation, oxytocin administration, epidural anesthesia, occiput posterior fetal position, and longer second-stage duration were found more frequently.

Similarly, although many authors suggested that mediolateral episiotomy prevented OASIS during operative vaginal delivery, the role of mediolateral episiotomy during operative vaginal delivery to prevent OASIS has not been confirmed by large randomized controlled trials (RCT) or meta-analysis [47]. Historically, international guidelines did not support routine mediolateral episiotomy in operative vaginal deliveries to reduce OASIS incidence. However, recently, RCOG has stated that mediolateral episiotomy prevents OASIS in primiparous women [40]. Van Bavel *et al.* [48] evaluated the effect of mediolateral episiotomy on OASIS rate during operative vaginal delivery in a retrospective study in 2018. The incidence of OASIS in primiparous women who underwent mediolateral episiotomy was 2.5%, and in those who did not was 14%, with an episiotomy rate of 84.5%. They reported a protective effect of mediolateral episiotomy during instrumental delivery in both primiparous (adjusted OR 0.14, [95% CI, 0.13–0.15]) and multiparous (adjusted OR 0.23, [95% CI, 0.21–0.27]) women [48]. De Vogel *et al.* [49] corroborated the protective effect of episiotomy on perineal tears during operative vaginal delivery (OR 0.17, [95% CI, 0.12–0.24]). Data from 2861 operative vaginal delivery showed an OASIS rate of 3.3% in women managed with episiotomy and 15.6% in those managed without it. The global episiotomy rate was 81%.

Conversely, other authors suggested that the risk of OASIS was not affected by the use of episiotomy [50]. Schreiber *et al.* [51], in their retrospective cohort study on 2370 nulliparous women who underwent a vacuum-assisted delivery, reported that there were no significant differences in the rates of severe perineal lacerations between the episiotomy and the non-episiotomy group. A meta-analysis of fifteen studies regarding the effect of mediolateral episiotomy during vacuum-assisted delivery did not find a protective effect of episiotomy in nulliparous women (OR 0.68, [95% CI, 0.43–1.07]), whereas in multiparous women, it might even increase maternal morbidity (OR 1.27, [95% CI, 1.05–1.53]) [52].

In the literature, there is only one pilot RCT on routine versus selective use of episiotomy in operative vaginal deliv-

ery, including 200 nulliparous women. However, the study was underpowered to prove a significant change in the OASIS risk, mainly due to a high rate of episiotomy (52%) in the selective use group [53, 54]. Ankarcrona *et al.* [55] evaluated 63654 nulliparous women delivered with vacuum extraction. They showed that episiotomy could reduce the prevalence of OASIS from 15.5% to 11.8%. However, a high number of episiotomies had to be done to prevent one case of fourth-degree perineal injury due to its relative infrequency.

4. Discussion

The prevention of perineal lesions during vaginal delivery is a priority for obstetricians. Some established risk factors may be identified before and during labor. Antenatal risk factors, such as ethnicity, primiparity, even though non-modifiable, should be identified and discussed with the woman.

Concerning modifiable intrapartum risk factors for OASIS, we identified labor augmentation, epidural anesthesia, and operative vaginal delivery. These factors can be considered modifiable, being not intrinsically present during labor and delivery but introduced by medical decision (labor augmentation and operative vaginal) or women preference (epidural anesthesia). Regarding labor augmentation and operative vaginal delivery, clinical audits aimed to improve obstetric practice reducing their inappropriate adoption may reduce the OASIS risk. However, when these interventions during labor cannot be avoided to guarantee fetal and maternal wellbeing, they could be referred to as non-modifiable factors. Regarding epidural analgesia, the increased risk of OASIS may be included in the patient counseling.

Since spontaneous vaginal births and operative vaginal delivery are two non-comparable conditions, we separately described the role of episiotomy in preventing severe perineal tears in these two types of delivery. In spontaneous vaginal births, routine use of episiotomy is not associated with relevant advantages compared with a selective one. Furthermore, the literature does not report absolute indications for episiotomy in spontaneous vaginal births. Similarly, the role of mediolateral episiotomy in preventing OASIS during an instrumental delivery has not been established due to the absence of properly designed and adequately sized RCT. Furthermore, performing a RCT is challenging, given the ethical difficulties (women will undergo an iatrogenic perineal injury without the certainty of avoiding OASIS) and feasibility of recruitment.

Although data from the literature show that episiotomy can reduce the prevalence of severe lacerations in assisted deliveries, the number of procedures needed to prevent one OASIS case is high [55]. Moreover, the group of patients who could benefit from episiotomy has not been identified yet. In this regard, evidence is further limited for specific subgroups of patients, such as in the case of female genital mutilations [56].

5. Conclusions

Given that the "informed choice" is becoming increasingly relevant in modern obstetrics and that risk factors for OASIS are well known, women with high-risk factors for third- and fourth-degree lacerations should be identified and informed of their individual risk of complications.

Author contributions

All the authors contributed to the intellectual content of the study and approved the final version of the article. MF, RR, and MB—Study Conceptualization. SG, PCZ, and SU—Methodology. PCZ and IP—Resources and Data Curation. PCZ, SG, SL, and IP—Writing the Original Draft. PCZ, SG, IP, MB, MF, RR, SL, RDP, PP, FL, and SU—Writing, Review, and Editing. MF and SU—Visualization and Supervision. All authors contributed to the interpretation of results, as well as reviewed and approved the final version.

Ethics approval and consent to participate

Not applicable.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of interest

The author declares no conflict of interest. SG is the Editor Board Member of this journal, given his role as Editor Board Member, had no involvement in the peer-review of this article and has no access to information regarding its peer-review.

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