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Diversity, Equity, and Inclusion in Hernia Surgery

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Diversity, Equity, and Inclusion in Hernia Surgery

We are excited to present the inaugural Journal of Abdominal Wall Surgery Diversity, Equity, and Inclusion Special Issue to celebrate the diversity across the study of hernia surgery.

Gender disparities, minorities discriminations, barriers related to migration, and limited access to healthcare because of low-income and deprived social networks, are still routinely embedded in current culture, systems, policies, and practices, perpetuating a vicious cycle of inequity.

Journal of Abdominal Wall Surgery joins the European Hernia Society to ensure equity in hernia surgery worldwide today and build a more sustainable future for all tomorrow.

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Editorial: Diversity, Equity, and Inclusion in Hernia Surgery

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Keywords: diversity, equity, inclusion, inequity, gender-biased, gender gap, surgery, minorities

Editorial on the Special Issue

Diversity, Equity, and Inclusion in Hernia Surgery

In this Special Issue of the Journal of Abdominal Wall Surgery, de Beaux shared his reflections on his inability to see issues about gender inequality. In his article, he shares reading tips regarding books which impacted on his views, sometimes bearing some uncomfortable truths. Diving deeper into Scottish history, the impressive stories of the Edinburgh Seven are described by Au and de Beaux.

The CanMeds roles state that as physicians, we need to demonstrate a commitment to patients by applying best practices [1]. Christoffersen and Henriksen found that more than half of the women with epigastric hernias in the Danish national database underwent suture-based repairs, even though mesh-based repairs reduce the rate of recurrence. Most groin hernias are found in men, therefore the article by Dahlstrand et al. on groin repairs in Swedish women adds to solving a knowledge gap. Only 19 out of 52 studies that included female patients showed separate results for women, highlighting an important focus for future study reporting. Following changes in guidelines, the proportion of endolaparoscopic surgery for groin hernia repairs (vs. open repair) has steadily risen over time in women, indicating growing adherence to guideline recommendations. Holland et al. explored racial and socioeconomic disparities in complex abdominal wall reconstruction referrals, as the equal access to minimally invasive surgery based on racial disparities has been a concern.

Some research questions will never be asked if female surgeons are not growing into principal investigators. And in order for them to climb the academic ladder, they need to be provided with opportunities for growth, mentoring and promoting from the early beginning of their careers. During training, female residents are perceived as needing more guidance and are offered less intraoperative autonomy [2–4]. Once in independent practice, women receive fewer referrals than men, especially from male colleagues [5]. This often results in less focused practices with fewer opportunities to build experience of performing complex procedures [6, 7].

Female surgeons least commonly performed the most lucrative surgical procedures [8]. Over a simulated 40 years career, female surgical specialists earn $2.5 million less than males after adjustment for factors such as hours worked, clinical revenue, type of practice and subspecialty, resulting in lower savings for retirement [9–11]. An American survey among over 25,000 academia, industry and government showed that all marginalised social groups earned less than white heterosexual males, with the latter granted more career opportunities, feeling more respected at work, experiencing less harassment and less likely to leave science [12].

A report from the Australian National Health Medical Research Council found that men were disproportionately awarded 23% more grants than women and received an additional $95 million in funding [13]. Women are less likely to be promoted even after adjusting for number of publications,

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amount of grant support, tenure vs. other career track, number of hours worked and specialty [14], and are less likely to become department chairs, as are specialists from non-white backgrounds [15]. In a randomised double blind study, applications with invented male names were rated as more competent and hirable by science faculty, given higher starter salaries and offered more mentoring whilst applications with invented female names were viewed as less competent [16].

Changing practice for the better requires a working culture that recognizes, supports and responds effectively to colleagues in need. Some barriers that women experience are invisible to others. In the operation room, if the surgeon's gender differs from the primary gender composition of the rest of the surgical team, cooperation is higher, and conflict is lower [17]. Attending a (social event at a) conference can be a barrier to women and other minorities if they witnessed or experienced harassment inside and outside the hospital. Gender and racial based discrimination, verbal and physical abuse, and sexual harassment are reported at higher rates by women, with up to 65.1% of women reporting gender discrimination and 19.9% reporting sexual harassment [18]. A recently published systematic review by our research group describes the (additional) challenges that female surgeons face during pregnancy and early motherhood. [19] As members of the surgical community, we need to recognize and respond to unprofessional and unethical behaviours and some institutions have started to offer bystander training for developing this skill.

Creating an environment where females and underrepresented minorities are recognised as experts (not only as moderators) is an open opportunity for anyone who organises an educational event. If you are an invited speaker and the programme's speakers are a poor representation of society: this is the time for you to speak up and promote others. The pharmaceutical and medical device industry is far behind, creating an industry payment gap -again in favour of male experts [20].

In 2023 I was awarded the American College of Surgeons Dr. Abdol and Mrs. Joan Islami International Guest Scholarship. One session at the annual meeting was dedicated to promoting women in leadership positions. And the following statement was shared: "A female leader must be competent, fearless and authentic." I never heard a better description to fit Agneta Montgomery, a role model for so many female surgeons of my generation (Henriksen and Miserez). If you wish to be part of the solution: please find, mentor and promote more *Agnetas* to inspire the future generations of surgeons. Arrange a seat for them at the table where decisions are being made, as well as speaking time.

AUTHOR CONTRIBUTIONS

This editorial has been written by GvR and has been shared with Nadia A. Henriksen and Barbora East upon submission.

CONFLICT OF INTEREST

GvR - Chair of the Diversity, Equality and Inclusivity working group of the European Society of Coloproctology.

GENERATIVE AI STATEMENT

The author(s) declare that no Generative AI was used in the creation of this manuscript.

PUBLISHER'S NOTE

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Racial and Socioeconomic Disparities in Complex Abdominal Wall Reconstruction Referrals

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Background: Health disparities are pervasive in surgical care. Particularly racial and socioeconomic inequalities have been demonstrated in emergency general surgery outcomes, but less so in elective abdominal wall reconstruction (AWR). The goal of this study was to evaluate the disparities in referrals to a tertiary hernia center.

Methods: A prospectively maintained hernia database was queried for patients who underwent open ventral hernia (OVHR) or minimally invasive surgical (MISR) repair from 2011 to 2022 with complete insurance and address information. Patients were divided by home address into in-state (IS) and out-of-state (OOS) referrals as well as by operative technique. Demographic data and outcomes were compared. Standard and inferential statistical analyses were performed.

Results: Of 554 patients, most were IS (59.0%); 334 underwent OVHR, and 220 underwent MISR. IS patients were more likely to undergo MISR (OVHR: 45.6% vs. 81.5%, laparoscopic: 38.2% vs. 14.1%, robotic: 16.2% vs. 4.4%; $p < 0.001$) when compared to OOS referrals. Of OVHR patients, 44.6% were IS and 55.4% were OOS. Patients' average age and BMI, sex, ASA score, and insurance payer were similar between IS and OOS groups. IS patients were more often Black (White: 77.9% vs. 93.5%, Black: 16.8% vs. 4.3%; $p < 0.001$). IS patients had more smokers (12.1% vs. 3.2%; $p = 0.001$), fewer recurrent hernias (45.0% vs. 69.7%; $p < 0.001$), and smaller defects (155.7 ± 142.2 vs. 256.4 ± 202.9 cm^2; $p < 0.001$). Wound class, mesh type, and rate of fascial closure were similar, but IS patients underwent fewer panniculectomies (13.4% vs. 34.1%; $p < 0.001$), component separations (26.2% vs. 51.4%; $p < 0.001$), received smaller mesh (744.2 ± 495.6 vs. 975.7 ± 442.3 cm^2; $p < 0.001$), and had shorter length-of-stay (4.8 ± 2.0 vs. 7.0 ± 5.5 days; $p < 0.001$). There was no difference in wound breakdown, seroma requiring intervention, hematoma, mesh infection, or recurrence; however, IS patients had decreased wound infections (2.0% vs. 8.6%; $p = 0.009$), overall wound complications (11.4% vs. 21.1%; $p = 0.016$), readmissions (2.7% vs. 13.0%; $p = 0.001$), and reoperations (3.4% vs. 11.4%; $p = 0.007$). Of MISR patients, 80.9% were IS and 19.1% were OOS. In contrast to OVHR, MISR IS and OOS patients had similar demographics, preoperative characteristics, intraoperative details, and postoperative outcomes.

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Conclusion: Although there were no differences in referred patients for MISR, this study demonstrates the racial disparities that exist among our IS and OOS complex, open AWR patients. Awareness of these disparities can help clinicians work towards equitable access to care and equal referrals to tertiary hernia centers.

Keywords: racial disparity, socioeconomic inequalities, ventral hernia repair, tertiary hospital, abdominal wall reconstruction

INTRODUCTION

Health disparities permeate many facets of surgical care, thus social determinants of health have become a frequently discussed topic in hopes to improve health equity and access to care. These disparities predominantly revolve around racial and socioeconomic inequities, which have been particularly discussed in the setting of emergency general surgery [1–3].

Specifically, disparities have been frequently reported in incisional hernia management. It has been demonstrated that Black patients were more likely to present with acute incarceration requiring emergent repair and resulting in greater complications, while White patients were more likely to undergo elective repair [4–8]. Click or tap here to enter text. Our prior work employed the National Surgical Quality Improvement Program (NSQIP) database to evaluate the longevity and potential change of this racial disparity over time [9]. Consistent with other data [4–6], Black and Hispanic patients were more likely to require emergent ventral hernia repair compared to their White counterparts; a national trend which unfortunately showed no improvement from 2008 to 2019 [9].

Socioeconomic status (SES), which can be defined by a variety of methods, has also been associated with inequitable elective hernia repair [8]. One surrogate of SES was utilizing zone improvement plan (zip) codes to obtain estimated household income [4, 10]. Handzel et al. found that patients with higher income were more likely to undergo elective hernia repair [4]. Insurance status, another surrogate for SES, represented a modifiable risk factor in published literature and has been shown to impact hernia management and outcomes [11, 12]. Lack of insurance was associated with more than twice the rate of emergent repair as well as increased serious adverse effects [13]. Medicaid and Medicare were predictors of postoperative complications, such as reoperation, readmission, and emergency department visit, when compared to private payer status [5, 6, 11–14].

Equal access to minimally invasive surgery has also been a concern [1, 9, 15]. Several studies have demonstrated a racial disparity in the laparoscopic or robotic approach for common intraabdominal surgeries [1, 16, 17]. Tatebe et al. evaluated the socioeconomic factors influencing the management and outcomes of paraesophageal hernia repairs by comparing county and private hospitals [15]. Within each respective hospital, there were no disparities in access to robotic repair; however, overall factors associated with robotic surgery included private hospital location, increased income, and private insurance status [15]. Vu et al. noted similar findings, where Black patients were less likely to undergo minimally invasive inguinal hernia repair, as a result of disparate access to expert minimally invasive surgeons [17]. For ventral and incisional hernias nationally, laparoscopy was more commonly utilized in White patients compared to Black or Hispanic patients, though this incongruity appeared to be slowly improving based on Katzen et al.'s review of the NSQIP database [9, 16].

The aforementioned literature has documented several disparities that exist in emergency general surgery, specifically ventral hernia repair; but little evidence on disparities in referral patterns for elective abdominal wall reconstruction (AWR) has been reported. The goal of this study was to evaluate the potential racial and demographic disparities in patients referred to our own tertiary hernia center. To do so, we examined the characteristics and outcomes of our in-state and out-of-state referral populations. We hypothesized that our patients travelling from out-of-state for care were less likely be of a racial minority and were more likely to have private insurance, a surrogate for SES.

METHODS

Patient Selection and Study Design

Institutional review board (IRB) approval was obtained prior to the beginning of this study. Patients provided written informed consent to participate in this study and have their information documented in our institutional database.

This study was conducted at a tertiary care hernia center in North Carolina, which is home to a multidisciplinary AWR program. The patient population at this facility is comorbid with complex hernias. Given the expertise of this AWR program, particularly in open preperitoneal ventral hernia repairs, patients from across the country are referred to this institution for hernia management.

A prospectively maintained institutional database was queried for patients who underwent open, laparoscopic, and robotic ventral hernia repair from 1 January 2011 to 31 December 2022. Patients were included if they had documented insurance status and address information. Patients with other types of hernias were excluded from the study. Patients were divided into in-state (IS) referrals and out-of-state (OOS) referrals based on their home address at the time of surgery and were compared. The distance from patients' home zip codes to the hospital address zip code was calculated for every patient in the most direct path between the two points. Open ventral hernia repairs (OVHR) were evaluated separately from minimally invasive repairs (MISR), which included both laparoscopic (LVHR) and robotic ventral hernia repairs (RVHR).

The primary aim was to assess the demographic differences in our in-state referrals when compared to our out-of-state referrals, particularly race and socioeconomic status. Insurance payer was categorized into private and commercial insurance, Medicare, or public assistance, which included Medicaid, self-pay, Veterans Affairs insurance, and worker's compensation. Operative characteristics and postoperative outcomes were also reviewed. Overall wound complications were defined as any incident of wound breakdown, infection, cellulitis, seroma or hematoma requiring intervention, or mesh infection. Data was reported as in-state versus out-of-state.

Statistical Analysis

Standard statistical methods and descriptive statistics were used for this study. Between-group comparisons were performed and analyzed by a trained statistician using Statistical Analysis Software (SAS Version 9.4). Fisher's exact tests and Chi-Square were applied to analyze categorical variables, which were reported as percentages. While Kruskal-Wallis were utilized to compare continuous variables and were reported as mean values with corresponding standard deviations. All p-values were two-sided. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 554 patients met inclusion criteria. Of these, 334 underwent OVHR and 220 underwent MISR. The majority of all patients, 59.0% ($n = 327$), were IS, while 41.0% ($n = 227$) were from OOS. IS patients traveled a minimum of 2.0 km and maximum of 397.9 km to the hernia center. OOS patients traveled a minimum of 23.1 km and maximum of 3662.9 km (**Figure 1**). IS patients were more likely to undergo MISR (OVHR: 45.6% vs. 81.5%, LVHR: 38.2% vs. 14.1%, RVHR: 16.2% vs. 4.4%; $p < 0.001$) when compared to OOS referrals.

Open Ventral Hernia Repairs

After review, 334 patients underwent OVHR; 44.6% ($n = 149$) were IS referrals and 55.4% ($n = 185$) were OOS referrals. Patients' average age (56.6 ± 12.3 vs. 58.8 ± 11.4 years; $p = 0.075$), body mass index (BMI) (31.7 ± 7.0 vs. 32.8 ± 7.0 kg/m^2; $p = 0.168$), and sex (53.0% vs. 50.3% female; $p = 0.617$) were similar between IS and OOS groups. IS patients were statistically more likely to be Black or of another racial minority compared to the OOS patients (White: 77.9% vs. 93.5%, Black: 16.8% vs. 4.3%, other race: 5.4% vs. 2.2%; $p < 0.001$). IS patients traveled shorter average distances to reach the hernia center (67.4 ± 75.5 vs. 451.6 ± 532.7 km; $p < 0.001$). Insurance payer was not statistically different between IS and OOS (private insurance: 55.0% vs. 51.4%, Medicare: 36.9% vs. 44.9%, public assistance: 8.1% vs. 3.8%; $p = 0.119$). IS patients were more often current smokers (12.1% vs. 3.2%; $p = 0.001$), but there was no difference in rate of diabetes (28.2% vs. 21.1%; $p = 0.158$) or American Society of Anesthesiologists (ASA) scores (III: 54.4% vs. 51.4%; $p = 0.541$). IS patients had smaller defects (155.7 ± 142.2 vs. 256.4 ± 202.9 cm^2; $p < 0.001$) and were less likely to have had a prior

TABLE 1 | Clinical information and outcomes of open ventral hernia repairs at our tertiary referral hernia center.

	Demographic information**		
	In-State ($n = 149$)	**Out-of-State ($n = 185$)**	***p*-value**
Race			<0.001
White	116 (77.9%)	173 (93.5%)	
Black	25 (16.8%)	8 (4.3%)	
Other Races	8 (5.4%)	4 (2.2%)	
Distance Traveled			<0.001
Miles	41.9 ± 46.9	280.6 ± 331.0	
Kilometers	67.4 ± 75.5	451.6 ± 532.7	
Insurance Payer			0.119
Private	82 (55.0%)	95 (51.4%)	
Medicare	55 (36.9%)	83 (44.9%)	
Public Assistance[a]	12 (8.1%)	7 (3.8%)	
Smoking Status			0.001
Never Smoker	83 (55.7%)	128 (69.2%)	
Former Smoker	48 (32.2%)	40 (21.6%)	
Current Smoker	18 (12.1%)	6 (3.2%)	
ASA* Score			0.318
I	3 (2.0%)	1 (0.5%)	
II	60 (40.3%)	84 (45.4%)	
III	81 (54.4%)	95 (51.4%)	
IV	5 (3.4%)	5 (2.7%)	
Hernia Defect Size (cm^2)	155.7 ± 142.2	256.4 ± 202.9	<0.001
Recurrent Hernia	67 (45.0%)	129 (69.7%)	<0.001
	Intraoperative details**		
Wound Class			0.893
Clean	122 (81.9%)	150 (81.1%)	
Clean-Contaminated	10 (6.7%)	16 (8.6%)	
Contaminated	8 (5.4%)	10 (5.4%)	
Dirty-Infected	9 (6.0%)	9 (4.9%)	
Mesh Type			0.101
Synthetic	112 (75.2%)	152 (82.2%)	
Biologic	37 (24.8%)	31 (16.8%)	
No Mesh	0 (0.0%)	2 (1.1%)	
Mesh Location			0.039
Preperitoneal	145 (97.3%)	185 (100.0%)	
Intraperitoneal	4 (2.7%)	0 (0.0%)	
Mesh Size (cm^2)	744.2 ± 495.6	975.7 ± 442.3	<0.001
Panniculectomy	20 (13.4%)	63 (34.1%)	<0.001
Component Separation	39 (26.2%)	95 (51.4%)	<0.001
Operative Time (minutes)	147.8 ± 60.2	200.2 ± 86.9	<0.001
	Postoperative outcomes**		
Length-of-Stay (days)	4.8 ± 2.0	7.0 ± 5.5	<0.001
Wound Complications[b]	17 (11.4%)	39 (21.1%)	0.016
Wound Infection	3 (2.0%)	16 (8.6%)	0.009
Readmission	4 (2.7%)	24 (13.0%)	0.001
Reoperation	5 (3.4%)	21 (11.4%)	0.007
Recurrence	2 (1.3%)	10 (5.4%)	0.073
Follow-Up (months)	10.8 ± 14.2	8.8 ± 16.7	0.011

OVHR, open ventral hernia repair; ASA, American society of anesthesiologists.
***Data are presented as n(%) or mean ± SD.*
[a]*Compilation of self-pay, workers' compensation, Medicaid, and Veterans Affairs coverage.*
[b]*Compilation of wound breakdown, cellulitis, wound infection, seroma requiring intervention, hematoma, mesh infection.*

TABLE 2 | Clinical information and outcomes of minimally invasive ventral hernia repairs at our tertiary referral hernia center.

	Demographic information**		
	In-State (*n* = 178)	**Out-of-State (*n* = 42)**	***p*-value**
Race			0.225
White	125 (70.2%)	35 (83.3%)	
Black	45 (25.8%)	6 (14.3%)	
Other Races	7 (3.9%)	1 (2.4%)	
Distance Traveled			<0.001
Miles	22.6 ± 24.4	77.6 ± 134.5	
Kilometers	36.3 ± 39.2	124.8 ± 216.3	
Insurance Payer			0.362
Private	93 (52.2%)	17 (40.5%)	
Medicare	67 (37.6%)	22 (52.4%)	
Public Assistance[a]	18 (10.1%)	3 (7.1%)	
Smoking Status			0.329
Never Smoker	116 (65.2%)	24 (57.1%)	
Former Smoker	51 (28.7%)	13 (31.0%)	
Current Smoker	11 (6.2%)	5 (11.9%)	
ASA* Score			0.318
I	10 (5.6%)	0 (0.0%)	
II	76 (42.7%)	23 (54.8%)	
III	84 (47.2%)	18 (42.9%)	
IV	8 (4.5%)	1 (2.4%)	
	Intraoperative details**		
Operative Technique			0.442
Laparoscopic	125 (70.2%)	32 (76.2%)	
Robotic	53 (29.8%)	10 (23.8%)	
Wound Class			
Clean	158 (88.8%)	39 (92.9%)	0.617
Clean-Contaminated	17 (9.6%)	2 (4.8%)	
Contaminated	3 (1.7%)	1 (2.4%)	
Dirty-Infected	0 (0.0%)	0 (0.0%)	
Mesh Type			0.086
Synthetic	163 (91.6%)	37 (88.1%)	
Biologic	2 (1.1%)	1 (2.4%)	
No Mesh	13 (7.3%)	4 (9.5%)	
Mesh Location			0.227
Intraperitoneal	115 (68.5%)	23 (60.5%)	
Preperitoneal	50 (29.8%)	14 (36.8%)	
Retrorectus	3 (1.8%)	0 (0.0%)	
Onlay	0 (0.0%)	1 (2.6%)	
	Postoperative outcomes**		
Length-of-Stay (days)	3.4 ± 2.5	3.3 ± 2.0	0.904
Wound Complications[b]	26 (14.6%)	1 (2.4%)	>0.999
Readmission	10 (5.6%)	3 (7.1%)	0.309
Reoperation	2 (1.1%)	0 (0.0%)	>0.999
Recurrence	13 (7.3%)	0 (0.0%)	>0.999
Follow-Up (months)	41.4 ± 31.4	39.9 ± 36.5	0.542

**MISR, minimally invasive surgical repair; ASA, American society of anesthesiologists.*
***Data are presented as n(%) or mean ± SD.*
[a]Compilation of self-pay, workers' compensation, Medicaid, and Veterans Affairs coverage.
[b]Compilation of wound breakdown, cellulitis, wound infection, seroma requiring intervention, hematoma, mesh infection.

ventral hernia repair (45.0% vs. 69.7%; $p < 0.001$). There was no difference in use of preoperative abdominal wall Botulinum Toxin A injection (2.7% vs. 3.8%; $p = 0.760$).

Intraoperatively, there was no difference in Centers for Disease Control (CDC) wound class (clean: 81.9% vs. 81.1%; $p = 0.893$), mesh type (75.2% vs. 82.2% synthetic; $p = 0.101$), rate of fascial closure (98.0% vs. 97.3%; $p = 0.736$), or delayed primary closure (7.4% vs. 4.9%; $p = 0.488$), but IS patients had a lower rate of preperitoneal repair (preperitoneal: 97.3% vs. 100.0%, intraperitoneal: 2.7% vs. 0.0%; $p = 0.039$), panniculectomy (13.4% vs. 34.1%; $p < 0.001$), and component separation (26.2% vs. 51.4%; $p < 0.001$). IS also underwent shorter operations (147.8 ± 60.2 vs. 200.2 ± 86.9 min; $p < 0.001$), received smaller mesh (744.2 ± 495.6 vs. 975.7 ± 442.3 cm^2; $p < 0.001$), and required shorter length-of-stay (4.8 ± 2.0 vs. 7.0 ± 5.5 days; $p < 0.001$).

There was no difference in postoperative rates of wound breakdown (2.7% vs. 7.0%; $p = 0.082$), cellulitis (2.0% vs. 3.8%; $p = 0.521$), seroma requiring intervention (5.4% vs. 9.2%; $p = 0.177$), hematoma (2.7% vs. 3.2%; $p > 0.999$), intraabdominal abscess (1.3% vs. 2.7%; $p = 0.465$), or mesh infection (0.0% vs. 2.7%; $p = 0.067$) between IS and OOS patients. However, IS patients had decreased wound infections (2.0% vs. 8.6%; $p = 0.009$) and overall wound complications (11.4% vs. 21.1%; $p = 0.016$). IS patients had fewer readmissions (2.7% vs. 13.0%; $p = 0.001$) and reoperations (3.4% vs. 11.4%; $p = 0.007$) but no difference in hernia recurrence (1.3% vs. 5.4%; $p = 0.073$). IS patients had longer follow-up (10.8 ± 14.2 vs. 8.8 ± 16.7 months; $p = 0.011$) (**Table 1**).

Minimally Invasive Ventral Hernia Repairs

A total of 220 patients underwent MISR, with 71.4% ($n = 157$) undergoing LVHR and 28.6% ($n = 63$) undergoing RVHR. Most MISR were performed on IS patients, 80.9% ($n = 178$), compared to 19.1% ($n = 42$) of OOS patients. In contrast to the findings in OVHR IS and OOS patients, there were no statistical differences in race between MISR IS and OOS patients (White: 70.2% vs. 83.3%, Black: 25.8% vs. 14.3%, other race: 3.9% vs. 2.4%; $p = 0.225$). Average age (57.2 ± 13.0 vs. 59.1 ± 12.9; $p = 0.385$), BMI (33.0 ± 7.4 vs. 38.4 ± 44.2 kg/m^2; $p = 0.298$), sex (56.7% vs. 59.5% female; $p = 0.743$), and insurance payer (private insurance: 52.2% vs. 40.5%, Medicare: 37.6% vs. 52.4%, public assistance: 10.1% vs. 7.1%; $p = 0.362$) were similar between IS and OOS. However, IS patients traveled statistically shorter distances to the hernia center (36.3 ± 39.2 vs. 124.8 ± 216.3 km; $p < 0.001$). There were no differences in rates of smoking (6.2% vs. 11.9%; $p = 0.329$), diabetes (23.6% vs. 16.7%; $p = 0.332$), ASA scores (III: 47.2% vs. 42.9%; $p = 0.318$), recurrent hernias (19.7% vs. 14.3%; $p = 0.421$), or defect size (29.3 ± 31.8 vs. 34.6 ± 33.9 cm^2; $p = 0.313$).

Intraoperatively, there was no difference in CDC wound class (clean: 88.8% vs. 92.9%; $p = 0.617$), mesh type (91.6% vs. 88.1% synthetic; $p = 0.086$), mesh location (intraperitoneal: 68.5% vs. 60.5%; $p = 0.227$), mesh size (374.0 ± 225.4 vs. 352.4 ± 234.3 cm^2; $p = 0.566$), rate of fascial closure (79.2% vs. 78.6%; $p = 0.927$), or component separation (3.9% vs. 2.4%; $p > 0.999$). Operative time (128.2 ± 71.8 vs. 135.4 ± 56.9 min; $p = 0.203$) and hospital length-of-stay (3.4 ± 2.5 vs. 3.3 ± 2.0 days; $p = 0.904$) were comparable between MISR IS and OOS patients.

Again, in contrast to the findings in the OVHR patients, there were no differences in rates of postoperative

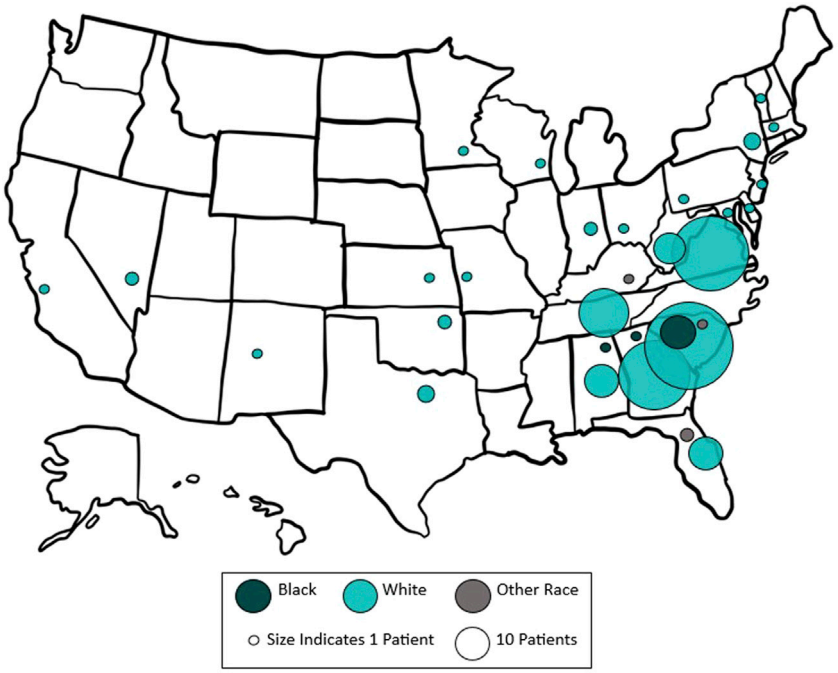

FIGURE 1 | Map of out-of-state referrals to our tertiary hernia center by race. The approximate size of each circle represents the number of patients referred from each state.

complications between IS and OOS patients. Specifically, wound breakdown (0.6% vs. 0.0%; $p > 0.999$), wound infection (1.7% vs. 0.0%; $p > 0.999$), cellulitis (10.7% vs. 0.0%; $p > 0.999$), seroma requiring intervention (0.6% vs. 0.0%; $p > 0.999$), hematoma (1.7% vs. 2.4%; $p > 0.999$), intraabdominal abscess (0.0% vs. 0.0%; $p > 0.999$), mesh infection (0.0% vs. 0.0%; $p > 0.999$), and overall wound complications (14.6% vs. 2.4%; $p > 0.999$) were comparable. MISR IS and OOS patients also had similar rates of readmissions (5.6% vs. 7.1%; $p = 0.309$), reoperations (1.1% vs. 0.0%; $p > 0.999$), hernia recurrence (7.3% vs. 0.0%; $p > 0.999$), and length of follow-up (41.4 ± 31.4 vs. 39.9 ± 36.5 months; $p = 0.542$) (**Table 2**).

DISCUSSION

There are known racial and socioeconomic disparities in emergency general surgery, ventral hernia repair being no exception, but the goal of this study was to evaluate potential disparities among IS and OOS patients referred to a tertiary hernia center for elective, complex AWR. Ventral hernias can lead to significant financial burden and poor quality of life, thus the establishment of tertiary, regional referral centers has been particularly beneficial for patients with complex and burdensome defects [18, 19]. The multidisciplinary approach at such Centers of Excellence has contributed to improved patient outcomes, but what remains unclear is how equitable access to these centers really is [20, 21]. Although Shulkin et al. suggested that hernia centers are evenly distributed across the country, this initial investigation of our own hernia center suggests there remain disparities in availability to high-risk populations [19].

Ultimately, we found that in open AWR, there was a racial disparity between local patients and out-of-state patients; however, we did not find evidence of socioeconomic disadvantages, which we had hypothesized. IS patients had less complex, smaller hernias and ultimately underwent more MISR. The OOS patients were more likely to be White and had more complex hernias, as exemplified by their higher frequency of recurrent hernias, component separations, panniculectomies, larger defect sizes, and longer hospital length-of-stay. It was not unexpected then that these patients had increased wound complications, readmissions, and reoperations. OOS patients underwent more preperitoneal repairs, which we suspect was a result of OOS patients having larger hernias and being referred specifically for our expertise in this technique.

We had predicted that patients with private insurance or higher SES would be able to afford the time and cost to travel further to a specialty hernia center. However, there was no statistical difference between the IS and OOS insurance payer for OVHR. One potential contributor to this finding could be the impact of Medicare on SES. When older patients reach the age to qualify for Medicare, the disparities between private and public assistance coverage may be mitigated. As a hernia practice with older patients (average age was 57.7 ± 12.3 years for this entire cohort), insurance status may not represent an accurate surrogate of SES.

Additionally, we found that IS patients had greater length of follow-up, likely explained by the increased ease of local patients traveling to clinic. Whereas OOS patients require more time and effort to attend appointments and may choose to be evaluated closer to home. This finding, though, is different from our previous work, where more complex hernias with greater complications required more frequent visits and resulted in longer follow-up.

Although we saw a racial disparity in our OVHR IS and OOS referral populations, there was no evidence of disparate treatment by race or an overt explanation for this discrepancy. The etiology for racial and socioeconomic disparities remains multifactorial, including patient-factors, provider-biases, and systemic-level issues [9, 22, 23]. In an elective AWR practice, preoperative optimization is important for successful fascial closure and durable repair, but patients requiring optimization and their success may be influenced by race and SES [9, 24–27]. Preoperative optimization usually includes weight loss, smoking cessation, and glucose control. Yet, it has been demonstrated that racial minority patients and those from lower socioeconomic backgrounds have higher prevalence of obesity, tobacco use, and diabetes, putting them at increased odds of requiring optimization prior to hernia management [28–30]. Al-Mansour et al. sought to assess whether these at-risk populations were then less successful at achieving preoperative optimization goals [31]. Black race, female sex, and socioeconomic distress were factors associated with failure to meet at least one preoperative goal [31]. These findings reinforced the importance of a multidisciplinary practice to facilitate optimization in disadvantaged patients, who otherwise may have difficulty achieving eligibility for elective surgery [21, 32, 33].

Travel burden is another social determinant of health that may inhibit equitable access to hernia care. This was evidenced by the distance patients were required to travel for care, which may be unique to the United States as compared to Europe, where traveling is more feasible and accepted. Lussiez et al. evaluated surgical outcomes of patients in health professional shortage areas [34]. Expectedly, patients in health shortage areas traveled three times as far and twice as long for surgical care when compared to patients in more advantaged communities [34]. Although there were no differences in surgical outcomes, increased travel could discourage or prevent patients from accessing a tertiary hernia center. Patients from healthcare sparse areas have greater difficulty accessing primary care physicians, which may decrease the incidence in which they are referred for hernia care. Lack of personal transportation or unpredictability of public transportation can again impede OOS patients from accessing our tertiary hernia center. Data to further elucidate this disparity would be difficult to obtain, but it certainly is an important barrier to care that surgeons should consider.

We found evidence of a racial inequity in the referral patterns to our hernia center. There is no control at the surgeon-level regarding who was referred to us, suggesting that the origin of this problem occurs prior to surgical consultation. So then, why are Black patients not getting referred to OOS hernia centers like their White counterparts? There is little to no published literature on how or why patients are sent to local general surgeons as opposed to regional abdominal wall reconstruction-trained surgeons, and there remains no established protocol to guide general practitioners' referrals. The referral system remains largely non-transparent, and it is difficult to know details such as how patients learned of our center, how many physicians they saw prior to us, or how long it took to be referred. Data in orthopedic surgery and bariatric surgery suggested that barriers to referral included lack of provider familiarity, minimal communication with subspecialists, and provider concerns or negative perceptions [35–38]. Further, there is no algorithm that primary care physicians can follow to best decide when to refer a patient out for management. Previous research in emergency medicine and cardiology has shown that healthcare providers' implicit bias negatively altered their treatment of racial minorities and patients from low socioeconomic backgrounds [23, 39–41]. There is potential for bias in referral patterns for hernia repair too. Contrastingly, many patients do not have a primary care physician and instead self-refer to a surgeon via an internet search [42]. This introduces another realm of disparity in health literacy, which could impact where patients choose to go for their hernia care. Regardless of the etiology of this difference in OOS referral pattern, further research needs to be done to understand and hopefully dampen the disparity.

In the MISR patients, we did not find any statistical differences or disparities among the IS and OOS patients. This finding was surprising given the aforementioned literature that suggested there are racial and socioeconomic inequities in laparoscopic and robotic abdominal surgery [1, 9, 15–17]. Our tertiary referral center has expertise in open, complex AWR, which may explain our findings that more OOS patients were referred for OVHR rather than MISR. LVHR and RVHR is usually reserved for less complex hernias, which could suggest that OOS patients were appropriately managed by local surgeons and did not need referral to our center.

The limitations of this study include the retrospective nature and use of a single institution's experience. These results may not be generalizable to other hernia Centers of Excellence or to other geographical locations, particularly outside of the United States. It would be interesting for other tertiary hernia centers to evaluate their referral demographics. Further, our institutional database only captures patients who undergo operative repair, thus we cannot make conclusions about the disparities among patients who are not offered surgery. Additionally, we included patients from South Carolina in the OOS group, although there are scenarios where those OOS patients were actually closer by distance to our hernia center than some patients from within North Carolina. Another limitation is the simplification of demographic data. For example, this study defined patients as White, Black, or other racial minority, but it does not consider multiracial patients; nor does this study have a comprehensive definition of SES. We utilized insurance payer as a surrogate, but there are several factors that contribute to SES. We initially discussed utilizing zip code to obtain average household income, but zip code alone may misrepresent SES. Future assessment could explore more accurate methods of measuring socioeconomic disadvantage. Collection of granular datapoints,

such as transportation access, employment status, and health literacy, as well as more information on the referral process may also improve our interpretation of patients' health disparities [6].

The goal of this study was to identify potential racial and socioeconomic disparities among in-state versus out-of-state referrals to a tertiary hernia center. However, the importance of this study is now to utilize this data to reduce barriers to care and improve equity in hernia management.

CONCLUSION

Disparities continue to exist in elective abdominal wall reconstruction, as demonstrated by the racial disparity among our in-state and out-of-state open ventral hernia repair patients. This study raises awareness about the inherent possible biases and nonsystematic nature of the referral system. As a society, guardrails for seeking specialty referrals should be removed so clinicians can offer appropriate treatment in a timely manner. Identification of these disparities helps clinicians work towards equitable access to care, equal referrals to tertiary hernia centers, and ultimately improved hernia management.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Institutional review board (IRB) approval was obtained from Atrium Health Carolinas Medical Center prior to the beginning of this study. Patients provided written informed consent to participate in this study and have their information documented in our Carolinas Laparoscopic and Advanced Surgical Program institutional database.

AUTHOR CONTRIBUTIONS

AH, BM, and WL were involved in data acquisition. GS performed the statistical analysis. AH wrote the manuscript, and VA completed critical review of the manuscript. All authors contributed to the article and approved the submitted version.

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CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

PUBLISHER'S NOTE

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Agneta Montgomery—A Role Model

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Keywords: diversity, women in science, women in surgery, EHS, parastomal hernia repair

AGNETA MONTGOMERY AND THE EHS

Agneta, as part of the #herniafamily, is synonymous with the EHS. She was active within the EHS from the early 1990's when it was still a very small society run by a hernia elite of European men, collaborating strongly with American hernia surgeons. For many years (2013–2020) she was a board member (of Education, Journal Hernia, President-elect) taking over the Presidency of the EHS from Professor Marc Miserez (her Co-Editor at Hernia) in 2019.

We know her to be an excellent surgeon, scientist, President, and friend. She demonstrated a unique blend of authentic integrity, drive, honesty, and the capacity to bring surgeons (sometimes fractious) together (which was at times, necessary). She charmingly inspired and admired her colleagues so enthusiastically that it brought out the best in them, and indeed in us. Her work on guideline committees, the Swedish registry, and co-organisation of the fantastic Copenhagen 2021 joint EHS/AHS Congress need mentioning. The EHS owes Agneta everlasting respect and gratitude for an amazing career, and devoted service to the EHS. A role model for so many, an inspiration to more and a friend and great surgeon to all. We wish her all the very best in her retirement.

On behalf of the EHS board,
Maarten Simons, President.
Andrew deBeaux.

AGNETA MONTGOMERY—A ROLE MODEL

Nadia A. Henriksen, Marc Miserez.

Agneta Montgomery was born in 1955 in Sweden. Agneta grew up in the countryside with her twin brother and older sister. Both of her parents were teachers at the local school, although her father's dream was always to become a surgeon. When she was growing up, Agneta designed and sewn almost all of her clothes. Probably this was already an early sign that sewing would become an important part of her later career. Agneta began her medical studies at the University of Lund in 1974, got her degree as an MD in 1982, and became a specialized surgeon 6 years later. Since then, she has been working as a consultant surgeon at the Department of Surgery, Malmö hospital, Sweden.

Agneta started clinical research early in her career and defended her PhD thesis in 1995 entitled "*Intramucosal pH of the gut. A measure of splanchnic ischemia*." Shortly thereafter, she became an associate professor at the University of Lund, and the main supervisor for seven PhD students there. Her research has focused largely on the abdominal wall including the open abdomen, and parastomal hernia in addition to the outcomes and quality of life after inguinal and incisional hernia repair. Agneta has also been involved in the development of several international guidelines from the European Hernia Society (EHS). Agneta has an h-index of 38 based on more than 100 original publications. Apart from the guidelines papers, some of her most cited papers were multicenter randomized controlled trials on recurrence rates after open and laparoscopic inguinal hernia repair and short-term outcomes after open and laparoscopic ventral hernia repair.

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FIGURE 1 | Picture of Agneta Montgomery and Nadia Henriksen at Malmø University Hospital, Sweden.

Agneta has been an active reviewer for many surgical journals and a member of the editorial boards of the British Journal of Surgery and the Scandinavian Journal of Surgery. In 2016, Agneta became an associate editor of the Hernia journal, and played an important role in raising the journal's impact factor.

Agneta's surgical career began with the introduction and development of the use of laparoscopy; Agneta was an active member and eventually became president of the Swedish Society of Laparoscopic Surgery. In 1996, Agneta became the head of the upper GI and the section of laparoscopy and abdominal wall reconstruction. With her colleagues, she developed the Malmö modified peritoneal flap repair for large incisional hernias and the local parastomal (LoPa) hernia repair, and their department became the premier centre in Sweden for handling complicated cases.

Agneta has been an active member of many surgical societies including the Council of the British Journal of Surgery and has also been the first female president of both the Swedish Surgical Society, the European Society for Surgical Research and the EHS. Furthermore, she has been a Board member of the Swedish Hernia Register and one of the founders of the Swedish Ventral Hernia Register. This underlines her strong interest in systematic quality control using surgical outcome registries.

Agneta must have been used to being the only woman on many boards and being the first female president in some of them. Agneta never actively spoke about women's rights, nor did she specifically promote women in surgery. However, Agneta became a member of these societies based on her merits and qualifications, and not because a woman was needed as a token. Agneta has always participated lively in discussions with a smile and by referring to evidence and facts. Agneta has been an ambitious supervisor in both surgery and research, expecting hard work and commitment from her students and co-workers alike (**Figure 1**). With a few of them, Agneta has to develop a structured education and training programme for surgeons in Sweden much of which remains applicable at an international level.

There is a natural respect around Agneta, and she consistently abstains from leveraging feminine allure as a strategy to attain her goals. Agneta has long been considered a respected and equally valued surgeon and scientist by the men around her. Agneta is indeed a role model for younger surgeons because of her former presence in different surgical societies and her great achievements in research and surgery. Agneta is an all-round loving and caring person and a very dear friend to many in hernia societies.

Agneta has retired from surgical practice and is currently supervising PhD students. She spends most of her spare time with her lovely husband, children, and grandchildren in Malmö or at her summer house in Mossby on the South coast of Sweden.

ETHICS STATEMENT

Written informed consent was obtained from the individuals for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Female Groin Hernia Repairs in the Swedish Hernia Register 1992–2022: A Review With Updates

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Introduction: Groin hernias in women is much less common than in men; it constitutes only 9% of all groin hernia operations. Historically, studies have been performed on men and the results applied to both genders. However, prospectively registered operations within national registers have contributed to new knowledge regarding groin hernias in women. The aim of this paper was to investigate and present a body of literature based upon the Swedish Hernia Register together with recent data from the register's annual report.

Patients and Methods: PubMed and Embase were searched for studies based on the Swedish Hernia Register between 1992 and 2023. Based on the initial reading of abstracts, studies that presented results separately for women were selected and read. Recent data were acquired from the 2022 annual report of the Swedish Hernia Register.

Results: A total of 73 studies of interest were identified. Of these, 52 included women, but only 19 presented separate results for women. Four themes emerged and were analysed further: emergency surgery and mortality, femoral hernias, the risk of reoperation for recurrence, and chronic pain following female groin hernia repairs.

Discussion: Studies from the Swedish Hernia Register clearly describe that both the presentation of hernias and outcomes after repair differ significantly between the two genders. The differences that have been identified over the years have been incorporated into the national guidelines. Register data indicates that the guidelines have been implemented and are fairly well adhered to. As a result, significant improvements in outcomes regarding recurrences have been made for women with groin hernias in Sweden.

Keywords: women, inguinal hernia, femoral hernia, register study, gender differences

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INTRODUCTION

A groin hernia is a common condition, and several million groin hernia repairs are performed annually worldwide. There is a vast body of scientific evidence regarding treatment and outcomes.

While all of this is true for men, groin hernias in women are a much less common condition. Only 9% of the groin hernia repairs registered in the nationwide Swedish Hernia Register (SHR) are performed on women [1]. No randomised controlled trials have been performed specifically on women, and other prospective studies on female groin hernia surgery are sparse in the current literature [2].

Following the more wide-spread adoption of mesh techniques, such as the Lichtenstein technique in the 1990s, the risk of reoperation for recurrence became markedly reduced in men [3, 4]. This tension-free open mesh hernioplasty method of repair was also introduced for women.

In 1992, Swedish surgeons started to register groin hernia repairs in the SHR, and in time, a unique nationwide database of prospectively registered operations emerged that now offers opportunities to study women with groin hernia repairs in more detail [5]. Over the years, the different aspects of groin hernia repair in women that have received increasing study are mortality, outcome following femoral hernia repairs, the risk of reoperation for recurrence, hernia anatomy and the risk of chronic pain following groin hernia repair.

The aim of this review was to summarise 31 years of groin hernia repair in women using the latest national report from the SHR and to review previous studies based on data from the SHR pertaining to groin hernia in women with the intention of highlighting the foremost insights regarding groin hernia repair in women.

MATERIAL AND METHODS

The Swedish Hernia Register

The SHR is a non-mandatory quality register that is concerned with groin hernia repair in adults. It was established in 1992 with only eight hospitals being aligned in the beginning. The objective was to study and analyse groin hernia repairs in Sweden and stimulate improvement at participating units by comparing local outcomes with those from the rest of the nation. Today, some 90 units participate, and more than 90% of all groin hernia operations performed in Sweden are registered with the SHR, which has created a national database of more than 400,000 operations. Procedures are recorded prospectively, and patients are identified by their personal identity number, which is unique for each citizen in Sweden [6]. Patients are followed from operation until reoperation, death or emigration. SHR is linked with the Swedish population register, which allows more accurate follow-up times.

Many variables have been unchanged over the years, but others have been added, and a few have been discarded. Data registered includes patient and hernia characteristics (e.g., BMI, smoking status, comorbidity, hernia anatomy, size of the hernia defect, type of hernia, etc.), technical details (method of repair and anaesthesia, use of mesh, type of mesh, fixation) and complications occurring within 30 days (including severity and need for readmission or reoperation). Reoperations for recurrence, infection or pain are included.

In addition, between 2012 and 2018, a pain questionnaire assessing patient-reported outcome measures (PROMs) was sent out 1 year after surgery to all patients that had undergone a groin hernia repair in a unit participating in the SHR. The distributed questions were collected with a 70% response rate, which is unusual for national cohorts. The short-form PROMs questionnaire included one question concerning patient satisfaction and one from the Inguinal Pain Questionnaire (IPQ) assessing chronic pain in the groin following a groin hernia repair [7]. A short-form questionnaire has been shown to be exchangeable to the longer original version of IPQ [8]. The intensity of the pain is assessed using a 7-step fixed-rate scale with steps operationally linked to pain behaviour or pain descriptors. Responses that indicate that the pain cannot be ignored and affects daily activities are regarded as moderate to severe pain. The PROM pain question and possible answers are provided in **Supplementary Appendix S1**.

The SHR employs a standardised annual validation of registered data, where 10% of the aligned units are audited by external evaluators. The validity of the register has been studied with a finding of 98% correct variables and a 97% cover rate for procedures in the participating units, making it a register with high validity [9].

Study Design

A review was conducted on previously published studies based upon data from the Swedish Hernia Register between 1 January 1992 and 30 April 2023. PubMed and Embase were searched for studies based on data from the Swedish Hernia Register, applying the search string "'hernia' AND ('Swedish Hernia Register' OR 'Swedish Hernia Registry')". Conference abstracts were disregarded. These searches were checked against a list of studies kept by the SHR. Any additional studies found there were also identified and accessed by online search. Abstracts were read by all authors. Only studies specifying results for the female gender were included in the review.

Study Population

Recent data and figures were adopted from the 2022 annual report, and information from the SHR website [1, 10]. Data for 1992–2022 is presented because of its historical value. Data from a more modern period, 2012–2022, is presented separately, also coinciding fairly well with the introduction of national treatment recommendations for groin hernia from the National Board of Health and Welfare in 2011 [11].

RESULTS

In total, 73 studies based on the Swedish Hernia Register, between 1 January 1992 and 30 April 2023, were published in peer-reviewed journals. Two were reviews, and one was a study

TABLE 1 | Female groin hernia repairs in the Swedish Hernia Register, 1992–2022, in total and divided by surgical technique into open and endo-laparoscopic surgery.

	Open surgery	Endo-laparoscopic surgery	All female repairs
Patients	19,514 (63.6)	11,030 (35.9)	30,699
Age, years	63.9	55.5	61.2
Hernia repairs	21,414 (60.1)	13,547 (38.5)	35,179
Reoperation for recurrence	1,041 (87.1)	137 (11.5)	1,195
Type of Hernia			
Primary	20,026 (60.7)	12,837 (38.9)	33,001
Recurrent	1,353 (65.5)	699 (33.8)	2,066
Type of Hernia			
Unilateral	20,861 (66.5)	10,292 (32.8)	31,362
Bilateral	553 (14.5)	3,255 (85.3)	3,817
Emergency repairs	4,390 (86.9)	619 (12.3)	5,052

Data are in numbers with percentages in parentheses. Due to missing data in some variables during the earlier years of the SHR the sum of percentages does not always equal 100. Age is presented in median.

TABLE 2 | Female groin hernia repairs in the Swedish Hernia Register, 2012–2022, in total and divided by surgical technique into open and endo-laparoscopic surgery.

	Open surgery	Endo-laparoscopic surgery	All female repairs
Patients	5,177 (34.8)	9,682 (65.2)	14,859
Age, years	68.8	59.1	62.6
Hernia repairs	5,895 (33.3)	11,764 (66.7)	17,659
Reoperation for recurrence	183 (62.9)	108 (37.1)	291
Type of Hernia			
Primary	5,483 (32.6)	11,290 (67.4)	16,773
Recurrent	375 (44.7)	463 (55.3)	838
Type of Hernia			
Unilateral	5,725 (38.8)	9,044 (61.2)	14,769
Bilateral	164 (5.7)	2,723 (94.3)	2,887
Emergency repairs	1,648 (74.6)	561 (25.4)	2,209

Data are in numbers with percentages in parentheses. Age is presented in median.

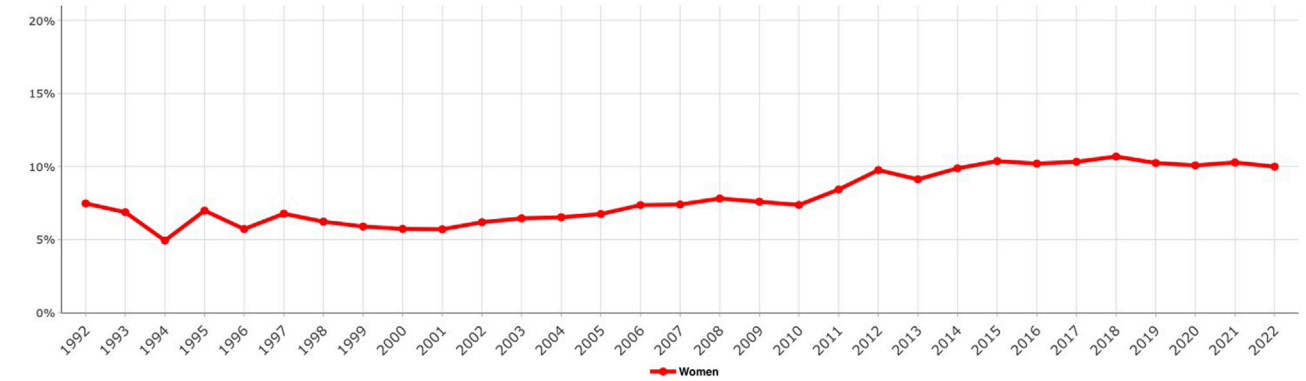

FIGURE 1 | Proportion of female groin hernia repairs in the Swedish Hernia Register, 1992–2022.

protocol. Fifty-two of the original studies included women, whereas 19 of them presented results separately for the genders and are included in this article (see **Supplementary Appendix S2**). Four important topics concerning female groin hernia repairs were deducted and presented below. These themes of interest are emergency surgery and mortality, femoral hernia, risk of reoperation for recurrence and chronic pain following female groin hernia repairs. A description of the current data from the SHR regarding female groin hernia repairs is also presented and illustrated in tables and figures.

Current Data Regarding Female Groin Hernia Repairs in the SHR

In Sweden, approximately 16,000 groin hernia operations are registered annually in the SHR, except for 2020 due to the

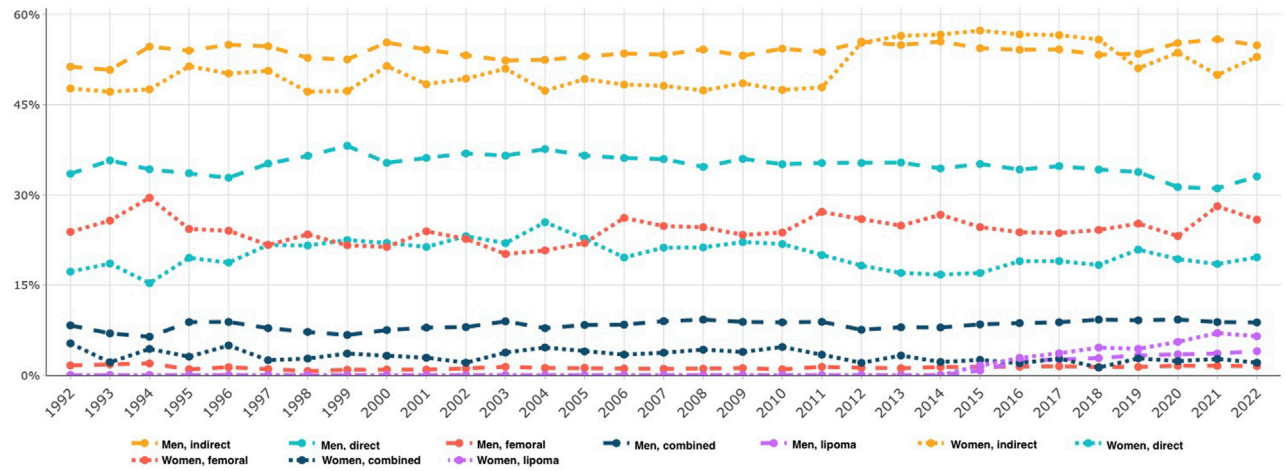

FIGURE 2 | Proportion of hernia anatomy in all groin hernia repairs in women compared to men over time, 1992–2022.

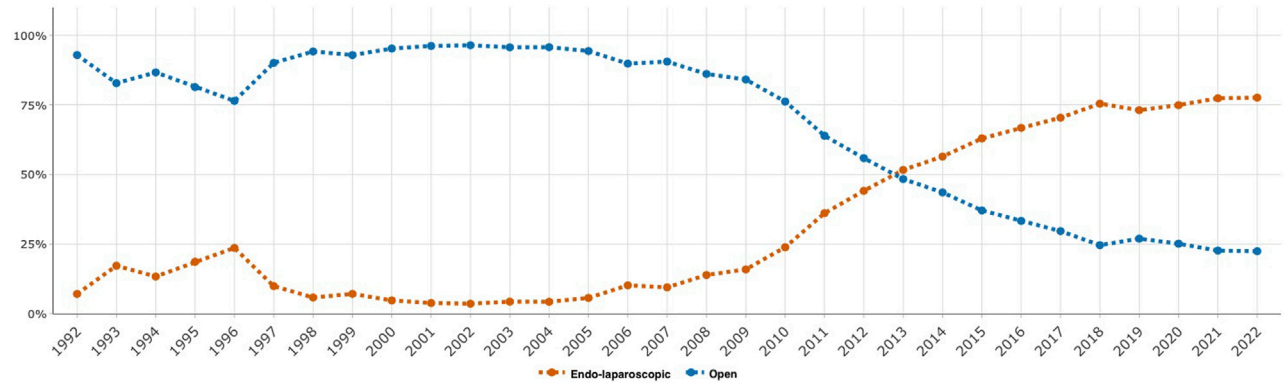

FIGURE 3 | Proportion of groin hernia repairs in women for endo-laparoscopic versus open surgery over time, 1992–2022.

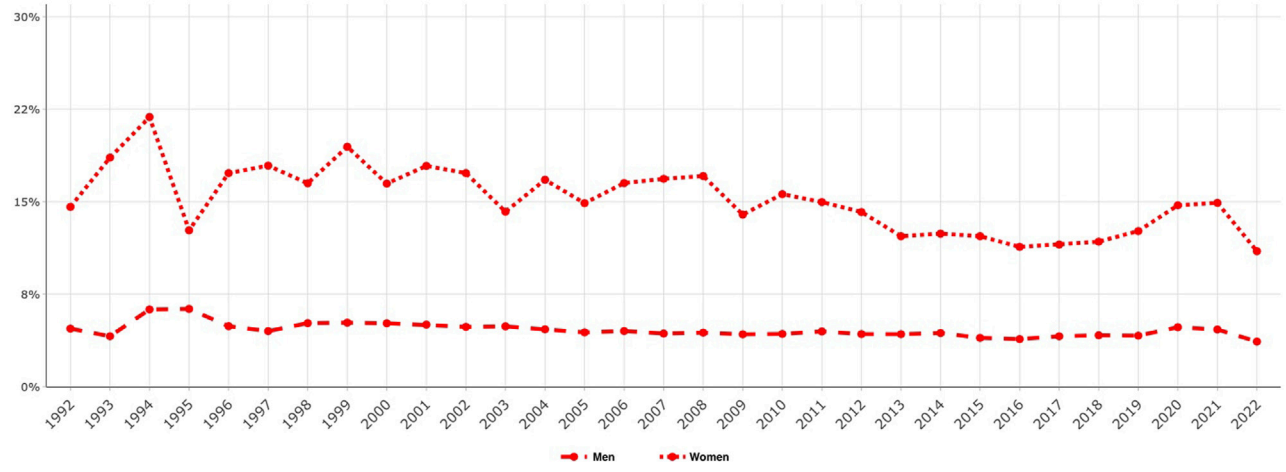

FIGURE 4 | Proportion of emergency groin hernia repairs over time, women compared to men, 1992–2022.

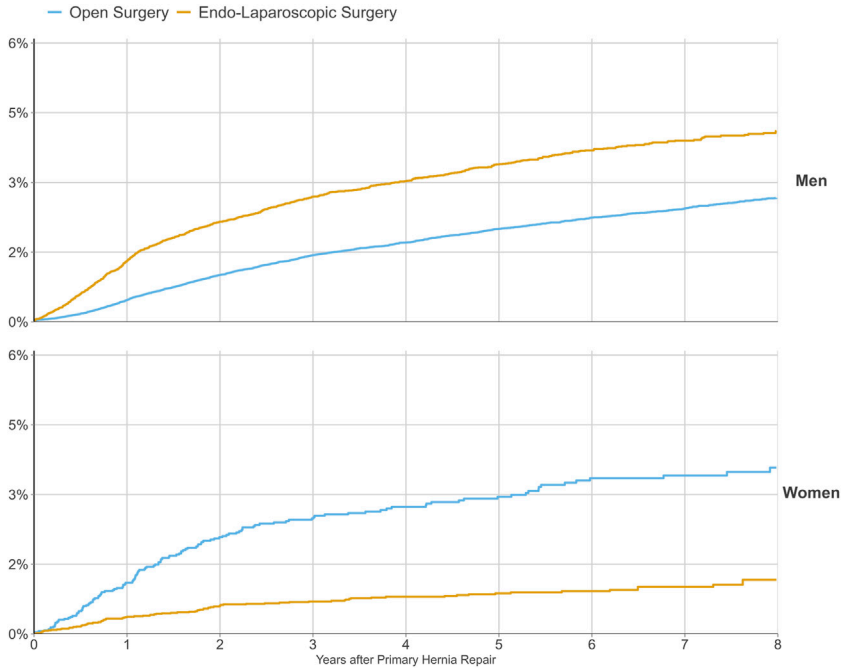

FIGURE 5 | Risk of reoperation for recurrence following a primary groin hernia repair with different surgical methods of repair between 2012 and 2022, demonstrated separately for women and men.

COVID-19 pandemic, during which the amount decreased to 12,689 operations [10]. In 2021, the number of registered operations increased again. Gender data has been reported in the SHR since the beginning. Cumulative demographic characteristics of female groin hernia repairs in the SHR in the years 1992–2022 and 2012–2022 are presented in **Tables 1**, **2**. Developments and trends in female groin hernia surgery in the SHR can also be followed by looking at changes over time between 1992 and 2022 in **Figures 1**–**5**.

The Basic Characteristics of Female Groin Hernia Repairs

The number of registered groin hernia repairs in women from 1992 to 2022 was 35,179 (**Table 1**). The proportion of female groin hernia repairs has increased over time from around 6% of all groin hernia repairs in the early 2000s to approximately 10% in the past 8 years (**Figure 1**). Demographics for female groin hernia patients during the different time periods, which are classified in terms of open or endo-laparoscopic surgery, are presented in **Tables 1**, **2**. The median age of women is consistent over time. Women who underwent endo-laparoscopic surgery were younger than women who underwent open surgery (**Tables 1**, **2**).

In **Figure 2**, the hernia anatomy, as recorded by surgeons at participating units in the SHR, demonstrates that femoral hernias made up 28.6% of women's hernias in 2021. This can be compared to a much lower proportion of femoral hernias in men (approximately 1%). Lateral inguinal hernias are still the most common hernia type registered by the SHR for women who undergo groin hernia surgery.

Rosemar et al. investigated the association between BMI and groin hernia surgery in 2010 [12]. They found a marked overrepresentation of females among patients with a BMI < 20 kg/m^2 (29.3% as compared to 7.7% in the entire study cohort of 49,094 patients). Femoral hernias were over four times as common in this group of patients, and the gender ratio (male:female) for femoral hernias in the group was 1: 4.4 rather than the 1:1.9 for the entire study cohort. Another study that used data from the SHR investigated whether waist circumference was a better predictor for groin hernia or surgery for groin hernia than BMI but did not find a difference between the two measures of body composition in either men or women [13].

A study that investigated tobacco as a risk factor for the repair of groin hernias did not establish an association in women; however, the possibility of drawing firm conclusions was limited due to the fact that only patients accepted for surgery were categorised as hernia patients [14].

The Surgical Method of Repair

The proportion of female groin hernia repairs performed using the endo-laparoscopic technique increased from 38.6% to 66.7% over the study period (**Tables 1**, **2**). This change in the surgical method of repair in women over time is also illustrated in **Figure 3**, which indicates an increase over time of endo-laparoscopic repairs compared to open repairs beginning in 2010. Endo-laparoscopic repairs constituted 77.6% of all repairs in women in 2022 (**Figure 3**).

Emergency Hernia Repair, Mortality and Morbidity

The cumulative percentage of women who underwent emergency repair for their groin hernias was almost triple that of men (14.4% vs. 5.3%) during the 1992–2022 period. The change over time is illustrated in **Figure 4**. Studies from the SHR have consistently shown that groin hernia repairs in women more often are carried out as an emergency then in men [15, 16].

Emergency surgery is associated with significantly increased mortality [17, 18]. In 2007, data from the SHR was merged with that from the death register and the standardised mortality ratio was calculated using death statistics in Sweden. 107,838 hernia repairs, including 8,182 repairs in women, were analysed. After emergency surgery, women had a higher risk of mortality than the background population, with a standardised mortality ratio of 20.49 (95% CI 13.26–30.25) if bowel resection was undertaken and one of 5.36 (95% CI 3.47–7.92) if no bowel resection was needed [18]. When the medical records of patients who had died within 30 days of hernia repair were examined, only 37% of patients with signs of bowel obstruction had had a documented groin examination upon admittance, and women were significantly less likely to undergo a groin examination compared to men [19].

A protective impact on risk for postoperative complications within 30 days of operation was seen in a study in 2012 [20]. When adverse events were studied later, and merged data from the SHR with data from the national patient register, the male gender was found to be associated with an increased risk of both cardiovascular events and intraoperative complications [21]. A study from 2002 found that although women had neither more registered nor more self-perceived adverse events, they sought healthcare advice regarding their perceived complications more often (in 75% of cases versus 48% for men, $p = 0.003$) in a study cohort from 2002 [22]. A tendency, although not statistically significant, for women to file damage claims more often (OR 1.62, 95% CI 0.98–2.71, $p = 0.06$) after groin hernia surgery was found by Nordin et al., while they were investigating damage claims between 2008 and 2010 [23]. Women (and men) who were lean (BMI < 20 kg/m^2) or overweight (BMI > 25 kg/m^2) had an increased risk of postoperative complications within 30 days of a groin hernia repair [12].

Femoral Hernia Repair

The first study using SHR data that focused on femoral hernias was published in 1999, but it included few comparisons between men and women [24]. A larger cohort of femoral hernia repairs was studied by Dahlstrand et al., who analysed 3,980 femoral repairs with a focus on recurrence, mortality and emergency operations [16]. The study demonstrated that 22.8% of groin hernia procedures in women were due to femoral hernias, whereas the corresponding proportion for men was 1.1%. Emergency procedures were more common in women, constituting 40.6% of their repairs (22.8% for men, $p < 0.001$). A study where 442 femoral hernia patients with emergency repairs retrospectively reported whether they had sought medical advice regarding their hernia and/or known about it prior to their surgery indicated that only 46.7% of the patients were aware of their hernias, while 31.3% denied symptoms from the groin more than 2 weeks before surgery. There were no differences between men and women in terms of symptoms [25].

Risk of Reoperation and Method of Repair

Each hernia operation is followed in the SHR until either reoperation of the same groin or the patient's death. This allows the probability of reoperation due to recurrence to be calculated as a function of the time after a hernia operation. Before 2005, gender had not been assessed as a risk factor for recurrence in studies from the SHR. In 2005, 6,895 prospectively registered groin hernia operations in women were studied specifically. Koch et al. found that women had a significantly increased risk of having a reoperation because of a recurrence (HR 1.30, 95% CI 1.13–1.49) [15]. They also found that Lichtenstein, the repair method with the lowest risk of reoperation in men, was associated with the highest risk for reoperation in women. Furthermore, femoral hernia was diagnosed in 41.6% of reoperations after hernias originally classified as inguinal hernias. A more recent study of more than 17,000 repairs in women confirmed the results and reported that by far, endo-laparoscopic repair was the method associated with the least risk for reoperation in women but, doubled the risk for reoperation due to recurrence in men [26]. Koch et al. suggested that surgeons missed femoral hernias when open anterior mesh techniques were used. Thus, the 2011 national guidelines recommended a laparoscopic posterior mesh repair in all groin hernias in women due to the superior ability to visualise all groin hernia orifices during the procedure. The method of choice has changed for women in Sweden since then (**Figure 3**).

Today, the female gender is no longer associated with an increased risk of reoperation in Sweden. **Figure 5** indicates the cumulative risk of reoperation for recurrence following a primary groin hernia repair with open versus endo-laparoscopic surgery. In Cox regression analysis regarding reoperation for recurrence following open or endo-laparoscopic surgery for primary groin hernia repair 2013–2022, stratified by gender, endo-laparoscopic repair was associated with a lower risk for reoperation than open repair for women [hazard ratio (HR) 0.303; 95% CI 0.232–0.396; $p < 0.001$] but a higher risk for men (HR 1.728; 95% CI 1.601–1.864; $p < 0.001$) [10]. The difference in the effectiveness of totally extra-peritoneal (TEP) groin hernia repair for the different genders was also demonstrated in a study of TEP procedures registered in the SHR 2005–2013 [27]. The authors found that women had a lower risk for reoperation due to recurrence (HR 0.39, 95% CI 0.26–0.59) compared to men.

Chronic Pain

One of the most important adverse events following groin hernia surgery is chronic pain. A total of 4,021 women with unilateral primary groin hernia repair answered the 1 year follow-up questionnaire for patient-reported outcomes that was sent out by the SHR between 2012 and 2018. A significantly larger proportion of women than men reported suffering from chronic pain; 18.4% of women versus 15.2% of men [28]. In the same study, women also reported severe pain more frequently. Moreover, TEP groin hernia repair was associated with less chronic pain in men but not in women. However, a similar trend was indicated for women. Bjurström et al.

investigated 955 women and 1,129 men with repairs who had completed the PROM during the same time period [29]. The authors found that the differences in pain between genders described at 1 year after surgery were still present 5 years after surgery when assessed with the Brief Pain Inventory [30]. Reoperation due to pain after groin hernia repair is rare, with a frequency of 0.13% in the SHR, but women have been found to be at greater risk (HR 2.13, 95% CI 1.41–3.21) [31].

The association between sleep disturbances and chronic pain after groin hernia repair has been investigated, with a specific focus on differences between the genders [29]. Retrospectively, women reported persistent sleep problems prior to surgery more often than men. Preoperative sleep difficulties were a significant risk factor for chronic pain both 1 year after surgery and in the long-term follow-up.

Chronic pain has also been studied for the subpopulation with femoral hernia repairs. Pain was demonstrated to be as common as after inguinal repairs in a study that investigated 1,461 patients who completed the IPQ at a median follow-up time of 4.7 years after surgery. Women constituted 72% of the 1,461 respondents; no differences between the genders were seen in terms of pain, with 5.5% of patients reporting pain of at least moderately severe intensity [32].

DISCUSSION

While groin hernias in women are infrequent, information regarding more than 35,000 repairs on females has now been gathered in the SHR over 30 years. The collected data encompasses the vast majority of repairs in the country and constitutes an unparalleled cohort. In this article, we demonstrate how results based upon this cohort have changed the surgical management of groin hernias in women, significantly improving the outcome after surgery.

During the first decade of the SHR's history, female repairs were included in the results presented, but no analyses taking gender into account were performed. This was not unique to Sweden. In fact, there is an absolute paucity of scientific reports regarding groin hernia in women prior to the early 2000s. Shortly after the study by Koch et al. was published in 2005, the Danish Hernia Database (DHD) published data that concentrated on outcomes for women and showed a higher risk for reoperation among women due to recurrence compared to men [15, 33]. From then on, gender has been included as an independent factor or a variable of stratification in virtually all studies based on the data from the SHR that include both genders as shown in this study.

The results from these two studies (which showed a surprising number of femoral recurrences in women) together with the evidence that preperitoneal mesh techniques were superior in femoral hernias formed the foundation for the Swedish national guidelines on groin hernia repair which were issued in 2011. For the first time, a preperitoneal technique was recommended for women, and endo-laparoscopic techniques were preferred [11, 16]. The recommendations were also communicated in a state-of-the-art lecture during the 2011 national conference of the Swedish Surgical Society. The superiority of endo-laparoscopic repairs for femoral hernias has been confirmed in a Danish register study [34]. Since occult femoral hernias have been proven to be considerably more common in women and the endo-laparoscopic techniques have a clear advantage in being able to diagnose and treat possible femoral hernias, the scales have tipped in favour of such techniques [35, 36]. More recent studies in Sweden have confirmed that endo-laparoscopic repairs are associated with a lower risk of recurrence in women [26, 27]. In 2019, a study demonstrated the same pattern in Denmark. Hernias that are repaired with a laparoscopic mesh technique in women are much less prone to recur, regardless of whether the primary hernia is inguinal or femoral [37]. The international guidelines now present a strong recommendation that endo-laparoscopic mesh repair is the recommended method of choice for women [2]. From the annual report of the SHR and the results reported in this study, it can be deduced that these guidelines are being followed, and the results in terms of recurrences in women have greatly improved as a result of that.

In terms of mortality risk after emergency hernia repair in studies from the SHR, similar results have been reported from the Danish Hernia Database and the Herniamed register. The distinct increase in mortality, especially when bowel resection is needed, is now well established [38, 39]. Regretfully, both a Swedish study and a Danish study have shown that delays in diagnosis as well as logistics cause delays in surgical treatment [19, 40].

The female gender has previously been described as a risk factor for chronic post-operative pain [41, 42]. SHR-based studies have come to the same conclusion [28, 29, 31]. The reasons for this are not known, and the difference persists even though a larger proportion of women than men have minimally invasive procedures. This is an evident area for further improvement of groin hernia treatment in women. There are limitations to register studies. There is a limitation to the number of variables that can reasonably be included in a register for routine care. In the SHR data regarding history of pain medication is not available for analyses, for example. Neither does it to date include information regarding preoperative pain, although there are plans for including it in the near future.

The case of groin hernia in women illustrates the need for different types of scientific studies in evidence-based medicine. Even with a very common affliction, like a groin hernia, it is possible that subgroups do not follow the same pattern as the larger group of patients. One of the great strengths of quality registers with a high cover rate is the possibility of studying subpopulations or less common outcomes and providing knowledge in these areas. It has been proven that both the quality of outcomes and the cost-effectiveness of groin hernia repair have been improved in Sweden thanks to the register, especially among women who undergo groin hernia repairs.

CONCLUSION

Women constitute a subgroup of groin hernia patients. Knowledge gained from the large quality registers has pointed

out gender inequalities and has been instrumental in providing guidelines tailored for women. Data from the Swedish Hernia Register demonstrates that results regarding recurrence have improved for women as the guidelines have been implemented. Today, women who are operated with an endo-laparoscopic repair for a groin hernia in Sweden have a lower risk of reoperation due to recurrence than men.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving humans were approved by the Regional Ethical Committee in Gothenburg (Gothenburg, Sweden) representing the Swedish Ethical Review Authority with reference numbers 417-17 and amendment 2022-04941-02. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/ next of kin in accordance with the national legislation and institutional requirements.

AUTHOR CONTRIBUTIONS

HdC, UD, MM, JÖ, and AM has taken the initiative to the present study, contributed to the planning, the execution and the writing of the manuscript. All authors contributed to the article and approved the submitted version.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontierspartnerships.org/articles/10.3389/jaws.2023.11759/full#supplementary-material

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Long-Term Outcomes After Epigastric Hernia Repair in Women—A Nationwide Database Study

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Aim: Women have the highest prevalence of epigastric hernia repair. Outcomes after epigastric hernia repair are rarely reported independently, although pathology and surgical techniques may be different than for other primary ventral hernias. The aim of this study was to evaluate long-term outcomes after epigastric hernia repairs in women on a nationwide basis.

Methods: Nationwide cohort study from the Danish Hernia Database. Complete data from women undergoing elective epigastric hernia repair during a 12 years period (2007–2018) was extracted. A 100% follow-up was obtained by combining data from the National Civil Register. The primary outcome was operation for recurrence, secondary outcomes were readmission and operation for complications. Outcomes for open sutured repair, open mesh repair mesh, and laparoscopic repairs were compared.

Results: In total, 3,031 women underwent elective epigastric hernia repair during the study period. Some 1,671 (55.1%) women underwent open sutured repair, 796 (26.3%) underwent open mesh repair, and 564 (18.6%) underwent laparoscopic repair. Follow-up was median 4.8 years. Operation for recurrence was higher after sutured repairs than after open mesh and laparoscopic repairs (7.7% vs. 3.3%, vs. 6.2%, $p < 0.001$). The risk of operation for complications was slightly higher after open mesh repair compared with sutured repair and laparoscopic repair (2.6% vs. 1.2%, vs. 2.0%, $p = 0.032$), with more operations for wound complications in the open mesh group (2.0%, $p = 0.006$).

Conclusion: More than half of the women underwent a suture-based repair, although mesh repair reduces risk of recurrence. Open mesh repair had the lowest risk of recurrence, but on the expense of slightly increased risk of wound-related complications.

Keywords: primary ventral hernia, recurrence, female patients, mesh repair, sutured repair

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INTRODUCTION

Women have the highest prevalence of epigastric hernia repair [1, 2] and outcomes after epigastric hernias are not well investigated as an entity [3].

Primary ventral hernias in women may have a different epidemiology due to pregnancy with the rapid increasing pressure on the abdominal wall combined with the hormonal-induced softening of the connective tissue leading to widening of the linea alba [4]. Recent European and American guidelines suggest postponing elective ventral hernia repair in women of childbearing age until after

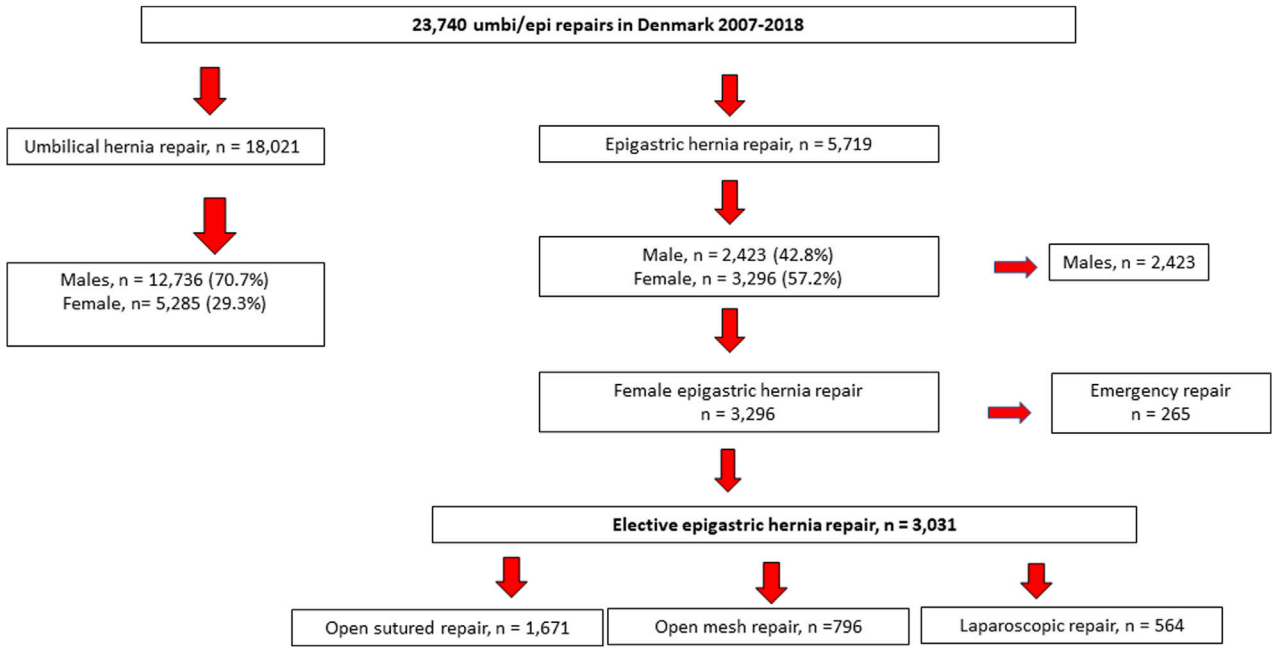

FIGURE 1 | Flowchart depicting the study cohort.

the last pregnancy and then perform a mesh-based hernia repair [5]. In line with this, an epidemiological study found that epigastric hernia repair had the highest prevalence in women of 41–50 years of age [1], where most women presumably have completed planned pregnancies. Although gender disparities in the surgical field has not previously been elucidated recent large-scaled studies have showed that women had a significantly higher risk of recurrence and complications after ventral hernia repair, regardless of the surgical technique and was less likely to receive a mesh-based repair [2, 6].

The aim of this study was to evaluate long-term outcomes after epigastric hernia repairs in women on a nationwide basis.

METHODS

This was a nationwide cohort study based on prospectively registered data from the Danish Hernia Database. The Danish Hernia Database provide detailed intraoperative data such as timing of repair (elective/emergency), primary or recurrent repair, defect size, type of mesh, sutures, and fixation. The inclusion period covered a 12 year period from 1st January 2007 to 31st December 2018. Exclusion criteria were umbilical or incisional hernias, male patients (phenotypic), patients undergoing recurrent repairs, and hernia repairs performed in relation to other surgical procedures. The follow-up period was defined as time from the primary operation until operation for recurrence, death, emigration, or end of study period (31st December 2018). Data from the Danish Hernia Database were supplemented with data from the National Civil Register, ensuring a 100% follow-up on deaths, immigration, mortality, readmittance, reoperation for complications, and reoperation for recurrence.

Moreover, the National Civil Register provides information regarding the patients American Society of Anesthesiologists score (ASA), comorbidities [Charlson Comorbidity Index (CCI)]. Operation for recurrence was defined as a subsequent operation for an epigastric hernia after a previous similar epigastric hernia repair (defined as an operation for a recurrent epigastric hernia in Danish hernia Database). We included only one (the first) operation for recurrence for each patient. Any additional operations for recurrence were not included in the analysis. The hernia size was defined as the widest diameter of the hernia defect measured intra-operatively by the surgeon registered in the Danish hernia Database.

The types of hernia repairs were divided into open or laparoscopic repair, and subgroup analyses were made for the open repairs (mesh vs. sutured repair).

Statistics

For statistical analysis we used statistical software package IBM statistical software package SPSS version 28. Observation time adjusted estimates of reoperation rates (cumulated reoperation rates) were obtained using the Kaplan-Meier method and presented as a cumulated hazard function and compared with log rank-test. Additionally, subgroup-analysis was made for the EHS size classification for primary ventral hernias, different techniques, mesh positioning (inlay/plug, sublay, onlay and, intraperitoneal), and for the different suture materials (non-

TABLE 1 | Patient demograpics.

	Open suture, *n* = 1,671, (55.1%) n (%)	Open mesh, *n* = 796, (26.3%) n (%)	Laparoscopic = 564, (18.6%) n (%)
Age (years)			
18–39	586 (35.1)	183 (23.0)	107 (19.0)
40–50	501 (30.0)	204 (25.6)	123 (21.8)
51–60	350 (20.9)	200 (25.1)	164 (29.1)
61–93	234 (14.0)	209 (26.3)	170 (30.1)
Charlson Comorbidity Index			
0	1,414 (84.7)	590 (74.5)	409 (72.5)
1	170 (10.2)	118 (14.9)	94 (16.7)
2	67 (4.0)	45 (5.7)	39 (6.9)
3	18 (1.1)	39 (6.9)	22 (3.9)
Hernia defect size[a]			
0–1 cm	1,419 (84.9)	403 (50.6)	82 (14.5)
>1–4 cm	225 (13.5)	371 (46.6)	411 (72.9)
>4 cm	27 (1.6)	22 (2.8)	71 (12.6)
Defect closure			
No closure	—	340 (42.7)	386 (68.4)
Sutured closure	1,671 (100)	456 (57.3)	178 (31.6)
Suture for defect closure			
Fast absorbable	59 (3.5)	13 (2.8)	3 (1.7)
Slowly absorbable	208 (12.5)	69 (15.0)	28 (15.7)
Non-absorbable	1,397 (84.0)	378 (82.2)	147 (82.6)
Mesh placement			
Onlay	—	299 (37.4)	0 (0)
Intraperitoneal	—	191 (24.1)	533 (94.5)
Preperitoneal	—	143 (17.8)	28 (5.0)
Retromuscular	—	131 (16.5)	3 (2.2)
Other	—	33 (4.1)	0 (0)
Mesh fixation			
No fixation	—	4 (0.5)	4 (0.7)
Glue	—	2 (0.3)	21 (3.7)
Sutures	—	771 (96.9)	12 (2.1)
Clips	—	6 (0.8)	2 (0.4)
Tacks	—	8 (1.0)	516 (91.5)
Other	—	5 (0.6)	9 (1.0)

[a]*European Hernia Society classification.*

absorbable, slowly absorbable, and fast absorbable). The statistical method used (Kaplan-Meier) ensure that the rate of recurrence is relative to the number of patients at risk.

Pearson Chi-Square Tests was used to compare the groups regarding to surgical technique and a multivariate multiple logistic regression or Cox regression analysis was performed for identification of independent covariates. Univariate covariates expressing a p-value lesser than 0.2 were entered simultaneously into the multiple logistic regression (or Cox regression model when appropriate). Presented hazard ratios (HR) were adjusted for possible contributions for other variables. A p-value < 0.05 was considered significant. Data are presented as median with range and percentages with 95% confidence intervals (95% CI), if not stated otherwise. Data are presented as median (range) and percentages with 95% CI, if not stated otherwise.

RESULTS

During the study period, a total of 23,740 patients underwent primary ventral hernia repair and the 18,021 patients who underwent umbilical hernia repair were excluded from the analysis. Some 5,719 patients underwent epigastric hernia repair and 57.2% were women and 42.8% were male patients. A total of 3,031 women underwent elective epigastric hernia repair and were included in the analysis (**Figure 1**). A 100% follow-up on readmission, operations for complications, and recurrence was obtained, and follow-up was median 4.8 years (range: 2.6–7.1 years).

More than half of the women [n = 1,671, (55.1%)] underwent a sutured repair. Open mesh repair was performed in 796 (26.3%) of the women, whereas only 564 (18.6%) underwent laparoscopic repair. The mean defect length was 1.81 cm (95% CI = 1.63–1.99) and mean width was 1.72 (95% CI = 1.55–1.90). Further demographic and intraoperative details are depicted in **Table 1**.

The long-term risk of recurrence was lowest after open mesh repair [n = 26/796, (3.3%)], laparoscopic repair [n = 35/564, 6.2%], and highest after sutured repair (n = 129/1,671, 7.7%, p < 0.001) (**Figure 2**). However, operation for complication was slightly but significantly higher after open mesh repair (n = 21/796, 2.6%, p = 0.032), mainly due to wound complications (2.0% vs. 0.4% and 0.5%, p < 0.0001) (**Table 2**). The readmission rate was highest after laparoscopic repair (62/564, 11.0%, p < 0.0001). The most frequent reason for readmission was postoperative pain (23/564, 4.1%, p < 0.001).

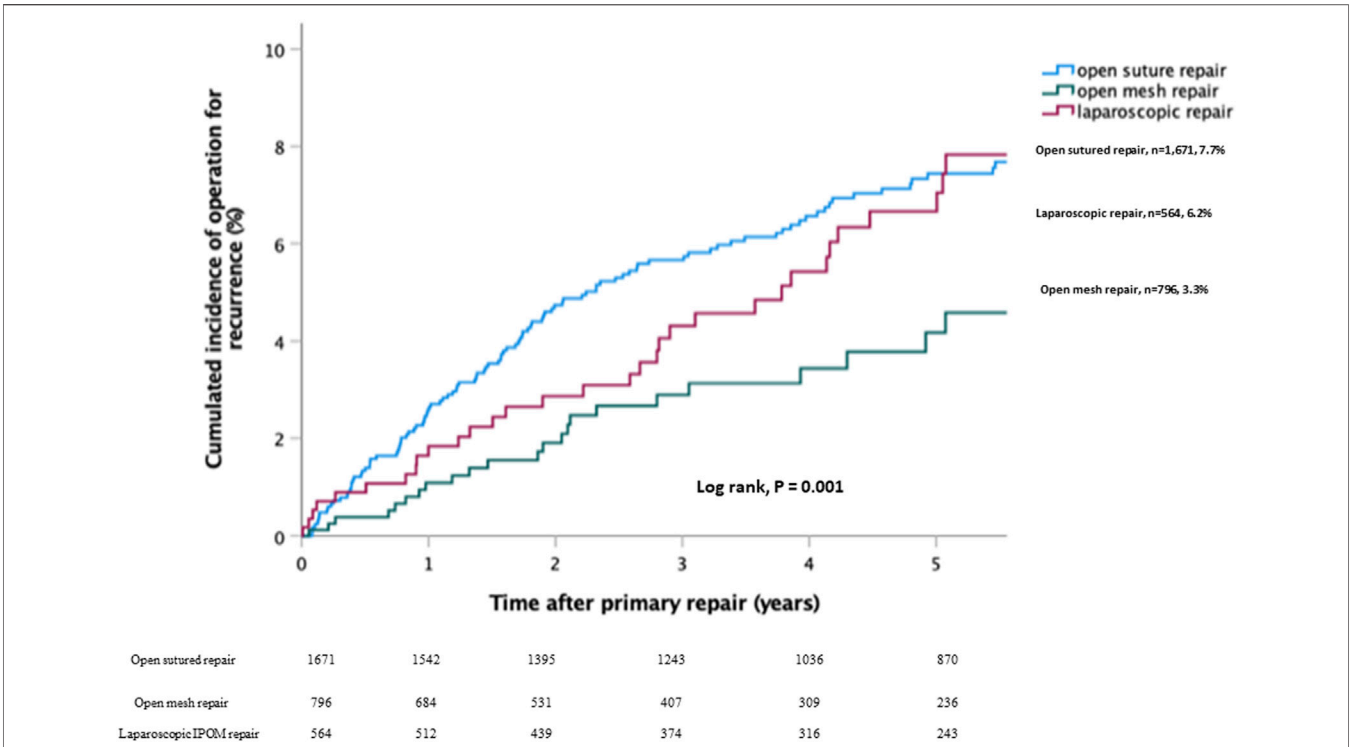

FIGURE 2 | Kaplan-Meier plot illustrating the cumulated risk of recurrences for open sutured repair vs. open mesh repair vs. laparoscopic repair.

TABLE 2 | Readmission and reoperation for complication within 90 days after elective epigastric hernia repair.

	Open sutured repair [*n* = 1,671 (55.1%)] n (%)	Open mesh repair [*n* = 796 (26.3%)] n (%)	Laparoscopic repair [*n* = 564 (18.6%)] n (%)	*p*-value
Readmission	88 (5.3)	61 (7.7)	62 (11.0)	<0.001
Cause of readmission				
Pain	11 (0.7)	9 (1.1)	23 (4.1)	<0.001
Heamatoma/bleeding	7 (0.4)	10 (1.3)	4 (0.7)	
Wound infection	5 (0.3)	10 (1.3)	0 (0)	
Postop care and rehabilitation	12 (0.7)	3 (0.4)	5 (0.9)	
Sepsis	4 (0.2)	0 (0)	1 (0.2)	
Ileus/subileus	0 (0)	0 (0)	1 (0.2)	
Constipation	1 (0.1)	0 (0)	2 (0.4)	
Medical diagnoses[a]	48 (3.0)	29 (3.6)	92 (3.7)	
Operation for complications	20 (1.2)	21 (2.6)	11 (2.0)	0.032
Cause of reoperation				
Deep bleeding	2 (0.1)	2 (0.3)	1 (0.2)	
Wound complication	7 (0.4)	16 (2.0)	3 (0.5)	0.006
Laparoscopy	2 (0.1)	1 (0.1)	3 (0.5)	
Bowel resection	1 (0.1)	0 (0.0)	0 (0.0)	
Endoscopic procedure	8 (0.5)	1 (0.1)	3 (0.5)	
Drainage of the abdominal cavity	0 (0.0)	1 (0.1)	1 (0.2)	

[a]*Pneumonia, urinary tract infection, cardiac complications, hepato-biliary, electrolyte derangement, diarrhea, dermatological disease, neurological diseases.*

In the multivariable analysis, significant risk factors for recurrence were sutured repair and reoperation for complications within 90 days (OR: 2.2, CI: 1.4–3.6, $p = 0.03$) (**Table 3**).

DISCUSSION

This nationwide study of more than 3,000 women undergoing elective epigastric hernia repair revealed that less than half of the

TABLE 3 | Uni- and multivariable analysis. Risk factors for recurrence.

	Univariate analysis HR (95% CI)	*P*	Multivariate analysis HR (95% CI)	*P*
Age, quartiles, years				
18–39	1	0.004	1	
40–50	0.59 (0.40–0.85)	0.005	0.647 (0.40–0.84)	0.272
50–60	0.66 (0.45–0.96)	0.028	0.499 (0.44–0.95)	0.236
61–93	0.53 (0.34–0.82)	0.004	0.579 (0.32–0.79)	0.202
Charlson Comorbidity Index				
0 = no	1	0.319	1	
1 = mild	1.39 (0.94–2.06)	0.098	1.601 (1.07–2.39)	0.126
2 = moderate	0.96 (0.47–1.96)	0.912	1.136 (0.55–2.33)	0.050
3 = severe	1.49 (0.66–3.38)	0.337	2.071 (0.89–4.79)	0.026
Defect size				
0–1 cm	1	0.325		
1–4 cm	1.25 (0.93–1.69)	0.135		
>4 cm	1.13 (0.55–2.32)	0.736		
Use of mesh	0.68 (0.50–0.92)	0.013	0.690 (0.50–0.94)	0.021
Sutured repair				
Open vs. Lap repair	1.02 (0.71–1.46)	0.91		
Readmission within 90 days	1.23 (0.73–2.08)	0.444		
Reoperation for complications within 90 days	2.78 (1.55–4.99)	<0.001	2.91 (1.61–5.24)	0.026

women underwent a mesh-based repair. Open mesh repair had the lowest risk of recurrence, but on the expense of a slightly increased risk of operation for wound-related complications. Readmission was significantly higher after laparoscopic repair compared with both open techniques, mainly due to postoperative pain. Surprisingly, were recurrence rates after laparoscopic repair higher than after open mesh repair—but this result may be biased by defect size and/or body mass index in the laparoscopic group, since more women in the laparoscopic group had defects >4 cm (**Table 1**).

Several previous studies found a benefit of mesh reinforcement in even the smallest primary ventral hernias [7, 8]. Accordingly, the high rate of sutured repairs in the present study is perturbing. A recent Swedish, nationwide cohort study found that women undergoing umbilical hernia repair had higher risk of recurrence [2]. In relation to this, an American retrospective quality database study analyzing outcomes from >5,000 patients demonstrated that women were less likely to have a mesh-based repair and that women had higher risk of adverse events [6]. A recent propensity-score matched study from the German Herniamed registry found that female patients had higher risk of chronic pain after elective epigastric hernia repair, but with no other differences in outcomes [9]. Other previous studies have shown that rates of complications, hospital readmission, and poor quality of life are higher among females following ventral and incisional hernia repair [10–12]. These findings should encourage future studies on causes and solutions to sex disparities in hernia repair.

Although, causes often are multifactorial, one explanation for the high rate of sutured repair could be the fact that pregnancy increases the risk of recurrence and thus, it is suggested to postpone ventral hernia repair until after the last pregnancy [13]. However, a Danish epidemiological study showed that epigastric hernia repair in women was performed most frequently at the age of 41–50 years, where women most likely are post pregnancies where mesh repair should be the preferred choice [5]. The findings of the present, and other studies may reflect a reluctance to use mesh in female patients, even after pregnancies. Whether this is due to a fear of mesh-related complications, or a presumption that suture is enough, by either patient or surgeon, can only be speculated. Whether these differences are a result of sex disparities in patient -and hernia-related risk factors, or different choices of techniques are not clear, but pose an interesting topic to highlight in future studies.

The higher risk of recurrence after sutured repair compared with mesh repair may be on the expense of a slightly higher risk of wound complications. These findings could argue that a sutured repair could be first choice of repair in patients with low risk of recurrence in shared decision making, as well as patients with high risk of recurrence should be advised repair with mesh, and patients with risk factors for wound complications should be offered minimally invasive repair. Accordingly, surgical societies recommend using a mesh-based repair to reduce recurrence rate, and to choose a minimally invasive approach to decrease the risk of surgical site infection. The present findings of a higher risk of readmission due to postoperative pain after laparoscopic repair, may have driven the shift in many surgical societies from IPOM repair to other new minimally invasive approaches [14–16]. There are several concerns when choosing the optimal repair technique, and both patient-and hernia-related factors, as well as the local expertise may influence outcomes.

This study is strengthened by a large sample size based on nationwide real-life data. However, there are limitations to database studies. First, recurrences in this study were registered as reoperation for recurrence, which highly underestimated clinical recurrence [8, 17]. Second, there were no data on smoking status and body mass index, as these variables were not registered in the Danish Hernia Database until 2018, which could potentially could have impacted the results regarding complications and recurrence. Furthermore, are the reasons for choosing specific procedure and the use of mesh or not, are not registered in the database. Given the nature of a database cohort study the data reflects real-world data and thus, may be biased by surgeons' preferences regarding defect size and type of repair.

Future large-scaled studies investigating different patient categories with different risk patterns are warranted.

CONCLUSION

Epigastric hernias are more frequently performed in women. Nationwide data found that less than half of the women underwent a mesh-based repair, although mesh repair significantly lowered recurrence rate. However, open mesh repair also slightly increased risk of operation for wound complications.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving humans were approved by the Danish Data Protection Agency (reg. no. REG-138-2018) clinicaltrials.gov, ID: NCT05750368. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

AUTHOR CONTRIBUTIONS

NH and MWC conceived of the presented idea. NH developed the theory and performed the computations. MWC and NH verified the analytical methods. NH encouraged MWC to investigate epigastric hernia repair in women and supervised the findings of this work. All authors contributed to the article and approved the submitted version.

CONFLICT OF INTEREST

MWC and NH are both members of the steering committee of the Danish Hernia Database. NH has received speaker fees from Medtronic and Gore.

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REVIEW
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The Women Making Their Mark in Modern Scottish Medical History

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Introduction: Women in medicine and surgery are a recent phenomenon. The aim of this study was to review the modern history of pioneering women in medicine and surgery in Scotland.

Methods: A variety of sources were searched including Google, PubMed, and the Royal College of Surgeons of Edinburgh publications to source the material for this paper.

Results: Despite over five centuries of Scottish universities offering medical degrees, women have only had the right to study medicine for 150 years. However, the lives of women pioneers who either circumnavigated or surmounted this inequality, namely, "James Barry" and Sophia Jex-Blake, are briefly told.

Conclusion: Doctors today owe a debt to those who pushed the boundaries, challenged the unfair rules and tackled institutional gender inequality in medicine. Reading about their lives and work is uplifting.

Keywords: gender disparity, diversity, women in surgery, women in medicine, medical history

INTRODUCTION

Scotland is a country that at times led the way in medical education. The King's College of Aberdeen, now known as the University of Aberdeen, established the first chair of medicine in the English-speaking world in 1497. And in 1505, a group of barber surgeons and other authorities created the organisation now known as the Royal College of Surgeons of Edinburgh.

Back in the 16th century, Henry VIII declared that "No carpenter, smith, weaver or women shall practice surgery." He forbade women from entering the Company of Barber Surgeons [1]. Indeed, similar edicts were in force across Europe at that time, forbidding women from the study or practice of medicine. Gender disparity has improved remarkably in the past century or so, and there are now many female doctors including surgeons. Yet there is still room for improvement when it comes to diversity in medicine [2]. So how did women first find their way into the field of surgery and medicine in Scotland in modern history?

This paper recounts some of the key women who prevailed against the odds in the practice of medicine and surgery. Space is too limited to tell everyone's story. Many have lived, worked and influenced the situation in Scotland, with little recognition. But a few names stand out whose remarkable stories ought to be told.

METHODS

Knowledge is a journey, and working in Scotland, some of what we present in this paper we already knew. However, Google, PubMed, and the publications of the Royal College of Surgeons of Edinburgh were

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FIGURE 1 | Dr. James Barry, c. 1820s. Photo credit: Oneworld Publications.

searched where necessary to check the accuracy of what is told in this paper, about some remarkable women in recent Scottish History. The search terms were "James Barry AND surgeon," "The Edinburgh Seven," and "RCSEd AND women surgeons." Scientific publications, newspaper and magazine articles were read to add the details and confirm the facts stated in the current paper. The inclusion criteria related to the topic of the current paper, and articles were excluded if they did not add to, or repeated the facts identified. The searches were undertaken during January 2023, by both authors.

RESULTS AND DISCUSSION

Margaret Bulkley (James Barry)

The story began in Edinburgh. In the early 19th century, an Irish girl in her late teens named Margaret Bulkley, after failing to obtain a position as a teacher in London, set out to explore a career in medicine. Under the encouragement and help from influential friends of her late uncle, James Barry, an artist and Royal Academician, she received 2 years of further education to prepare herself. However, only men were allowed to enter formal medical education back then. And thus, in November 1809, she disguised herself as a man and travelled by sea to Leith, a port to the north of Edinburgh. She took on the name James Barry, after her late uncle, and enrolled at the University of Edinburgh as a medical student. Despite the startling fact that at that time, only 20% of medical students would graduate from Edinburgh University, she graduated with an M.D. in 1812 [3] (**Figure 1**).

At that time in the United Kingdom, most surgeons did not go to medical school, but their teaching was an apprentice system straight out of school with older surgeons in their established practices in both charitable public hospitals and private practice.

FIGURE 2 | Sophie Jex-Blake. Photo credit: Royal Free Hospital.

Physicians were educated first in medical school at a university—it was the latter who were called doctors in the United Kingdom, whilst surgeons were called "Mister." While mister is now a generic title for an adult male, at the time it was originally used by surgeons, it was a title in itself. Skilled craftsmen would be called "Master." And those that achieved even higher skills in their craft would become "Mister." The anomaly persists to this day, with male surgeons still referred to as Mr., and female surgeons, irrespective of their marital status as Miss.

That being the case, after her graduation, James Barry travelled to London and became a pupil at the United Hospital of Guy's and St. Thomas', where she attended ward teaching and observed surgical procedures. She was examined at the Royal College of Surgeons of England the year after and qualified as a Regimental Assistant.

She continued her disguise and was recruited into the British Army, being posted across the globe from South Africa to Mauritius, Jamaica, Saint Helena, West Indies, Malta, Corfu, and Canada. She was famous for her surgical prowess and was one of the first people who performed Caesarean-sections in which both mother and child survived. During her various posts, she also brought about significant changes to the local population, particularly to the underprivileged. She improved the sanitation and water systems. She improved the conditions and medical care of enslaved people, prisoners and the mentally ill, and established sanctuaries for people suffering from leprosy. During her four decades of military service, she rose through the ranks from Assistant Surgeon to the Forces to ultimately, Inspector General of Hospitals [4].

James Barry eventually retired from the army on 19th July 1859 and died from dysentery on 25th July 1865. It was only upon her death that "James Berry" was discovered to be biologically female by the women who laid out her body [4].

The Edinburgh Seven

The story then takes us back to Edinburgh. Four years after the death of James Barry, Sophia Jex-Blake (**Figure 2**) applied to

study medicine in the University of Edinburgh in March 1869. Her application was rejected by the University Court as the university could not make the necessary arrangements "in the interest of one lady" [5]. More women joined in and the group grew. They were known as the Edinburgh Seven, comprising of Sophia Jex-Blake, Isabel Thorne, Edith Pechey, Matilda Chaplin, Helen Evans, Mary Anderson and Emily Bovell [6]. Their application for matriculation was finally approved by the University Court in the summer of 1869, granting them the right to attend all the classes and examinations required for a degree in medicine, provided that the classes were separate and confined entirely to women [5].

They began preparing for their preliminary examination. Only five of the 152 examination candidates in October 1869 were women but four of the women came in the top seven places. The women signed the matriculation roll in November 1869 [5] and so University of Edinburgh became the first British University to accept women.

However, these women were not being treated as equal to their male counterparts. Edith Pechey ranked first in the Chemistry examination among the students who sat the examination for the first time and therefore had first claim to the Hope Scholarship. However, the scholarship was awarded to male students who achieved lower grades than Pechey as "women are not part of the University class, because they are separately taught" [7].

A debate was held in April 1870 by the University Court to decide whether the women should be allowed in mixed classes, meaning that they would be fully equal to the male students. This would reduce their significantly higher school fees and render them eligible to scholarships and prizes. Some of the prominent professors were against mixed classes and this created a toxic environment that discouraged other staff from teaching them. An increasing number of male students also began to display offensive and often childish behaviours to make the women uncomfortable, including shutting doors in their faces, crowding into seats that they usually occupied and bursting into "horse laughs and howls" whenever the women approached [8].

As antagonism to the Edinburgh Seven grew, this culminated in the Surgeons' Hall Riot on 18th November 1870. The women were due to sit an Anatomy examination. The street to the examination hall was blocked by a dense mob. As the women battled their way through the crowd, the crowd threw rubbish and mud at them and shouted abuse and insults. When they finally reached the entrance of Surgeons' Hall, the gates were slammed in their faces. A sympathetic male student eventually came to help and opened the gates for them. This incident however won the women much support from their fellow male students, as they were appalled by the way that the Edinburgh Seven were treated that day [8, 9].

For 2 years, the women diligently studied for the required classes of Chemistry, Practical Chemistry, Institutes of Medicine, Botany, Natural History, Anatomy, Practical Anatomy and Surgery, and passed all the examinations. However, several professors, whose classes the women were required to attend next, refused to teach them as the University regulations permitted but did not expressly require the professors to conduct classes for the women. When they applied to sit for their first professional examination in October 1871, the Medical Faculty rejected their application. On 11th November 1871, the Senatus, with a majority of 1, recommended the University Court to rescind the existing regulations that allowed women to be taught in the University. This decision was supported by the Court of Session in 1873 which ruled that women should not have been admitted in the first place [5].

However, this did not stop the Edinburgh Seven from pursuing their dream of studying medicine. Sophia Jex-Blake moved to London and facilitated the establishment of the London School of Medicine for Women in 1874 [9]. Six of the original seven attended this School. This was also the School that the first English female surgeon, Dame Louisa Aldrich-Blake, graduated from in 1892, earning a gold medal for surgery in the process [10]. She also became the first English women to obtain the degree of Master of Surgery [11].

Female Pioneers at the Royal College of Surgeons of Edinburgh

The role of women in the Royal College of Surgeons of Edinburgh has a much shorter history. The first women to obtain the FRCSEd diploma was Alice Mabel Headwards-Hunter in 1920. This came shortly after the Sex Disqualification (Removal) Act of 1919 made it illegal in the UK to exclude any woman from employment because of her sex. However, much of Miss Headwards-Hunter's clinical practice was in India, and her story too is fascinating [12]. The first woman to be elected to the Council of the RCSEd was Miss Caroline May Doig. Her election in 1984, came some 64 years after Miss Headwards-Hunter's successful diploma by examination. At the start of 2023, four of the 17 Council members are female.

Gone are the times that women needed to disguise themselves as men to enter the field of medicine and surgery. As we celebrated the 150th anniversary of the matriculation of the Edinburgh Seven and awarded them a posthumous MBChB, gender disparity has improved across the field of medicine. Over the recent decade, the number of female doctors has risen by 27% in the United Kingdom, making up just under 48% of all licensed doctors in 2020 [13].

However, general surgery remains a male-dominant specialty with 40% of registrars and just 17% of the consultants being female [14]. It was estimated that general surgery may achieve gender parity at specialty registrars level in the UK by 2028 [14]. Signs of gender bias persist in the surgical field. For example, only 2 of 24 Presidents and 18.1% of the executive committees of surgical societies are women in the United Kingdom [15]. Surgery has a gender pay gap of 21.7% and there are culture barriers to women entering the specialty and perceptions that they would have to adapt their behaviour or expect a less supportive environment [16]. Moreover, it is reported that sexual abuse and harassment are not uncommon in the surgical workplace [17].

CONCLUSION

This paper is no more than a whistle-stop tour of the history of women in medicine and surgery. It is hoped that readers are encouraged to research any minorities who shaped medicine and surgery in their own countries. More work needs to be done to understand the reason behind gender disparity and devise policies to attract, recruit and retain women in surgery.

AUTHOR CONTRIBUTIONS

AdB contributed to the conception of the work. SA conducted the research of the work and drafted the article. AdB revised the article. All authors contributed to the article and approved the submitted version.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Educating Men—Compulsory Reading in the Enlightenment of Gender Diversity

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Keywords: men, women, gender, diversity, inequality

I was raised in a loving home, with a dominant, powerful and at times opinionated mother, and two similar older sisters. My dad, my brother and I had no chance. Now married with two sons, we think the odds at home are about even. With this background, I failed to see the issues about gender inequality, and in failing to see them, I was inherently sexist, call it "antiwomen in surgery." At times it came out, was overt, and I am sure it caused offence. For that I apologies unreservedly.

This editorial is written in honour of my mentors, some older, some younger than me, who all shall remain nameless. But I thank them for educating me, taking me on a journey which I hope many other of my male colleagues will also walk. Not to tick a box, but to believe in, and tackle diversity in all its forms. I would like to share with you, my learning material.

As a surgeon myself, I would like to think of my intellectual prowess. So it was with some chagrin, that the first two books on my syllabus, were largely picture books, akin to comics. The first, "The trouble with women," was a defining text (1). It is described as "a brilliantly witty book of cartoons, it reveals some of our greatest thinkers' baffling theories about women." Examples are drawn from history of great women, often under recognised because they were women, their research not publishable as they were women, and their work "stolen" by men and published to great acclaim. The second in the picture book series, was "Fruit of knowledge" (2). It explores the cultures and traditions that have shaped women's health and beyond. At times, almost a sex manual, but that would denigrate the powerful messages in the book. The author uses the comics medium to reveal some very uncomfortable truths about how far we haven't come.

The final book in the introductory or basics educating men course, is "We should all be feminists" (3). I am sure all of you will have a stereotypical view of a "feminist." I had too, but this book so cleverly and expertly in a few sentences changed my view. I leave you to the pleasure of it changing your view as well.

From this point, there is an explosion in books you could read. Many biographical works of great women, some famous, others not so. But they may not always help you change or refine your view on women as leaders, scientists, surgeons at the very top of their game, or indeed doing a sterling job in whatever their position. I would like to share with you 3 other titles to add to your essential reading list. Let's call it the "intermediate syllabus;"

"Inferior. The true power of women and the science that shows it" (4) is an interesting treatise of the present-day research on sex/gender differences. It exposes the fascinating and at times absurdity around the research into male/female differences. For centuries this research seems to focus on a relatively small number of differences identified between males and females, rather than on the many similarities. This obsession with the differences has perhaps led to decisions that have not been good for this world in general or its people that we share the earth with. Yes, women may in general be smaller, and thus have "smaller brains," but we so easily fall into the trap of quantity over quality.

"Invisible women" (5) has to be next. A remarkable essay on how women have been forgotten about in so many aspects of everyday life. City planning, safe car seat design, you name it, the design was based around male shapes, sizes and traditional male work patterns. So what you may say? But for example, women in a

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car, in any seat, are more likely to die in a road traffic accident than their male equivalent under identical accident conditions.

And my final recommendation, was perhaps the book that flipped my thinking patterns, into the power of women, and perhaps better, the power of men and women, let's call them people, working together for the better, using their combined skills. "x+y, A mathematician's manifesto for rethinking gender" (6). We talk of masculine characteristics in men as good, and feminine traits in men as not good, and *vice versa*. But there are times when 'masculine traits' in either a man or woman are useful for the task in hand. Degenderising such traits, does allow advertising and employing the right person for the job! With the logic and clarity of a mathematician, we get a different view of the world optimising the place for everyone based more on their individual real talents, than stereotypical opinions.

Diversity thankfully is here to stay. We fight it, as humans tend to do about any change. But I leave you with an image that also has changed my view of people. It was the picture of a small child, wearing a T-shirt that had written on it;

Birthplace: earth.
Race: human.
Politics: freedom.
Religion: love.

I hope I, and anyone who has kindly read this far, continues to read and explore the reasons why we are like we are today, and when change for the better is needed, become a soldier to the cause. I am NO feminist. But I believe in the need to redress injustice, and gender equity is good and right for this world.

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CONFLICT OF INTEREST

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