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ORIGINAL ARTICLE

# Prevention and Management of Severe Obstetric Anal Sphincter Injuries (OASIs): a National Survey of Nurse- Midwives

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## Abstract

**Introduction and hypothesis** There are no data on midwives' knowledge and management of obstetric anal sphincter injuries (OASIs) in the USA. We performed a cross-sectional national survey characterizing OASI practice by certified nurse midwives (CNMs), hypothesizing that few midwives personally repair OASIs and that there are gaps in CNM OASI training/education.

**Methods** We emailed a REDCap internet-based survey to 6909 American College of Nurse Midwives members (ACNM). We analyzed responses from active clinicians performing at least one delivery per month, asking about OASI risks, prevention, repair, and management. We summarized descriptive data then evaluated OASI knowledge by patient and provider characteristics.

**Results** We received 1070 (15.5%) completed surveys, and 832 (77.8%) met the inclusion/exclusion criteria. Participants were similar to ACNM membership. Respondents most frequently identified prior OASI (87%) and nutrition (71%) as antepartum OASI risk factors and, less frequently, nulliparity (36%) and race (22%). Identified intrapartum risks included forceps delivery (94%) and midline episiotomy (88%). When obstetric laceration is suspected, 13.6% of respondents perform a rectal examination routinely. Only 15% of participants personally perform OASI repair. Overall, participants matched 64% of evidence-based answers. OASI education/training courses were attended by 30% of respondents, and 44% knew of OASI protocols within their group/institution. Of all factors evaluated, the percent of evidence-based responses was only different for respondent education/CME and protocols.

**Conclusions** Quality initiatives regarding OASI prevention and management may improve care. Our data suggest OASI training for midwives may improve delivery care in the US. Further studies of other obstetric providers are needed.

**Keywords** Cross-sectional · Education · Midwifery · OASIs · Perineal trauma · Quality improvement

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## Introduction

Four percent of vaginal deliveries result in severe perineal lacerations (3rd- or 4th-degree vaginal-perineal laceration, also known as Obstetric Anal Sphincter Injuries or OASIs) that can lead to significant morbidity [1]. Women with OASI are at higher post-partum risk for acute pain, infection, and perineal wound disruption [2]. They are also more likely to report chronic pain and persistent sexual or urinary problems [3]. Up to 50% of women with third- or fourth-degree perineal lacerations go on to experience chronic anal sphincter disruption with fecal or flatal incontinence [4]. Patients may experience psychological distress and chronic embarrassment long after their delivery [5], and the long-term cost of perineal laceration complications can be as high as half a million dollars per patient [6]. In the USA, certified nurse-midwives (CNMs) attend about 12% of vaginal births and 8.3% of all births [7]. In one survey in the UK, just 34% of midwives reported they were confident in their assessment of delivery lacerations and 22% were prepared to perform the repair [8]. Another UK survey found that only 10% of midwives felt adequately trained to assess and/or repair perineal lacerations [9]. No similar studies of midwives' management of OASIs have been reported for the US.

Early and correct identification and repair of severe OASI are quality indicators in women's health. The Agency for Healthcare Research and Quality (AHRQ) lists third- and fourth-degree OASI as a provider-level patient safety indicator [10]. AHRQ reports national OASI rates as well as statewide data for 35 states and the District of Columbia [11]. Some states also report OASI rates publicly and compare hospitals [12]. Given the concern for patient safety and optimal clinical outcomes, we designed a cross-sectional survey instrument for a series of studies investigating how different providers (e.g., midwives, obstetricians, family medicine doctors) approach OASI prevention, repair, and management in the US. In this first study, we addressed CNM knowledge regarding OASI, hypothesizing that a majority of US certified nurse midwives do not personally repair OASI routinely and that there is a need for increased training/education regarding OASI prevention, repair, and management.

## Methods

### Survey design and testing

We reviewed the literature to construct lists of factors or actions that could influence OASI risk, prevention, repair, and management. From these, we designed an internet-based cross-sectional survey to assess respondents' clinical practice and knowledge. The survey instrument was composed in Research Electronic Data Capture (REDCap) [13], an electronic data capture tool that collects responses directly and stores de-identified data. The ACNM research committee and the Colorado Multiple Institutional Review Board approved the study (IRB no. 15–0619). The survey was completely voluntary and anonymous, and respondents gave informed consent on the first page.

We collected information on participants' knowledge of obstetric laceration risks, prevention techniques, and immediate and discharge management of OASIs. Participant demographic data were collected at the end of the survey. Questions were in the form of either checklist or open response, with one irrelevant answer option included in each question to assess random response entry. Adaptive (branched logic) questioning was used to ensure only relevant questions were presented, to reduce the survey length and to design the instrument for use by any provider type (e.g., midwives, obstetrician-gynecologists, family practice, labor and delivery nurses). The full survey included 20 screens with 1–15 questions per screen, and, on average, participants were presented with 60 items. Every mandatory question included options of "I don't know/Unsure" and "Other" so that each question could be answered by all participants. We also collected information on the identification and description of different types/degrees of OASIs, which is the topic of a separate analysis.

The survey was revised extensively among the authors and then tested with all members of the University of Colorado's Department of Obstetrics and Gynecology. For that pilot study, we sent 223 email solicitations to midwives, physicians, and trainees and received 89 responses (40%; 37% obstetricians, 22% labor and delivery nurses, 17% residents in training, 13% CNM, 9% fellows in training, and 2% other). We reviewed the pilot data, participant comments, and survey critiques and revised for organization, branching logic (to reduce length), and clarity. From August through December 2015, we solicited all email addresses on file with the ACNM membership ($n = 7367$) to participate in our final revised RedCap survey (Fig. 1). The ACNM coordinated email solicitation and maintained confidentiality with unique participant codes. We sent a pre-survey announcement to all ACNM members and then four rounds of invitations (every 3–6 weeks). We sent a fifth invitation to providers in states with < 10% participation. No financial or other incentives were offered. For final analysis we included active midwifery clinicians meeting the following criteria: agreed to participate, active participation in obstetric deliveries in the past year, and at least one delivery per month on average. Exclusion criteria were then applied: not currently performing clinical work in the US, no active CNM obstetric activities in the past year, or incomplete survey responses.

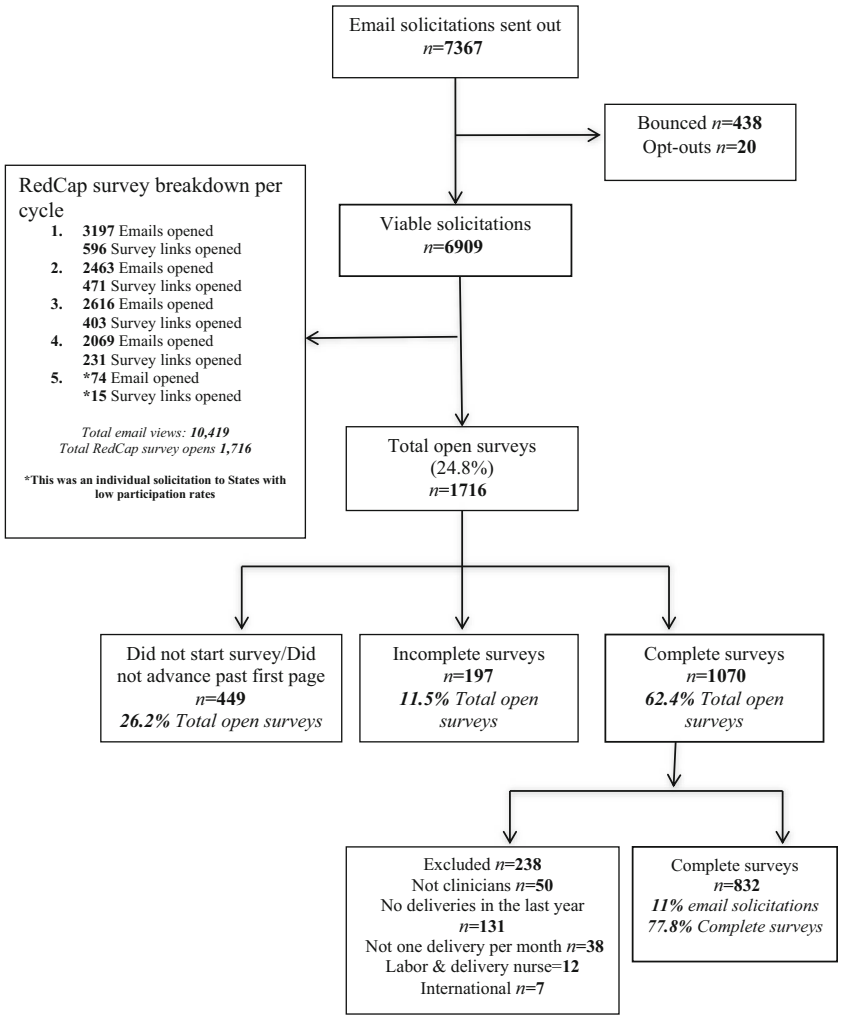


**Fig. 1** Survey invitations, responses, and participant flow sheet

## Consensus review process

At the time of this survey, there were no authoritative US national guidelines for severe OASI prevention, management, and repair. ACOG had not yet published the OASI Practice Bulletin [14]. Therefore, we used a variation of the nominal group technique [15] to perform a consensus review process among the authors. Consensus panelists are specialists and subspecialists in a tertiary academic medical center, with expertise in midwifery, obstetrics, pelvic floor disorders, and survey study design. We determined which risk and management options in our survey were supported by existing evidence. Items were reassessed and discussed through five rounds of deliberation, until we reached consensus for OASI best practices by categorizing each choice as alters risk/no effect/decreases risk and by recommended/not recommended. The final product of our consensus deliberation is provided in Appendix Table 5 and is nearly identical to the current published ACOG Practice Bulletin recommendations [16]. In the ACOG bulletin, antibiotic use before OASI repair is rated only "may be considered" while we rated this as "recommended." Perineal warm compresses during labor were not included in our choices but are "recommended" by ACOG; respondents could record this approach in free-text answers. All other evidence-based answers were identical between our consensus panel and the ACOG bulletin.

## Analysis

We first compared the characteristics of survey respondents with the overall ACNM membership public data for age, gender, race, and highest degree using t-tests and chi-square analysis [17]. Next, we summarized the responses for OASI prevention, management, repair, and education using descriptive statistics. We then compared participant responses for each survey question with our consensus panel answers. For each topic area, (e.g., antepartum risk, intrapartum risk, repair, management), we calculated the % of answers that matched the consensus answers for each respondent. The matching answers were counted as "correct," and these answers were then divided by the total answers to provide a total percent score for each topic. We then performed bivariate analysis to

identify participant demographic factors or participant self-reported patient population factors that significantly differed by % matched consensus answers. For open-ended free-text questions (i.e., routine prevention techniques used by the participant), answers were reviewed, systematically coded, and summarized (Appendix Table 11). Analyses were performed using IBM SPSS version 24 [18]. An alpha < 0.05 was set as the significance level for all statistical analyses.

## Results

### Participants

Figure 1 shows participant recruitment and selection. From 7367 initial ACNM email invitations (100% of email membership), 6909 addresses were active. Of those, we received 1070 (15.5%) completed surveys. Applying inclusion and exclusion criteria to sample current CNM clinical practice, 832 respondents (11% of total solicitations; 77.8% of completed surveys) were retained. We compared respondent demographics to the ACNM membership by age, race/ethnicity, gender, and highest degree earned (Table 1). There were no statistically significant differences by age or gender ($p > 0.05$), though survey participants were slightly more likely than all ACNM members to be white and to have completed a master's degree ($p < 0.05$ and $p < 0.001$, respectively). Overall, respondents were similar to the ACNM membership, and the significant differences were of small absolute magnitude.

### Antepartum OASI risk

We asked respondents to identify antepartum factors (i.e., existing prior to labor and delivery) they believe alter the risk for third- and fourth-degree OASI (Table 2). The most common selected antepartum risks were: prior third- or fourth-degree laceration (87% of respondents), nutrition (71%), infibulation (68%), and diabetes (56%). Our consensus panel identified prior third- or fourth-degree laceration, nulliparity, and patient ethnicity as factors with strong evidence supporting an influence on OASI risk. Less than 1% of respondents ($n = 5$) chose the distractor/irrelevant answer choice of recurrent UTI, suggesting unintentional selections were not a significant source of survey error. Of the 12 answer choices available, respondents agreed with 25% to 100% of the consensus panel answers, with a mean of 64% (Appendix Table 6).

**Table 1** Comparison of survey participants with ACNM membership

| Variable | Category | ACNM members[a] | Survey participants ($n = 832$) | t or χ |
|---|---|---|---|---|
| Age (mean ± SD) | | 48.7 ± 13.5 | 48.9 ± 11. 8 | 0.41*** |
| Race (*n*, %) | | | | 7.63* |
| | American Indian or Alaska Native | 30 (0.5%) | 3 (0.4%) | |
| | Asian, Southeast Asian, Asian Indian | 109 (1.6%) | 2 (0.2%) | |
| | Black or African-American | 327 (4.9%) | 14 (1.7%) | |
| | White | 5980 (90.2%) | 775 (93.2%) | |
| | More than one race | 0 | 10 (1.2%) | |
| | Unknown | 0 | 2 (0.2%) | |
| | Prefer not to answer | 63 (1.0%) | 22 (2.6%) | |
| | Other | 120 (1.8%) | 4 (0.5%)[b] | |
| Gender (*n*, %) | | | | 4.95*** |
| | Male | 45 (0.6%) | 11 (1.3%) | |
| | Female | 7150 (99.4%) | 821 (98.7%) | |
| Degrees (*n*, %) | | | | 31.88** |
| | Associate's | 35 (1.6%) | 4 (0.5%) | |
| | Bachelor's | 116 (5.2%) | 15 (1.8%) | |
| | Master's | 1824 (81.8%) | 727 (87.4%) | |
| | PhD or equivalent | 208 (9.3%) | 66 (7.9%) | |
| | Other | 47 (2.1%) | 20 (2.4%)[c] | |

*$p < 0.05$; **$p < 0.001$; ***$p > 0.05$ (not significant)

[a] Available ACNM data: age $n = 6708$, race $n = 6629$, gender $n = 7195$, degrees $n = 2230$

[b] Other (fill in) included: Euro-Celtic, Hispanic, Mestiza

[c] Other (fill in) included: CNM/PhD ($n = 2$), nursing doctorate ($n = 3$), doctor of nursing practice ($n = 5$), certified professional midwives ($n = 3$), post-master's degree ($n = 7$)

**Table 2** Ante- and intrapartum risk factors

| Risk factor | Participant response ($n$ = 832) | Consensus assessment |
|---|---|---|
| Participant identification of antepartum risks for OASIs and consensus matching | | |
| Prior 3rd- or 4th-degree laceration | 87.1% (725) | Alters risk |
| Nulliparity | 36.3% (302) | Alters risk |
| Patient ethnicity/race | 22.0% (183) | Alters risk |
| Nutrition | 71.3% (593) | No effect/evidence |
| Infibulation (female circumcision) | 67.5% (562) | No effect/evidence |
| Diabetes | 55.8% (464) | No effect/evidence |
| Maternal BMI | 29.9% (249) | No effect/evidence |
| Gestational age | 19.5% (162) | No effect/evidence |
| Maternal age | 16.1% (134) | No effect/evidence |
| Prior 1st- or 2nd-degree laceration | 7.0% (58) | No effect/evidence |
| Prior urinary tract infection[a] | 0.6% (5) | No effect/evidence |
| Multiparity | 6.0% (50) | Decreased risk |
| Other[b] | 7.6% (63) | |
| Participant identification of intrapartum risks of OASIs and consensus matching | | |
| Forceps assistance | 94.0% (782) | Alters risk |
| Midline/median episiotomy | 87.7% (730) | Alters risk |
| Vacuum assistance | 75.4% (627) | Alters risk |
| Shoulder dystocia | 67.2% (559) | Alters risk |
| Estimated fetal weight | 61.4% (511) | Alters risk |
| Position of fetal vertex (e.g., OP) | 57.0% (474) | Alters risk |
| Maternal positioning at delivery | 55.2% (459) | Alters risk |
| Oxytocin administration | 3.8% (32) | Alters risk |
| Uncontrolled delivery (e.g., no perineal protection) | 60.8% (506) | No effect/evidence |
| Duration of 2nd stage | 53.6% (446) | No effect/evidence |
| Mediolateral episiotomy | 30.6% (255) | No effect/evidence |
| Epidural analgesia | 17.5% (146) | No effect/evidence |
| Chorioamnionitis | 12.6% (105) | No effect/evidence |
| Duration of labor | 11.8% (98) | No effect/evidence |
| Misoprostol induction | 1.3% (11) | No effect/evidence |
| Foley bulb/Cook catheter use[a] | 0.6% (5) | No effect/evidence |
| Other[c] | 2.8% (23) | |

[a] Distractor choice

[b] Other included: smoking ($n$ = 16), macrosomia ($n$ = 12), vaginitis ($n$ = 10), STI ($n$ = 9), perineal integrity ($n$ = 6), prior episiotomy ($n$ = 4), anemia ($n$ = 2), perineal length ($n$ = 2), delivery stool ($n$ = 1), patient cooperation ($n$ = 1)

[c] Other included: forceful pushing ($n$ = 4), excessive manipulation ($n$ = 4), perineal length ($n$ = 3), precipitous birth ($n$ = 3), use of birth stool ($n$ = 2), vaginal infection ($n$ = 2), compound presentation ($n$ = 2), coached pushing ($n$ = 2), nutrition ($n$ = 1)

## Intrapartum OASI risk

We asked respondents to identify intrapartum factors (i.e., occurring during delivery) that they thought alter risk of 3rd- and 4th-degree OASIs (Table 2). The most frequently selected intrapartum risks were forceps use (94%), midline episiotomy (88%), vacuum use (75%), shoulder dystocia (67%), and estimated fetal weight (61%). Our consensus panel considered the following to alter OASI risk: instrumental delivery (vacuum or forceps), midline episiotomy, shoulder dystocia, estimated fetal weight, fetal vertex position, and oxytocin administration. Less than 1% ($n$ = 5) selected the distractor answer of Foley bulb/Cook catheter use. Of the 16 answer choices available, the respondents agreed with between 31% to 100% of the consensus panel answers, with a mean of 69% (Appendix Table 6).

## OASI repair

One hundred twenty-five (15%) midwife respondents reported personally repairing 3rd- or 4th-degree OASI, and an additional 3.7% stated they only repair up to third-degree lacerations (Table 3). The most frequent practices at the time of

**Table 3** OASI repair, examination, and education

| | Participant response |
|---|---|
| Personal repair of 3rd- or 4th-degree lacerations by CNM ($n = 832$) | |
| No | 79.1% (658) |
| Yes | 15.0% (125) |
| 3rd-Degree lacerations only | 3.7% (31) |
| Other[a] | 2.3% (19) |
| Rectal exam after delivery ($n = 832$) | |
| Routinely after every delivery | 4.3% (36) |
| To confirm 1st or greater degree tear | 0.7% (6) |
| To confirm 2nd or greater degree tear | 19% (158) |
| To confirm 3rd or greater degree tear | 64.4% (536) |
| To confirm 4th-degree tear | 6.8% (57) |
| I do not know/unsure | 0.7% (5) |
| Other[b] | 4.1% (34) |
| Routine rectal examination for suspected obstetric laceration ($n = 832$) | |
| No | 85.8% (714) |
| Yes | 13.6% (113) |
| I do not know/unsure | 0.6% (5) |
| Repair approach to primary or first 3rd- or 4th-degree laceration ($n = 124$)[c] | |
| End-to-end external anal sphincter (EAS) repair | 63.7% (79) |
| Overlapping EAS repair | 16.9% (21) |
| Refer or consult another provider | 14.5% (18) |
| I do not know/unsure | 3.2% (4) |
| Other[d] | 1.6% (2) |
| Repair approach to subsequent or recurrent 3rd- or 4th-degree laceration ($n = 124$)[c] | |
| Refer or consult another provider | 51.6% (64) |
| End-to-end EAS repair | 28.2% (35) |
| Overlapping EAS repair | 12.1% (15) |
| I do not know/unsure | 4.0% (5) |
| Other[e] | 4.0% (5) |
| Protocols/guidelines regarding obstetric lacerations available in practice setting ($n = 832$) | |
| No | 38% (315) |
| Yes | 44% (364) |
| Unsure | 18% (153) |
| Continuing medical education (CME) or review courses attended regarding obstetric laceration repair ($n = 832$) | |
| No | 70% (580) |
| Yes | 30% (252) |

[a] Other included: Will repair up to partial third-degree tear ($n = 14$), hospital does not allow ($n = 2$), have at other institutions ($n = 1$), residents repair ($n = 1$), will with OB assistance ($n = 1$)

[b] Other included: If repair is close to rectal tissue ($n = 8$), after repair of second or greater tear ($n = 8$), after every repair ($n = 7$), provider will perform after 3rd/4th-degree tear ($n = 3$), to confirm/classify tear ($n = 2$), to check quality of repair ($n = 2$), after episiotomy ($n = 1$), after extensive repair ($n = 1$), depends on the tear ($n = 1$), never had greater than second-degree tear ($n = 1$)

[c] One participant who personally repairs lacerations did not answer

[d] Other included: End-to-end for third degree and repair anal mucosa first before anal sphincter for fourth degree ($n = 1$), retrieve muscle, do figure eight, then reinforce with additional suture ($n = 1$)

[e] Other included: Have never had recurrent third/fourth-degree laceration ($n = 2$), retrieve muscle, do figure eight then reinforce with additional suture ($n = 1$), repair in layers: first repair the rectal mucosa, then the sphincter, transverse perineal muscle for strength, and lastly vaginal repair ($n = 1$), recommend cesarean delivery if prior third/fourth-degree laceration ($n = 1$)

repair were rectal examination before and after repair (73% and 91%, respectively) and additional anesthesia (67%; Table 4). None of the participants chose the distractor/irrelevant answer choice of bowel preparation. Our consensus panel found evidence supporting the following for OASI repair: rectal examination before and after, additional anesthesia, irrigation of the wound, antibiotics prior to repair, and in selected cases move to the operating room or consult a specialist (based on clinical judgment). Of the ten listed choices for repair, respondents matched between 30% to 100% of consensus panel answers, with a mean of 59% (Appendix Table 7).

Participants were asked about use of rectal examination for evaluation and repair of OASI (Table 3). If a laceration is suspected, 13.6% ($n = 113$) routinely perform a rectal examination, and 64.4% ($n = 536$) perform it primarily to confirm third-degree tear or worse. Of the participants that routinely perform laceration repairs, 20% routinely performed rectal examinations for suspected lacerations (Appendix Table 8). The preferred repair for midwives who personally repair OASI was end-to-end anastomosis for primary occurrence (64%, Table 3 and Appendix Table 9). For subsequent OASI (i.e., second or subsequent), the most common response was that another provider (e.g., obstetrician) is called (52%). While 87% of respondents perform episiotomies at some time, less than 1% perform them "routinely" (Appendix Table 10).

## OASI management

Participants who personally repaired lacerations were asked what they recommend/prescribe upon discharge (Table 4). The most frequent recommendations included stool softeners (94%), sitz baths/pericare (90%), NSAIDs (81%), and lidocaine ointment spray (66%). Forty-five percent of participants recommend narcotic pain medication, and 26% recommend future vaginal delivery after OASIs. Our consensus panel considered sitz baths, stool softeners, NSAIDs, early follow-up, and narcotic pain medication as beneficial for OASI outcomes and considered it appropriate to recommend future vaginal delivery. No participants chose the distractor/irrelevant answer choice of bedrest. Of the 15 listed procedure choices, respondents selected between 47% and 100% of the consensus panel answers, with a mean of 72% (Appendix Table 7).

## CME and OASI protocols

Less than half of participants (44%) knew about OASI protocols in their practice group or hospital. Only 30% had attended any CME or review courses regarding obstetric laceration repair (Table 3). Of the participants who personally perform laceration repairs, 42% had attended CME or review courses regarding OASI repairs and 40% knew of available protocols (Appendix Table 8).

**Table 4** Procedures performed at time of OASI and management approach for patients with 3rd- or 4th-degree laceration repair by participants

| | Frequency (%) procedure Performed by CNM ($n$ = 125) | Consensus assessment |
|---|---|---|
| Procedures at time of OASI repair by participants and consensus matching | | |
| Rectal examination after repair | 91.2% (114) | Improves outcome |
| Rectal examination before repair | 72.8% (91) | Improves outcome |
| Additional anesthesia | 67.2% (84) | Improves outcome |
| Consult a specialist or another provider[b] | 47.2% (59) | Improves outcome |
| Irrigation of wound | 19.2% (24) | Improves outcome |
| Antibiotic(s) before or during repair | 2.4% (3) | Improves outcome |
| Move to the operating room for repair[b] | 1.6% (2) | Improves outcome |
| Delayed repair | 0 (0) | Improves outcome |
| Antibiotic(s) after repair | 10.4% (13) | No effect/ evidence |
| Bowel prep or enema[a] | 0 (0) | No effect/ evidence |
| Other[c] | 3.2% (4) | |
| Management approach for patients with 3rd- or 4th-degree lacerations and consensus matching | | |
| Stool softener | 93.6% (117) | Improves outcome |
| Sitz baths/pericare | 89.6% (112) | Improves outcome |
| NSAIDs | 80.8% (101) | Improves outcome |
| Early follow-up (before routine postpartum visit) | 44.8% (56) | Improves outcome |
| Narcotic pain meds | 43.2% (54) | Improves outcome |
| Recommend future vaginal delivery | 26.4% (33) | Improves outcome |
| Lidocaine ointment or spray | 66.4% (83) | No effect/evidence |
| Fiber supplements | 44.8% (56) | No effect/evidence |
| High-fiber diet | 43.2% (54) | No effect/evidence |
| Physiotherapy/pelvic floor exercises | 31.2% (39) | No effect/evidence |
| Glycerin suppositories | 6.4% (8) | No effect/evidence |
| Antibiotics | 3.2% (4) | No effect/evidence |
| Low-fat diet | 1.6% (2) | No effect/evidence |
| Bedrest[a] | 0 (0) | No effect/evidence |
| Recommend future cesarean delivery | 0.8% (1) | Case dependent |
| Other[d] | 0.8% (1) | |

[a] Distractor choice

[b] Based on clinical judgment, in selected cases

[c] Other included: Transfer to hospital and consult OBGYN for 4th-degree laceration ($n$ = 4)

[d] Other included: Offer (but do not recommend) future cesarean delivery ($n$ = 1)

## Free-text responses: Prevention techniques

In a separate optional question, participants were invited to list any techniques that they routinely use to prevent lacerations. Eighty-three percent of participants ($n$ = 690) completed this optional question (Appendix Table 11). The most common free-text responses included perineal support (48%), guided/controlled delivery (40%), avoiding episiotomies (25%), warm compresses (21%), and maternal positions other than lithotomy (21%).

## Midwife and patient factors and OASI expertise

We explored whether particular CNM characteristics differ significantly by OASI expertise (Appendix Table 12). Most participant characteristics did not differ by overall % matching consensus recommendations, except for CME and institutional protocols. Respondents who had *not* attended CME courses regarding obstetric lacerations and those *with* known protocols at their institution had slightly greater matching with our consensus panel answers [67% vs. 66% ($p$ < 0.05) and 68% vs. 66% (p < 0.05), respectively]. There was no statistically significant link between patient factors and increased matching with consensus answers.

# Discussion

Nurse midwives assist in over 300,000 births annually in the US [7]. Knowledge of current practice and

identification of training gaps is key to developing effective educational programs; therefore, we performed the first national study to characterize US midwives' knowledge and management of perineal lacerations. This survey study was performed in collaboration with the ACNM and gives a snapshot of clinical practice for OASI. We summarized current recommendations for OASI prevention and management from review of the literature and a multidisciplinary panel consensus process. We also summarized CNM self-reported education and training on OASI and identified CNM and patient factors associated with OASI expertise. Our results are consistent with our hypothesis that most CNMs in the US do not routinely repair OASIs and that there are educational gaps regarding OASI prevention, repair, and management. This study addresses an important descriptive deficit and provides crucial information for optimizing OASI education. We did not identify provider or patient characteristics that might help direct effective training programs. This project is the first in a series of studies to characterize OASI knowledge among various US delivery attendants (e.g., midwives, obstetricians, family practitioners).

Several risk factors associated with OASI were not frequently identified, such as nulliparity and patient ethnicity. Few respondents selected oxytocin administration as an intrapartum risk factor for OASIs, suggesting that prolonged labor augmentation may not be perceived as an OASI risk [16, 19]. For management, only a small number of respondents administered antibiotics prior to or at the time of laceration repair though randomized controlled study suggests this is beneficial [16]. For postpartum care, respondents widely agreed with suggested practices for adequate pain control, sitz baths/pericare, and stool softeners [16]; however, fewer than half recommend early follow-up for perineal inspection of the repair (to allow for early treatment of infection or wound breakdown).

We heard from many respondents in free-text comments that they have never or only very rarely attended deliveries with severe perineal lacerations. Rare but significant events in clinical practice are prime opportunities for training to improve care. We found that nearly 90% of respondents do not perform a rectal examination to evaluate for third- and fourth-degree lacerations, even when a laceration is suspected (recommended [16] to improve diagnosis and prevent complications [20]). Even those respondents who personally perform laceration repairs do not report performing rectal examinations routinely for suspected lacerations. Andrews et al. found OASI detection increased from 11% to 24.5% when re-examined using endoanal ultrasound, indicating that occult sphincter rupture may be frequently missed even when a full examination is performed [21]. Lack of familiarity with the perineal examination and repair may influence the utility of postpartum follow-up and could influence the risk for future complications (e.g., fecal incontinence). Only 15% of respondents repair severe lacerations themselves, and the majority that do chose the end-to-end technique. This is supported by evidence showing similar rates of incontinence after either end-to-end or overlapping repair [22].

There are no standard OASI curricula or training requirements for CNM education endorsed by ACNM, and only a third of respondents reported receiving any continuing education or training on OASI management [23]. We did find, however, those with *no training* were slightly more likely to have an increase in matched consensus answers (67.4% vs. 66.1%, $p < 0.05$; see Appendix Tables 8 and 12). Forty-four percent of respondents reported that OASI protocols are available in their practice or at their delivery institution, and those *with protocols* matched our consensus answers more often ($p < 0.05$). AHRQ recommends education on OASI protocols annually and when new protocols are added [24]. European studies such as the Stop Traumatic OASI Morbidity Project (STOMP) [25] have demonstrated that education and training programs can improve outcomes. Further studies investigating educational approaches such as increased protocols or CME to improve OASI identification and outcomes are needed in the USA. The utility of OASI training for midwives may be debated since most do not repair the lacerations, but thorough examination, early recognition, and appropriate follow-up could improve maternal outcomes by increasing provider awareness.

OASI rates and complications have been used as women's health quality indicators over the past decade, although there has been some debate regarding their utility as quality measures [16]. While many quality improvement (QI) measures identify medical evaluation, testing, or management that results in improved health outcomes, perineal lacerations are problematic QI measures as they are an *adverse outcome* rather than a *prevention measure*. The evidence on preventive measures that are clearly associated with reduced OASI is scant. In our risk and prevention review, we identified warm compresses and delivering in the lateral position instead of lithotomy as a procedure or practice with moderate to strong support in the literature [26]. OASI as a QI measure is further complicated by the competing goal of reducing cesarean delivery rates. Although cesarean delivery eliminates the risk for perineal laceration, it comes at the cost of other surgical complications (e.g., infection [27]) and increased risk in future pregnancies (e.g., placenta previa, placenta accreta, or placental abruption [28]). Nonetheless, the Joint Commission, the National Quality Forum, and the AHRQ have all used third- and fourth-degree lacerations as QI markers, [16], and AHRQ continues to review OASI data [10]. Surveys

of midwives in the UK provide some detail on how providers there identify, repair, and manage perineal lacerations, but no similar comprehensive data have been reported for the US. Our study addresses this descriptive deficit and provides crucial information for optimizing OASI education.

## Strengths and limitations

This study has several strengths. We performed the work in collaboration with the largest national organization of nurse-midwives and followed the CHERRIES guide [29] to report the study. The survey language and the collection instrument were extensively tested and revised prior to national recruitment. We obtained a national sample that represents the overall ACNM membership well. We included only providers who are clinically active to characterize current practice among US midwives. We included distractor answers throughout the survey, which confirmed an extremely low rate of indiscriminant answers [30]. Finally, we structured the study so that previous questions were unlikely to influence subsequent answers and obtained all demographic data at the end of the survey. To compare participant responses with "gold standard" state-of-the-evidence answers, we used a thorough literature search and multidisciplinary consensus panel. While the "correct approach" to OASI prevention and management may be debated, the use of our "consensus key" provided a convenient objective referent to evaluate provider and patient characteristics associated with evidence-based knowledge. Consensus studies have been used since the 1950s and are beneficial when clear published guidelines with definite recommendations are not available. Our consensus answers largely agree with current ACOG recommendations that were published after this study, although our consensus answers provided more definite classification of the evidence to allow quantitative analysis.

This study has important limitations. The overall response rate was low, consistent with other reports of decreasing survey participation but similar to the lower reported response rate for emailed surveys [31]. Monetary compensation is one way to increase response rates [31]; however, that can inject a different source of bias among responders. Due to limited funding, we were unable to pursue this approach and instead compared our responders with the overall ACNM membership as rigorously as possible. Fortunately, we were able to show that participants were similar to the overall ACNM membership in age and gender. They were significantly more likely to be white and to have completed a master's degree, but the difference was very small. With email survey studies there is potential for collection bias and duplicate participants. We minimized these by tracking participants with a coding system and removing participants from subsequent survey solicitations. We relied on self-reported participant and patient demographics, which cannot be confirmed with objective data. Like most survey studies, the data are limited by the cross-sectional, time-limited nature of the study. Additionally, we included only CNMs who were members of ACNM. In 2014, there were reportedly 11,116 midwives of all types in the US, and the ACNM group represents only about 60% of those [7]. While this approach reduces the generalizability for non-ACNM midwives, our study design was practical for participant recruitment. We invited from a large representative midwifery organization, and this population may have the highest level of training and expertise. Finally, the survey was performed just before publication of the ACOG Practice Bulletin on OASI prevention and repair [14]; knowledge and practice of OASIs could therefore be increased since our data were collected. This could be evaluated with repeat survey assessment, but that is beyond the scope of the current work.

## Conclusions

Severe OASIs carry long-lasting consequences for women, and timely identification and repair are important for better outcomes. CNMs are key providers during a woman's pregnancy and delivery experience, and their role in US women's healthcare is likely to increase as higher costs and limited resources drive increased patient care by nurse practitioners, physician assistants, and other non-MD providers. Our study identifies several areas for which continuing education and enhanced training may be valuable, including OASI risks, diagnosis techniques, and management protocols. Improving knowledge of OASI risks, prevention, and management could significantly improve long-term outcomes. Our findings imply that healthcare quality agencies that use severe OASIs as a safety indicator might achieve significant progress by forming interdisciplinary groups to develop and institute training.

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## Compliance with ethical standards

**Financial disclaimer/conflict of interest** None.

# Appendix

**Table 5** Consensus panel evidence-based practices for OASI prevention and management

**Antepartum risk factors**

| Direct relationship with risk | Inverse relationship with risk | Did not increase/decrease or no evidence |
|---|---|---|
| Prior 3rd- or 4th-degree laceration | Multiparity | Prior urinary tract infection[a] |
| Nulliparity | | Prior 1st- or 2nd-degree laceration |
| Patient ethnicity/race | | Maternal age |
| | | Gestational age |
| | | Maternal BMI |
| | | Diabetes |
| | | Infibulation (female circumcision) |
| | | Nutrition |

**Intrapartum risk factors**

| Direct relationship with risk | Inverse relationship with risk | Did not increase/decrease or no evidence |
|---|---|---|
| Forceps assistance | Maternal positioning (lateral, not lithotomy) at delivery | Foley bulb/Cook catheter use[a] |
| Midline/median episiotomy | | Misoprostol induction |
| Vacuum assistance | | Duration of labor |
| Shoulder dystocia | | Chorioamnionitis |
| Estimated fetal weight | | Epidural anesthesia |
| Position of fetal vertex (e.g., OP) | | Mediolateral episiotomy |
| Oxytocin administration | | Duration of 2nd stage |
| | | Uncontrolled delivery (e.g., no perineal protection) |

**Procedures routinely performed at time of OASI repair**

| Recommended procedure | Not recommended or no evidence | In specific circumstances, by clinical judgment |
|---|---|---|
| Rectal examination after repair | Bowel prep or enema[a] | Consult a specialist or another provider |
| Rectal examination before repair | Delayed repair | Move to the operating room for repair |
| Irrigation of wound | Antibiotic(s) after repair | Additional anesthesia |
| Antibiotic(s) before or during repair | | |

**Routinely recommended/prescribed on discharge for 3rd- or 4th-degree lacerations**

| Recommended procedure | Not recommended or no evidence | In specific circumstances, by clinical judgment |
|---|---|---|
| Stool softener | Bedrest[a] | Recommend future cesarean delivery |
| Sitz baths/pericare | Fiber supplements | |
| NSAIDs | Lidocaine ointment or spray | |
| Early follow-up (before routine postpartum visit) | Low-fat diet | |
| Narcotic pain meds | Antibiotics | |
| Recommend future vaginal delivery | Glycerin suppositories | |
| | Physiotherapy/pelvic floor exercises | |
| | High-fiber diet | |

[a] Distractor choice

**Table 6** Frequency of participants who matched consensus answer choices regarding ante- and intrapartum risk factors

| | Frequency (%) CNM matching consensus answer ($n$ = 832) |
|---|---|
| Antepartum risk factors[a] | |
| Prior urinary tract infection[b] | 99.4% (827) |
| Multiparity | 94.0% (782) |
| Prior 1st- or 2nd-degree laceration | 93.0% (774) |
| Prior 3rd- or 4th-degree laceration | 87.1% (725) |
| Maternal age | 83.9% (698) |
| Gestational age | 80.5% (670) |
| Maternal BMI | 70.1% (583) |
| Diabetes | 44.2% (368) |
| Nulliparity | 36.3% (302) |
| Infibulation (female circumcision) | 32.5% (270) |
| Nutrition | 28.7% (239) |
| Patient ethnicity/race | 22.0% (183) |
| Intrapartum risk factors[c] | |
| Foley bulb/Cook catheter use[b] | 99.4% (827) |
| Misoprostol induction | 98.7% (821) |
| Forceps assistance | 94.0% (782) |
| Duration of labor | 88.2% (734) |
| Midline/median episiotomy | 87.7% (730) |
| Chorioamnionitis | 87.4% (727) |
| Epidural analgesia | 82.5% (686) |
| Vacuum assistance | 75.4% (627) |
| Mediolateral episiotomy | 69.4% (577) |
| Shoulder dystocia | 67.2% (559) |
| Estimated fetal weight | 61.4% (511) |
| Position of fetal vertex (e.g., OP) | 57.0% (474) |
| Maternal positioning at delivery | 55.2% (459) |
| Duration of 2nd stage | 46.4% (386) |
| Uncontrolled delivery (e.g., no perineal protection) | 39.2% (326) |
| Oxytocin administration | 3.8% (32) |

[a] Percentage of 12 listed factors that matched consensus risk/no effect answers: 64% (range 25%–100%)

[b] Distractor choice

[c] Percentage of 16 listed factors that matched consensus risk/no effect answers: 69% (range 31%–100%)

**Table 7** Frequency of participants who matched consensus answer choices regarding procedures performed at time of OASI repair and management approaches for patients with 3rd- or 4th-degree lacerations

| | Frequency (%) CNM matching consensus answer ($n$ = 125) |
|---|---|
| Procedures at time of repair by participants[a] | |
| Delayed repair | 100% (125) |
| Bowel prep or enema[b] | 100% (125) |
| Rectal examination after repair | 91.2% (114) |
| Antibiotic(s) after repair | 89.6% (112) |
| Rectal examination before repair | 72.8% (91) |
| Additional anesthesia | 67.2% (84) |
| Consult a specialist or another provider[c] | 47.2% (59) |
| Irrigation of wound | 19.2% (24) |
| Antibiotic(s) before or during repair | 2.4% (3) |
| Move to the operating room for repair[c] | 1.6% (2) |
| Management approach for patients with 3rd- or 4th-degree lacerations[d] | |
| Bedrest[b] | 100% (125) |
| Recommend future cesarean delivery | 99.2% (124) |
| Low-fat diet | 98.4% (123) |
| Antibiotics | 96.8% (121) |
| Stool softener | 93.6% (117) |
| Glycerin suppositories | 93.6% (117) |
| Sitz baths/pericare | 89.6% (112) |
| NSAIDs | 80.8% (101) |
| Physiotherapy/pelvic floor exercises | 68.8% (86) |
| High-fiber diet | 56.8% (71) |
| Fiber supplements | 55.2% (69) |
| Early follow-up (before routine postpartum visit) | 44.8% (56) |
| Narcotic pain meds | 43.2% (54) |
| Lidocaine ointment or spray | 33.6% (42) |
| Recommend future vaginal delivery | 26.4% (33) |

[a] Percentage of ten listed factors that matched consensus risk/no effect answers by CNMs: 59% (30%–100%)

[b] Distractor choice

[c] Based on clinical judgment, in selected cases

[d] Percentage of 15 listed factors that matched consensus risk/no effect answers by CNMs: 72.1% (47%–100%)

**Table 8** CME, protocols, and routine rectal examinations for those who personally repair OASIs

| | Frequency (%) $n = 125$ |
|---|---|
| Are there protocols/guidelines for classifying obstetric lacerations readily available to you in your practice or hospital? | |
| No | 49.6% (62) |
| Yes | 40% (50) |
| Unsure | 10.4% (13) |
| Have you had any continuing medical education (CME) or review regarding obstetric laceration repair? | |
| No | 57.6% (72) |
| Yes | 42.4% (53) |
| Routinely perform rectal exam for suspected laceration | |
| No | 78.4% (98) |
| Yes | 20% (25) |
| Unsure | 1.6% (2) |

**Table 9** Approach to OASI repair after primary or subsequent lacerations

| | Participant response ($n = 832$) |
|---|---|
| Repair approach to primary or first 3rd- or 4th-degree laceration | |
| I do not know/unsure | 54.2% (451) |
| End-to-end EAS[a] repair | 26.8% (223) |
| Refer to or consult another provider | 8.9% (74) |
| Overlapping EAS repair | 7.8% (65) |
| Other[b] | 2.3% (19) |
| Repair approach to subsequent or recurrent 3rd- or 4th-degree laceration | |
| I do not know/unsure | 69.5% (578) |
| Refer or consult another provider | 13.6% (113) |
| End-to-end EAS repair | 8.9% (74) |
| Overlapping EAS repair | 6.3% (52) |
| Other[c] | 1.8% (15) |

[a] EAS = external anal sphincter

[b] Other included: Varies according to the provider ($n = 14$), both are used ($n = 2$), end-to-end for third-degree ($n = 1$) repair in layers: first repair rectal mucosa, then sphincter, transverse perineal muscle for strength, and lastly vaginal repair ($n = 1$), end-to-end for third degree and repair anal mucosa first before anal sphincter for fourth degree ($n = 1$), retrieve muscle, do figure eight then reinforce with additional suture ($n = 1$)

[c] Other included: Varies according to the provider ($n = 5$), have never had recurrent third/fourth-degree laceration ($n = 5$), depends on provider ($n = 3$), recommend cesarean if prior third/fourth-degree laceration ($n = 2$)

**Table 10** Participant response to performing episiotomies

| | Participant response |
|---|---|
| Episiotomies performed ($n = 832$) | |
| No | 13.1% (109) |
| Yes | 86.9% (723) |
| Episiotomies routinely performed ($n = 723$) | |
| No | 99.7% (721) |
| Yes | 2 (0.3%) |

**Table 11** Participant free-text responses listing their routine OASI prevention techniques[a]

| | Participant response ($n = 690$) |
|---|---|
| Support perineum | 47.8% (330) |
| Controlled/guided delivery | 40.0% (276) |
| Avoid episiotomies | 24.8% (171) |
| Warm compresses | 21.3% (147) |
| Maternal position changes | 21.3% (147) |
| Perineal massage | 12.8% (88) |
| Delivery between contractions | 5.5% (38) |
| No perineal massage | 3.8% (26) |
| Flex fetal head | 3.0% (21) |
| Physiologic pushing | 2.9% (20) |
| Mineral oil | 2.6% (18) |
| Mediolateral episiotomy | 2.3% (16) |
| Avoid vacuum | 1.9% (13) |
| Healthy antenatal diet | 1.3% (9) |
| Labor down | 1.3% (9) |
| Intercourse before birth | 0.4% (3) |
| Avoid elective labor induction | 0.3% (2) |
| Mother putting hands on baby head | 0.3% (2) |
| Perineal ice | 0.1% (1) |

[a] Optional free-text answers from 690 (83%) participants were standardized, coded, and summarized

**Table 12** Knowledge and practice for OASIs by participant characteristics

| | Overall knowledge of OASI practice | *P* value |
|---|---|---|
| Participant characteristics | | |
| Years in practice | | 0.297 |
| < 5 (*n* = 167) | 66.9% | |
| 5–15 (*n* = 264) | 66.5% | |
| 15+ (*n* = 401) | 67.5% | |
| Training location | | 0.970 |
| Non-university (*n* = 347) | 67.0% | |
| University (*n* = 485) | 67.0% | |
| CME training in obstetric laceration repair | | 0.023* |
| No (*n* = 580) | 67.4% | |
| Yes (*n* = 252) | 66.1% | |
| CME training in obstetric laceration repair | | 0.593 |
| Within last 5 years (*n* = 126) | 66.3% | |
| 5 years or more ago (*n* = 126) | 65.8% | |
| Protocols available for laceration repair | | 0.026* |
| Yes (*n* = 364) | 67.7% | |
| No (*n* = 315) | 66.4% | |
| #Deliveries/month | | 0.349 |
| < 10 (*n* = 465) | 66.8% | |
| 10+ (*n* = 367) | 67.3% | |
| % of practice involving OB | | 0.923 |
| < 50% (*n* = 37) | 66.9% | |
| 50% + (*n* = 795) | 67.0% | |
| Perform laceration repairs | | 0.166 |
| No (*n* = 688) | 67.1% | |
| Yes (*n* = 125) | 66.3% | |
| Annual hospital delivery volume | | 0.261 |
| < 1000 (*n* = 318) | 66.6% | |
| 1000+ (*n* = 443) | 67.2% | |
| Geographical region[a] | | 0.832 |
| Northeast (*n* = 184) | 67.2% | |
| Midwest (*n* = 181) | 67.3% | |
| South (*n* = 229) | 66.6% | |
| West (*n* = 238) | 67.0% | |
| Practice location | | 0.966 |
| Urban (*n* = 404) | 67.0% | |
| Suburban (*n* = 267) | 67.1% | |
| Rural (*n* = 149) | 66.9% | |
| Practice type | | 0.439 |
| University based (*n* = 106) | 66.7% | |
| Private/community based (*n* = 528) | 66.9% | |
| Public hospital based (*n* = 197) | 67.7% | |
| Patient characteristics | | |
| % of practice patients using Medicaid | | 0.158 |
| < 50% (*n* = 419) | 66.8% | |
| 50% + (*n* = 332) | 67.6% | |
| % of practice patients using private insurance | | 0.287 |
| < 50% (*n* = 505) | 66.8% | |
| 50% + (*n* = 258) | 67.5% | |
| Patient race | | 0.234 |
| < 50% White (*n* = 306) | 66.6% | |
| 50% + White (*n* = 476) | 67.3% | |

Table values are mean percent correct for that group

*$p < 0.05$

[a] West: AK, AZ, CA, CO, HI, ID, MT, NV, NM, OR, WA, WY. Midwest: IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI. Northeast: CT, ME, MA, NH, NJ, NY, PA, RI, VT. South: AL, AR, DE, DC, FL, GA, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV

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