

Women's Perception of Transgastric and Transvaginal Natural Orifice Transluminal Endoscopic Surgery (NOTES) – Impact of Medical Education, Stage of Life and Cross-Cultural Aspects

Tahar Benhidjeb^{1,2,*}, Isabel Benhidjeb^{3,*}, Michael Stark², Stefan Kreisel⁴, Martin Krüger⁵, Jesco Pfitzenmaier^{3,*}, Jan Schulte am Esch^{1,*}

¹Department of General and Visceral Surgery, Center for General, Vascular, Thoracic and Visceral Surgery, Protestant Hospital of Bethel Foundation, University Hospital OWL, Campus Bielefeld Bethel, University of Bielefeld, Bielefeld, Germany; ²The New European Surgical Academy (NESA), Berlin, Germany;

³Department of Urology, Center for Computer-Assisted and Robotic Urology, Protestant Hospital of Bethel Foundation, University Hospital OWL, Campus Bielefeld Bethel, University of Bielefeld, Bielefeld, Germany; ⁴Department of Psychiatry and Psychotherapy, Section Gerontopsychiatry, Protestant Hospital of Bethel Foundation, University Hospital OWL, Campus Bielefeld Bethel, University of Bielefeld, Bielefeld, Germany; ⁵Department of Internal Medicine and Gastroenterology, Protestant Hospital of Bethel Foundation, University Hospital OWL, Campus Bielefeld Bethel, University of Bielefeld, Bielefeld, Germany

*These authors contributed equally to this work

Correspondence: Tahar Benhidjeb, Department of General and Visceral Surgery, Center for General, Vascular, Thoracic and Visceral Surgery, Protestant Hospital of Bethel Foundation, University Hospital OWL, Campus Bielefeld Bethel, University of Bielefeld, Schildescher Str. 99, Bielefeld, 33611, Germany, Email tahar.benhidjeb@yahoo.de; tahar.benhidjeb@evkb.de

Introduction: Despite that NOTES produces at least matchable clinical long-term results when compared to laparoscopy, still a restraint within the medical community and among patients is evident. Consequently, it might be meaningful to evaluate factors of patient's NOTES perception to promote its acceptance. NOTES is still quite novel and questionnaires regarding its perception by the public is still lacking even so in the Middle East. Aim of our survey is to investigate the viewpoint of female healthcare staff on NOTES.

Materials and Methods: A total of 350 questionnaires along with written information about Minimally Invasive Surgery and NOTES were distributed among the female staff in a Tertiary-care Hospital in Abu Dhabi, 257 were returned completely anonymously and voluntarily and entered into a database with a response rate of 73%. We surveyed factors like religion, medical background, age as well as history of previous laparoscopy, endoscopy, birth and other aspects that may impact a woman's perception of both transgastric and transvaginal NOTES for cholecystectomy and ovariectomy, respectively.

Results: Univariate analyses revealed the majority of Muslim women to be more receptive to NOTES as a choice of surgical technique for cholecystectomy and for ovariectomy, respectively, when compared to Christians and Hindus. However, when compared to Muslims, Christian and Hindu groups had a larger share of medical professions. Women with a medical background would opt significantly less for NOTES. Among younger women, NOTES cholecystectomy was refused due to anxiety concerning future pregnancies and sexual dysfunction. Multinomial logistic regression analysis determined medical background and with independent predictive value for the overall choice of interventional technique ($p < 0.001$). Marital status played a significant role only in the comparison of laparoscopy vs transgastric NOTES when performing cholecystectomy and ovariectomy ($p < 0.01$).

Conclusion: In this first study emanating from the Middle East, medical education and partly life stage rather than cross-cultural differences seem to influence NOTES perception in women.

Keywords: natural orifice transluminal endoscopic surgery, perception, Arab female

Introduction

Natural Orifice Transluminal Endoscopic Surgery (NOTES), as a technique to reach organs in the abdominal cavity through the stomach, anus or vagina, is not only about the size of the incisions but also about their avoidance on the skin with all the resulting

benefits of further reduction of the surgical trauma.^{1,2} Thus, NOTES strategies for cholecystectomy have been shown to significantly reduce postoperative pain and increase cosmetic satisfaction.³ Furthermore, a paired sample cross-sectional study comparing hysterectomy cases performed via conventional laparoscopy or vaginally assisted NOTES showed that vNOTES is associated with a shorter operation and briefer postoperative hospitalisation time.⁴ This study indicates that vNOTES is an approach which may offer better outcomes than a conventional laparoscopy for treating a variety of different uterine pathologies. In a recently published retrospective study evaluating the feasibility and surgical outcomes of the transvaginal NOTES method compared with conventional laparoscopy in gynecological emergency cases showed shorter surgery duration, lower postoperative pain scores, shorter hospital stays and better cosmetic outcomes in the transvaginal NOTES group.⁵ These benefits were paralleled by levels of complications that was either identical or reduced as a non-significant trend in favour of NOTES procedures.³ However, transgastric and transvaginal NOTES for cholecystectomy or ovariectomy is still rarely performed and continues to lack acceptance in the medical and patient community and is even regarded by some as experimental.⁶

Consequently, in parallel to outcome studies, it may be meaningful to evaluate factors of perception concerning this approach in order to promote NOTES acceptance. There is a broad range of literature pertaining to NOTES perception. Different target groups have been surveyed, ranging from broad populations, outpatients, inpatients and obese patients to surgeons and gynecologists.⁷⁻²⁴ To date, the total number of respondents has reached 2704 in China and Korea, 2510 in Europe, 1787 in the USA and Canada and 524 in Australia, reaching more than 7500 subjects polled (Table 1).⁷ However, the overall number of respondents alone does not reflect the broad scope of cross-cultural differences and similarities. These cultural distinctions have been well demonstrated in the Chinese population which revealed significant differences in comparison to surveys in the western population.^{8,9} In a recently published paper from Australia, a cohort of 175 Middle Eastern women attending a private gynaecology practice in Adelaide were surveyed.¹⁰ Focussing on the

Table 1 Global Surveys on NOTES Perception by Region

Publication Year	Middle East	USA/Canada	Europe	China/Korea	Australia
	Author (Number of Respondents)				
2008		Varadarajulu et al (100)	Thele et al (52)		
2009		Volckmann et al (357) Swanstrom et al (192) Peterson et al (100)			
2010			Rao et al (736)		Strickland et al (300) Olakkengil et al (49)
2011			Benhidjeb et al (118) Bucher et al (300)	Li et al (1797)	
2012		Bingener et al (409) Ross et al (152) Tsang et al (335)	Hucl et al (200) Rocchieto et al (62)	Kim et al (486)	
2013			Sulz et al (57)	Teoh et al (200) Wang et al (221)	
2014		Fei et al (142)	Weigt et al (432)		
2015			Gerntke et al (553)		
2021					Behnia-Willison et al (175)
Own survey	(257)				
Number of respondents	257	1787	2510	2704	524
TOTAL	7782				

potential influence of societal circumstances in an Arab-Islamic country, we have investigated factors like religion, medical background, age and other aspects that may impact on women's perception of NOTES for both transgastric and transvaginal cholecystectomy and ovariectomy respectively. To that respect, we performed a survey among female staff in a tertiary-care hospital in Abu Dhabi, United Arab Emirates.

Methods

This anonymous study was exempted from ethical approval by an institutional Research Ethics Committee (REC) according to Department Of Health Standard Operating Procedures for Research Ethics Committees released by the DOH, Ministry of Health and Community Protection of the United Arab Emirates (latest confirmation in its release from January 2020). Accordingly, no informed consent was obtained by the anonymous participants.

Questionnaires

Supplementary Material

An 18-item questionnaire focusing on personal information, previous endoscopic and surgical procedures with different access routes and NOTES specific questions, as well as a written information on Minimally Invasive Surgery (MIS) and NOTES concept in English ([Appendix 1](#)) and Arabic, drawing attention to potential benefits, was distributed among female employees for a period of 2 weeks at Burjeel Hospital, a tertiary-care hospital in Abu Dhabi, UAE.

Participants

350 questionnaires were distributed, 257 were returned completely anonymously and voluntarily and entered into a database with a response rate of 73%. Questionnaires were distributed and collected by co-author IB – at that time a medical student – who had not performed or been involved with studies regarding any of these particular operative techniques.

Data Analysis

Statistical analysis was carried out using the software STATA-SE 15 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, USA). Independence tests on categorical variables were performed using Pearson's chi², Mann-Whitney and Kruskal-Wallis test accordingly ([Tables 2–4](#)).

We evaluated the effect of age, marital status, profession, religious affiliation and history of vaginal delivery as potentially relevant independent predictors on the “preferred method for cholecystectomy” and “preferred method for ovariectomy” using multinomial logistic regression. To allow for model convergence, we excluded categories with only a few cell counts. These were: age – group of “20 y and younger” (n=3); religion – “other” (n=8); marital status – “other” (n=3). Reported relative risk ratios (RRR) are natural generalizations of the odds ratio. They express how much more or less likely it is to be classified in a category of the dependent variable – in respect to base dependent category – relative to being in a given independent predictor category vs its reference category. An omnibus Wald-based-test across all indicators of respective independent variables was performed to evaluate overall effects ([Tables 5 and 6](#); [Figure 1A and B](#)).

Results

Characteristics of the Surveyed Women

The stated religious affiliation was 21.8% (56) Muslim, 68.1% (175) Christian, 7.0% (18) Hindu and 3.1% (8) other including one person indicating to be non-religious. Concerning ethnicity, 93% of the surveyed women were Arab and 7% Indians. With 58.4% (150), a majority of our respondents was between 20 and 29 years old. 29.2% (75) were between 30 and 39 years of age. Concerning vocational education, the majority of 54.7% belonged to the medical service including nurses and physicians and 45.3% were non-medical. 4.3% were physicians and 30.6% indicated to hold a position in “other” fields of profession (manager, medical technical assistants, physiotherapists, personal trainer, housekeeping service, cleaning staff). 51.8% indicated to be married and 47.0% were single. 1.2% (3) stated other. 31.0% had a normal vaginal spontaneous delivery in the past. The vast majority (95.7%) had no endoscopic intervention (gastroscopy/ colonoscopy) in the past. Likewise, almost all of the respondents had not undergone a laparotomy (98.8%). Finally, the majority had also no laparoscopic intervention in the past (96.1%).

Table 2 Analysis Dependent on Religion

	Group/Level/Aspect	Religion			p-value*
		Islam	Christianity	Hinduism	
Respondents' characterization					
Age	≤ 20 y	3.6 (2)	0.0 (0)	0 (0)	0.053
	21–30 y	51.8 (29)	62.3 (109)	50.0 (9)	
	31–40 y	35.7 (20)	29.1 (51)	5.6 (1)	
	≥ 41y	8.9 (5)	8.6 (15)	44.4 (8)	
Profession	Medical	29.2 (16)	60.9 (106)	72.2 (13)	< 0.001
	Non-medical	70.9 (39)	39.0 (68)	27.8 (5)	
Marital status	Married	50.0 (28)	50.3 (88)	77.8 (14)	0.259
	Single	48.2 (27)	48.6 (85)	22.2 (4)	
	Others	1.8 (1)	1.1 (1)	0.0 (0)	
History of normal vaginal delivery	Yes	35.3 (18)	29.2 (49)	33.3 (6)	0.688
	No	64.7 (33)	70.8 (119)	66.7 (12)	
History of gastroscopy/coloscopy	Yes	3.6 (2)	4.7 (8)	5.6 (1)	0.919
	No	96.4 (54)	95.4 (164)	94.4 (17)	
History of laparotomy	Yes	3.7 (2)	0.6 (1)	0.0 (0)	0.168
	No	96.3 (52)	99.4 (172)	100.0 (18)	
History of laparoscopy	Yes	7.4 (4)	2.3 (4)	11.1 (2)	0.075
	No	92.6 (50)	97.7 (169)	88.9 (16)	
Respondents' decisional preferences					
Preferred overall technique for Cholecystectomy	Open	5.9 (3)	9.5 (16)	0.0 (0)	0.035
	Laparoscopic	54.9 (28)	68.1 (115)	70.6 (12)	
	NOTES (transvaginal)	11.8 (6)	13.6 (23)	11.8 (2)	
	NOTES (transgastric)	27.5 (14)	8.9 (15)	17.7 (3)	
Preferred overall technique for Ovariectomy	Open	9.6 (5)	9.4 (16)	0.0 (0)	0.040
	Laparoscopic	44.2 (23)	62.9 (107)	70.6 (12)	
	NOTES (transvaginal)	30.8 (16)	23.5 (40)	17.7 (3)	
	NOTES (transgastric)	15.4 (8)	4.1 (7)	11.8 (2)	
Preferred NOTES technique For cholecystectomy	Transgastric	59.2 (29)	57.3 (94)	43.8 (7)	0.538
	Transvaginal	40.8 (20)	42.7 (70)	56.3 (9)	
Preferred NOTES technique For ovariectomy	Transgastric	45.1 (23)	37.9 (61)	37.5 (6)	0.647
	Transvaginal	54.9 (28)	62.1 (100)	62.5 (10)	

(Continued)

Table 2 (Continued).

	Grouper/Level/Aspect	Religion			p-value*
		Islam	Christianity	Hinduism	
Reasons to refuse a Transvaginal approach for a Cholecystectomy	Fear of postop sexual dysfunction	19.6 (11)	29.7 (52)	22.2 (4)	0.301
	Anxiety about future pregnancies	37.5 (21)	37.1 (65)	27.8 (5)	0.724
	Objections based on moral grounds	21.4 (12)	17.1 (30)	11.1 (2)	0.574
	Experimental character of NOTES	21.4 (12)	27.4 (48)	11.1 (2)	0.248
	Other objections	12.5 (7)	5.1 (9)	0.0 (0)	0.076
Reasons to refuse a Transvaginal approach for a Ovariectomy	Fear of postop sexual dysfunction	16.1 (9)	32.6 (57)	22.2 (4)	0.049
	Anxiety about future pregnancies	30.4 (17)	33.1 (58)	22.2 (4)	0.618
	Objections based on moral grounds	19.6 (11)	17.1 (30)	11.1 (2)	0.704
	Experimental character of NOTES	25.0 (14)	25.7 (45)	16.7 (3)	0.799
	Other objections	8.9 (5)	6.3 (11)	0.0 (0)	0.401
Benefits to accept NOTES As alternative approach premise: complication rate of NOTES comparable to Laparoscopy	No visible scars	28.6 (16)	36.0 (63)	44.4 (8)	0.406
	No pain	42.9 (24)	32.0 (56)	22.2 (4)	0.184
	Short hospital stay	14.3 (8)	26.9 (47)	11.1 (2)	0.070
	Short sick leave	8.9 (5)	5.1 (9)	5.6 (1)	0.582
	Less complications	46.4 (26)	41.1 (72)	38.9 (7)	0.751

Note: *p-value bold when $p < 0.05$ and italic when $p > 0.05 / < 0.1$.

Table 3 Analysis Dependent on Medical Profession

	Grouper/Level/Aspect	Profession		p-value*
		Medical	Non-medical	
Respondents' characterization				
Age	≤ 20 y	0.7 (1)	0.9 (1)	0.505
	21–30 y	62.7 (85)	54.5 (61)	
	31–40 y	23.0 (31)	35.7 (40)	
	≥ 41y	13.3 (18)	8.9 (10)	
Religion	Islam	11.9 (16)	34.8 (39)	< 0.001
	Christianity	78.5 (106)	60.7 (68)	
	Hinduism	9.6 (13)	4.5 (5)	
Marital status	Married	60.0 (81)	42.0 (47)	0.017
	Single	39.3 (53)	56.3 (63)	
	Others	0.7 (1)	1.8 (2)	
History of normal vaginal delivery	Yes	26.0 (34)	36.5 (38)	0.080
	No	74.0 (97)	63.5 (66)	
History of gastroscopy/ coloscopy	Yes	4.51 (6)	4.5 (5)	0.998
	No	95.5 (127)	95.5 (106)	

(Continued)

Table 3 (Continued).

	Grouper/Level/Aspect	Profession		p-value*
		Medical	Non-medical	
History of laparotomy	Yes	1.5 (2)	0.9 (1)	0.676
	No	98.5 (131)	99.1 (109)	
History of laparoscopy	Yes	4.5 (6)	3.6 (4)	0.733
	No	95.5 (127)	96.4 (106)	
Respondents' decisional preferences				
Preferred overall technique for Cholecystectomy	Open	5.3 (7)	11.8 (12)	< 0.001
	Laparoscopic	79.7 (106)	47.1 (48)	
	NOTES (transvaginal)	7.5 (10)	20.6 (21)	
	NOTES (transgastric)	7.5 (10)	20.6 (21)	
Preferred overall technique for Ovariectomy	Open	7.5 (10)	10.7 (11)	< 0.001
	Laparoscopic	71.6 (96)	42.7 (44)	
	NOTES (transvaginal)	14.2 (19)	38.8 (40)	
	NOTES (transgastric)	6.7 (9)	7.8 (8)	
Preferred NOTES technique For cholecystectomy	Transgastric	54.8 (68)	59.2 (61)	0.507
	Transvaginal	45.2 (56)	40.8 (42)	
Preferred NOTES technique For ovariectomy	Transgastric	37.7 (46)	41.4 (43)	0.577
	Transvaginal	62.3 (76)	58.7 (61)	
Reasons to refuse a Transvaginal approach for a Cholecystectomy	Fear of postop sexual dysfunction	30.4 (41)	23.2 (26)	0.208
	Anxiety about future pregnancies	31.9 (43)	42.9 (48)	0.074
	Objections based on moral grounds	22.2 (30)	10.7 (12)	0.017
	Experimental character of NOTES	29.6 (40)	19.6 (22)	0.072
	Other objections	6.7 (9)	6.3 (7)	0.895
Reasons to refuse a Transvaginal approach for a Ovariectomy	Fear of postop sexual dysfunction	31.1 (42)	24.1 (27)	0.222
	Anxiety about future pregnancies	32.6 (44)	30.4 (34)	0.707
	Objections based on moral grounds	20.0 (27)	13.4 (15)	0.169
	Experimental character of NOTES	27.4 (37)	21.4 (24)	0.278
	Other objections	7.4 (10)	5.4 (6)	0.515
Benefits to accept NOTES As alternative approach premise: complication rate of NOTES comparable to Laparoscopy	No visible scars	37.8 (51)	32.1 (36)	0.356
	No pain	28.9 (39)	39.3 (44)	0.085
	Short hospital stay	26.7 (36)	17.9 (20)	0.100
	Short sick leave	6.7 (9)	4.5 (5)	0.456
	Less complications	43.7 (59)	41.1 (46)	0.677

Note:*p-value bold when $p < 0.05$ and italic when $p > 0.05 / < 0.1$.

Univariate Analyses

The Role of Religious Affiliation

To get a first impression of an impact of religious-cultural aspects on the perception of NOTES, we compared the results from our survey among the three world-religions represented in a total of 96.9% of the women questioned in this study

Table 4 Analysis Dependent on Age

	Grouper/Level/Aspect	Age				p-value*
		≤ 20 y	21–30 y	31–40 y	≥ 41y	
Respondents' characterization						
Religion	Islam	66.7 (2)	19.3 (29)	26.7 (20)	17.2 (5)	0.053
	Christianity	0.0 (0)	72.7 (109)	68.0 (51)	51.7 (15)	
	Hinduism	0.0 (0)	6.0 (9)	1.3 (1)	27.6 (8)	
	Other	33.3 (1)	2.0 (3)	4.0 (3)	3.5 (1)	
Profession	Medical	50.0 (1)	58.2 (85)	43.7 (31)	64.3 (18)	0.153
	Non-medical	50.0 (1)	41.8 (61)	56.3 (40)	35.7 (10)	
Marital status	Married	0.0 (0)	42.7 (64)	64.0 (48)	72.4 (21)	0.0016
	Single	100.0 (3)	57.3 (86)	33.3 (25)	24.1 (7)	
	Others	0.0 (0)	0.0 (0)	2.7 (2)	3.5 (1)	
History of normal vaginal delivery	Yes	0.0 (0)	20.0 (28)	44.6 (33)	53.6 (15)	< 0.0001
	No	100.0 (3)	80.0 (112)	55.4 (41)	46.4 (13)	
History of gastroscopy / coloscopy	Yes	0.0 (0)	3.4 (5)	2.7 (2)	13.8 (4)	0.120
	No	100.0 (3)	96.6 (144)	97.3 (71)	86.2 (25)	
History of laparotomy	Yes	0.0 (0)	0.0 (0)	1.4 (1)	6.9 (2)	0.010
	No	100.0 (3)	100.0 (147)	98.7 (73)	93.1 (27)	
History of laparoscopy	Yes	0.0 (0)	2.0 (3)	5.4 (4)	10.3 (3)	0.032
	No	100.0 (3)	98.0 (144)	94.6 (70)	89.7 (26)	
Respondents' decisional preferences						
Preferred overall technique for Cholecystectomy	Open	0.0 (0)	7.0 (10)	8.6 (6)	11.1 (3)	0.281
	Laparoscopic	33.3 (1)	69.9 (100)	61.4 (43)	48.2 (13)	
	NOTES (transvaginal)	33.3 (1)	9.1 (13)	21.4 (15)	18.5 (5)	
	NOTES (transgastric)	33.3 (1)	14.0 (20)	8.6 (6)	22.2 (6)	
Preferred overall technique for Ovariectomy	Open	0.0 (0)	9.0 (13)	8.7 (6)	7.1 (2)	0.115
	Laparoscopic	33.3 (1)	62.5 (90)	59.4 (41)	46.4 (13)	
	NOTES (transvaginal)	33.3 (1)	22.2 (32)	29.0 (20)	28.6 (8)	
	NOTES (transgastric)	33.3 (1)	6.3 (9)	2.9 (2)	17.9 (5)	
Preferred NOTES technique For cholecystectomy	Transgastric	66.7 (2)	62.3 (86)	48.5 (33)	42.3 (11)	0.016
	Transvaginal	33.3 (1)	37.7 (52)	51.5 (35)	57.7 (15)	
Preferred NOTES technique For ovariectomy	Transgastric	66.7 (2)	42.3 (58)	32.8 (22)	33.3 (9)	0.117
	Transvaginal	33.3 (1)	57.7 (79)	67.2 (45)	66.7 (18)	

(Continued)

Table 4 (Continued).

	Group/Level/Aspect	Age				p-value*
		≤ 20 y	21–30 y	31–40 y	≥ 41y	
Reasons to refuse a Transvaginal approach for a Cholecystectomy	Fear of postop sexual dysfunction	66.7 (2)	31.3 (47)	16.0 (12)	27.6 (8)	0.037
	Anxiety about future pregnancies	66.7 (2)	43.3 (65)	30.7 (23)	6.9 (2)	0.0002
	Objections based on moral grounds	0.0 (0)	18.7 (28)	17.3 (13)	10.3 (3)	0.501
	Experimental character of NOTES	66.7 (2)	24.0 (36)	24.0 (18)	34.5 (10)	0.688
	Other objections	0.0 (0)	4.0 (6)	10.7 (8)	6.9 (2)	0.097
Reasons to refuse a Transvaginal approach for a Ovariectomy	Fear of postop sexual dysfunction	66.7 (2)	30.7 (46)	21.3 (16)	27.6 (8)	0.153
	Anxiety about future pregnancies	33.3 (1)	39.3 (59)	22.7 (17)	10.3 (3)	0.0004
	Objections based on moral grounds	33.3 (1)	18.7 (28)	14.7 (11)	10.3 (3)	0.187
	Experimental character of NOTES	66.7 (2)	21.3 (32)	30.7 (23)	31.0 (9)	0.204
	Other objections	33.3 (1)	4.0 (6)	9.3 (7)	6.9 (7)	0.360
Benefits to accept NOTES As alternative approach premise: complication rate of NOTES comparable to Laparoscopy	No visible scars	33.3 (1)	38.0 (57)	33.3 (25)	27.6 (8)	0.279
	No pain	66.7 (2)	38.0 (57)	26.7 (20)	20.7 (6)	0.014
	Short hospital stay	33.3 (1)	22.7 (34)	21.3 (16)	20.7 (6)	0.700
	Short sick leave	33.3 (1)	4.7 (7)	6.7 (5)	6.9 (2)	0.815
	Less complications	66.7 (2)	40.0 (60)	40.0 (30)	48.3 (14)	0.739

Note: *p-value bold when $p < 0.05$ and italic when $p > 0.05 / < 0.1$.

(Table 2). The majority of Muslim women stated to be more receptive to NOTES over laparoscopic and open surgery respectively as a choice of surgical technique for cholecystectomy (39.3%) when compared to Christians (22.5%) and Hindus (29.5%). This was similarly observed for ovariectomy. Given the option of surgical approach, the majority of Muslim women were more receptive to NOTES regarding cholecystectomy (27.5% transgastric and 11.8% transvaginal) when compared to Christians (8.9% and 13.6% respectively) and Hindus (17.7% and 11.8% respectively). Similarly, for ovariectomy, Muslim women would favour NOTES (15.4% transgastric and 30.8% transvaginal) when compared to Christians (4.1% and 23.5% respectively) and Hindus (11.8% and 17.7% respectively). Despite practiced religion, women preferred transgastric (56.8%) over transvaginal access (43.2%) for NOTES cholecystectomy which was distributed vice versa for NOTES ovariectomy (39.5% vs 60.5%) when asked for a preferred NOTES approach. Muslim women were significantly less concerned than Christian and Hindu women about postoperative sexual dysfunction following ovariectomy (16.1% vs 32.6% vs 22.2% respectively). Of note, we observed a relevant difference with regard to medical professional background among the three groups of practiced religion: Christian (60.9%) and Hindu women (72.2%) had a larger share of medical professions when compared to the Muslim group (29.1%).

The Impact of Medico-Educational Background

Next, in light of an asymmetrical distribution of medical expertise in women's occupation among the religious groups, we stratified the data for medical versus non-medical professions (Table 3). Women with a medical background would opt for NOTES in only 15.0% as the preferred technique for cholecystectomy and in 20.9% for ovariectomy. The overall majority of the respondents with a medical background would prefer the laparoscopic approach for cholecystectomy (79.7%) and ovariectomy (71.6%). With a free choice of surgical approach, medical staff would prefer transvaginal NOTES for ovariectomy (14.2%) rather than for cholecystectomy (7.5%). Objections to the transvaginal NOTES procedure for cholecystectomy on moral grounds was given by 22.2% in the medical versus 10.7% in the non-medical cohort. Noteworthy, 60% medical staff members were married compared to non-medical staff women with 42%.

The Role of Age

Hypothetically, age as a parameter of life stage and experience may impact the assessment of NOTES especially concerning aspects of sexuality as well as pregnancy and transvaginal birth. To address this, we evaluated the data in a third step of age dependent analysis (Table 4). Responding women in this study were categorized into four groups with

Table 5 Multinomial Logistic Regression for Preferred Technique of Cholecystectomy*

Variable/Category	n	Laparoscopic (n=147) (ref.) vs Open (n=15)			Laparoscopic (n=147) (ref.) vs NOTES (Transvaginal) (n=29)			Laparoscopic (n=147) (ref.) vs NOTES (Transgastric) (n=29)			Prob > χ^2 ***			
		RRR**	[95% Conf, Interval]		P> z	RRR**	[95% Conf, Interval]		P> z	RRR**		[95% Conf, Interval]		P> z
Age														
21–30 y (ref.)	131													0.07
31–40 y	65	1.31	0.37	4.58	0.68	2.48	0.95	6.47	0.06	0.69	0.23	2.10	0.51	
Older than 40 y	24	2.05	0.20	20.52	0.54	4.70	1.16	19.08	0.03	4.82	1.22	19.09	0.03	
Marital status														
Married (ref.)	123													0.04
Single	97	2.70	0.74	9.89	0.13	1.39	0.54	3.59	0.50	4.20	1.45	12.14	<0.01	
Profession														
Medical (ref.)	127													<0.001
Non-medical	93	4.35	1.31	14.42	0.02	4.36	1.77	10.73	0.00	4.08	1.54	10.82	<0.01	
Religion														
Christianity (ref.)	159													0.22
Islam	44	0.49	0.10	2.44	0.38	0.64	0.21	1.99	0.44	3.13	1.15	8.47	0.03	
Hinduism	17	0.00	0.00	inf.	0.99	0.78	0.13	4.81	0.79	1.62	0.30	8.58	0.57	
History of normal vaginal delivery														
No (ref.)	153													0.71
Yes	67	1.00	0.26	3.83	1.00	0.79	0.29	2.10	0.63	1.64	0.58	4.63	0.35	

Notes: *Model statistics: Likelihood ratio $\chi^2(21) = 55.60$; Prob > $\chi^2 = <0.001$. ***Omnibus test of overall effect of respective variable; p-value bold when $p < 0.05$ and italic when $p > 0.05 / < 0.1$.

Abbreviation: **RRR, relative risk ratio.

Table 6 Multinomial Logistic Regression for Preferred Technique of Ovariectomy*

Variable/Category	n	Laparoscopic (n=132) (ref.) vs Open (n=21)			Laparoscopic (n=132) (ref.) vs NOTES (Transvaginal) (n=54)			Laparoscopic (n=132) (ref.) vs NOTES (Transgastric) (n=15)			Prob > chi ² ***			
		RRR**	[95% Conf, Interval]		P> z	RRR**	[95% Conf, Interval]		P> z	RRR**		[95% Conf, Interval]		P> z
Age														
21–30 y (ref.)	133													<i>0.07</i>
31–40 y	64	1.10	0.36	3.33	0.87	1.15	0.53	2.50	0.73	0.45	0.08	2.58	0.37	
Older than 40 y	25	3.56	0.59	21.54	0.17	3.42	1.01	11.60	0.05	11.00	1.97	61.58	0.01	
Marital status														
Married (ref.)	124													0.01
Single	98	2.87	0.92	8.95	0.07	0.92	0.43	1.99	0.83	9.68	1.87	50.03	0.01	
Profession														
Medical (ref.)	128													<0.001
Non-medical	94	2.02	0.74	5.56	0.17	4.64	2.22	9.69	0.00	1.25	0.33	4.72	0.75	
Religion														
Christianity (ref.)	160													<i>0.32</i>
Islam	45	1.39	0.43	4.53	0.58	1.26	0.54	2.94	0.59	5.77	1.44	23.10	0.01	
Hinduism	17	0.00	0.00	inf.	0.99	0.51	0.11	2.39	0.39	1.11	0.14	8.61	0.92	
History of normal vaginal delivery														
No (ref.)	155													<i>0.28</i>
Yes	67	0.88	0.26	3.03	0.84	0.65	0.29	1.45	0.29	2.98	0.66	13.44	0.16	

Notes: *Model statistics: Likelihood ratio chi²(21) = 55.60; Prob > chi² = <0.001. ***Omnibus test of overall effect of respective variable; p-value bold when p < 0.05 and italic when p > 0.05 / < 0.1.

Abbreviation: **RRR, relative risk ratio.

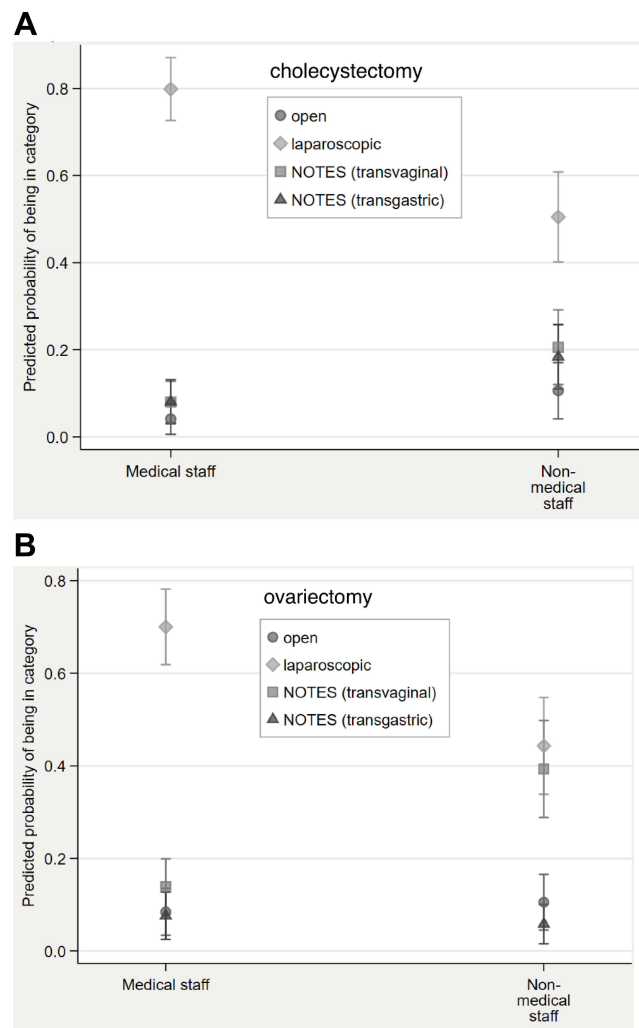


Figure 1 Predicted probabilities for preferred technique of cholecystectomy (**A**) and ovariectomy (**B**) as a result of multinomial logistic regression analyses.

younger than 20y, 20y to 29y, 30y to 39y and 40y and older. As to be expected, characteristics like marital status and medical history of interventions was different. As to be expected, women were more frequently married with increasing age. Further, previous normal vaginal delivery as well as history of laparotomy and laparoscopy respectively were increasingly found in older women.

Interestingly, with free choice of surgical technique, which was open versus laparoscopic versus NOTES (transvaginal and transgastric), for both cholecystectomy and ovariectomy, no preference was observed among groups in this age-related analysis of the data. When asked for the choice of access in a NOTES intervention, the transvaginal approach was preferred over the transgastric one with increasing years of age. Among younger women the reasons to refuse NOTES approach overall was anxiety about future pregnancies. In addition, cholecystectomy was paralleled by fear of post-operative sexual dysfunction with decreasing age.

Analyses of Independency for Prediction of Choice of Surgical Technique

Multinomial logistic regression was used to evaluate the effect of potentially relevant independent predictors on the preferred method of intervention. For both cholecystectomy (Table 5; Figure 1A) and ovariectomy (Table 6; Figure 1B) marital status and professional status predicted choice of surgical approach significantly. Religious affiliation and a history of normal vaginal birth did not play a relevant role.

Specifically, although the laparoscopic approach was the most preferred choice across the board, non-medical staff were significantly more likely to potentially choose the other surgical procedures (open, NOTES (transvaginal) and

NOTES (transgastric) given cholecystectomy – in comparison to the medical professionals – relative to the standard laparoscopic one (Tables 5 and 6 and Figure 1A and B). Given ovariectomy non-medical staff were 4.64 times as likely ($p < 0.001$) in comparison to the medical professionals to choose a transvaginal NOTES route relative to the standard laparoscopic one. The relative risk ratios of the other surgical techniques remained insignificant for this medical procedure. Marital status played a significant role only in the comparison of the potential choices laparoscopic technique vs NOTES (transgastric) when performing cholecystectomy (RRR 4.08, 95% CI 1.45–12.14, $p < 0.01$). The same pattern emerged in respect to ovariectomy.

Discussion

Target group-oriented perception plays an essential role in the process of developing and establishing emerging surgical techniques. Global labour market mobility and subsequent changes in the local composition of populations require a cross-cultural understanding of perceptions in the medical landscape in general and the surgical field in particular.

Hence, our questionnaire directed at female hospital workers in a Middle Eastern setting was intended to describe differentiating factors in respect to preferences in surgical techniques including NOTES and evaluate perceptions potentially specific to this population. For example: Does the surgical technique's anatomical proximity to the organ to be operated on influence the choice? Is the age and associated status of family planning of the respondents, perhaps reflecting a subjective perception “safety first” in respect to the transvaginal route relevant? Does religious affiliation motivate the preferences, especially in case transvaginal cholecystectomy would have been interpreted as a relevant violation of intimacy? Is prior medical knowledge or professional status of importance?

Status quo analysis reveals the existence of a worldwide range of literature pertaining to NOTES perception. However, different types and extents of questions as well as variable survey populations visibly impede a valid comparison.⁷

Although this study was performed in an Arabic country in the Middle East (this is the first study in this respect to our knowledge; Table 1), the population surveyed had diverse religious and professional backgrounds, which enabled us to uniquely evaluate this factor and compare it to other characteristics such as professional background of the respondents. While Pucher et al excluded studies in a review on NOTES perception which polled only health professionals to address a potential bias,¹¹ we deliberately also included respondents with a medical background, allowing us to differentiate how the professional status affects the decisions well knowing that being part of the medical staff does not automatically implicate that the participants are familiar with NOTES.

One limitation of our study is the fact that only 21.8% of our respondents were Muslims, which reflects the population in the United Arab Emirates. According to an estimate by the World Bank, the UAE's population in 2018 stands at 9.543 million. Expatriates and immigrants account for 88.52%, while Emiratis make up the remaining 11.48% of the population.¹² This explains the general distribution and composition of the employees in the private (non-governmental) hospital which served as the basis for this survey. Nonetheless, 93% of our surveyed females are settled Arabs, thus reflecting the traditions in this region.

In a recently published paper, Behnia-Willison et al performed a survey-based observational study, assessing the acceptability of transvaginal NOTES among a cohort of 175 Middle Eastern Persian speaking women.¹⁰ This report did not explicitly describe the socio-demographic background or religious affiliation of those surveyed, therefore making it difficult to compare their findings with ours, contrasting factors attributable to the different settings. Despite these limitations, the study by Behnia-Willison et al demonstrate that women of Middle Eastern heritage appear to be in favour of transvaginal NOTES for gynecologic surgery over cholecystectomy.¹⁰ In our study, Muslim women were more receptive to NOTES regarding cholecystectomy (transgastric and transvaginal) when compared to Christians and Hindus. Also, for ovariectomy, Muslim women would favour NOTES to a higher extent than Christians and Hindus. Furthermore, it is noteworthy that Muslim women in our study were significantly less concerned than Christian and Hindu women about postoperative sexual dysfunction for ovariectomy. Moreover, Muslim females expressed significantly less ‘ethical doubts’ than 671 surveyed Christian females in our previous German studies.^{7,13}

The majority of our respondents belonged to medical staff mainly practicing as nurses or to a lesser proportion as physicians. Interestingly, a significant majority of the respondents with medical background would choose the

laparoscopic approach for cholecystectomy and ovariectomy, instead of the NOTES procedures; the distribution of preferences is more balanced in non-medical staff, albeit that group also favours “traditional” procedures. Further, the medical staff were less likely to opt for NOTES as the preferred technique in both ovariectomy and cholecystectomy, as the proportion of medical professionals in the group of Muslims was relevantly lower compared to the Christian and Hindu group.

It bears mentioning that the decision to refuse transvaginal NOTES for cholecystectomy is mainly based on moral grounds. Whether the surveyed health professionals represent a potentially biased sample¹¹ and/or the interpretations of the results of public surveys have to be done cautiously because the public does not have the appropriate background¹⁴ remains a point of disagreement in recently published literature. However, in our study, multinomial logistic regression analyses identified availability of medical education as a relevant factor for the preference of surgical intervention for both ovariectomy and even more pronounced for cholecystectomy when derived from comparison among religious groups. The latter was true as medical profession was a significant independent predictive variable which was not found for the stated religion.

The need for proper information on transvaginal NOTES for the public as well as for health professionals has been highlighted before.⁷ Results from an online survey with 154 surgeons in Portugal demonstrates the importance of this aspect; the familiarity with transvaginal surgery was shown to be the strongest predictor of the option for the transvaginal approach in natural orifices specimen extraction. The results revealed a preference for the transvaginal access on the part of female surgeons who were familiar with this access.¹⁵ In general, the rationale behind a NOTES survey with health professionals seems to be obvious. Health professionals play an important role in informing the patients’ decision making. Since other surveys show that 73% of surgeons would not recommend NOTES to their patients and that 91% of the female surgeons see no advantage in transvaginal procedures,¹⁶ the surgeon’s opinion are key to the decision making process.

Recently published literature indicated emergent and diverse NOTES activity in China and Japan.^{8,9,17,18} Data from surveys about the perception of NOTES in East Asian populations revealed significant differences in comparison to surveys in the Western world. In Western patients, the oral route was the preferred access organ for NOTES in both male and female patients, whereas in Asian-Chinese patients, oral, anal and vaginal accesses were similarly acceptable. For the respondents of a large Arabic city in this study, both the transvaginal and transgastric NOTES routes are overall similarly accepted for cholecystectomy whereas two-thirds would choose transvaginal over transgastric access in NOTES ovariectomy (data not shown).

In this study, increasing age correlated independently with a preference of transvaginal access in NOTES cholecystectomy over transgastric approach. Among younger respondents the reasons to refuse NOTES cholecystectomy is fear of postoperative sexual dysfunction and anxiety about future pregnancies. The latter applies to a transvaginal ovariectomy as well. Furthermore, our respondents in the medical staff cohort expressed more often moral grounds as a reason for rejecting the transvaginal approach in cholecystectomy when compared with non-medical staff. In some German hospitals, the transvaginal cholecystectomy has already become a routine procedure.¹⁹ Short- and long-term follow-up do not show any negative influence on postoperative sexuality and fertility.^{20–27} A prospective randomized trial showed no evidence of sexual dysfunction six months postoperatively after Hybrid NOTES cholecystectomy.²⁸ Regarding pregnancy, very recent data exist showing that future pregnancies are not affected by NOTES procedures.²⁹

Women less than 40 years are less likely to choose the transvaginal cholecystectomy. This connection between younger as well as nulliparous women and their cautious acceptance for transvaginal NOTES is also reported by other authors.^{10,13,30,31} Concerns about future pregnancies are the leading doubt in younger women with regard to transvaginal NOTES for our respondents in Abu Dhabi when compared with older women. The method of choice for cholecystectomy overall is the laparoscopic access. Two other surveys revealed a clear preference for colon or stomach over vagina as NOTES access.^{17,32} Pucher et al reported that all studies which included the option of transvaginal access reported this to be the least preferred option, with an overwhelming preference for transgastric access.¹¹

Conclusions

Surveys among potential recipients of a new medical treatment are mandatory to get an objective impression. In this study, the decision made by women in an Arabic country concerning preference for surgical techniques of cholecystectomy and

ovariectomy was demonstrated to be mainly based on objective medical considerations and aspects of life stage like age and marital status rather than religious-cultural aspects. Medical experts in the female community demonstrated to be rather restrictive concerning the more novel NOTES approach when compared to classical laparoscopic concepts. These legitimate but unjustifiable concerns might be related to a certain lack of knowledge, since several published studies clearly demonstrate that transvaginal cholecystectomy is a safe, painless and well tolerated procedure and produces at least non-inferior clinical and long-term results when compared with the laparoscopic approach.^{3,20} It remains a challenge for NOTES proponents to reduce the perception of an association of transvaginal NOTES procedures with postoperative sexuality and fertility impairment. In that way, the awareness of proven benefits may be increased to counteract a fading interest of the surgical community in NOTES. Consequently, future long term outcome studies of transvaginal NOTES strategies need to focus particularly on perceived sexuality and fertility post-surgery. An observed preference for transgastric concepts in subgroups of this survey may warrant the consequent evaluation and development of NOTES procedures using that access to enter the peritoneal cavity.

Context and Relevance

NOTES is being considered as an important step in the evolution of minimal-invasive surgery. However, despite the demonstration of transvaginal surgery as a safe and painless procedure with matchable clinical and long-term results when compared to laparoscopy, a restraint among patients is still evident. In this first study about NOTES perception emanating from an Arabic country, the population surveyed had diverse religious and professional backgrounds, which enabled us to uniquely evaluate these factors in comparison to other characteristics of the respondents. Medical education and stage of life rather than cross-cultural differences seem to influence the perception of NOTES among women.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

The authors received no financial support for the research, authorship, and publication of this article.

Disclosure

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

1. Kallou AN, Singh VK, Jagannath SB, et al. Flexible transgastric peritoneoscopy: a novel approach to diagnostic and therapeutic interventions in the peritoneal cavity. *Gastrointest Endosc.* 2004;60(1):114–117. doi:10.1016/S0016-5107(04)01309-4
2. Benhidjeb T, Witzel K, Barlehner E, Stark M. “Natural-Orifice-Surgery- (NOS-)Konzept” Vision und Rationale für einen Paradigmenwechsel [The natural orifice surgery concept. Vision and rationale for a paradigm shift]. *Chirurg.* 2007;78(6):537–542. German. doi:10.1007/s00104-007-1346-0
3. Steinemann DC, Muller PC, Probst P, et al. Meta-analysis of hybrid natural-orifice transluminal endoscopic surgery versus laparoscopic surgery. *Br J Surg.* 2017;104(8):977–989. doi:10.1002/bjs.10564
4. Kaya C, Alay I, Cengiz H, Yildiz GO, Baghaki HS, Yasar L. Comparison of hysterectomy cases performed via conventional laparoscopy or vaginally assisted natural orifice transluminal endoscopic surgery: a paired sample cross-sectional study. *J Obstet Gynaecol.* 2021;41(3):434–438. doi:10.1080/01443615.2020.1741523
5. Karakas S, Kaya C, Yildiz S, et al. Comparison of vNOTES technique with conventional laparoscopy in gynecological emergency cases. *Minim Invasive Ther Allied Technol.* 2022;31(5):803–809. doi:10.1080/13645706.2021.2025111
6. Lacy AM, Borja De Lacy F, Valverde S. Transluminal Cancer Surgery. *Surg Oncol Clin N Am.* 2019;28(1):101–113. doi:10.1016/j.soc.2018.08.003
7. Gerntke CI, Kersten JF, Schon G, Mann O, Stark M, Benhidjeb T. Women’s perception of transvaginal natural orifice transluminal endoscopic surgery (NOTES): results of a survey of female medical staff and literature review. *Surg Innov.* 2016;23(2):201–211. doi:10.1177/1553350615598621
8. Li W, Xu H, Wang ZK, et al. Natural Orifice Transluminal Endoscopic Surgery (NOTES): patients’ perceptions and attitudes. *Dig Dis Sci.* 2011;56(8):2415–2422. doi:10.1007/s10620-011-1797-5

9. Teoh AY, Ng EK, Chock A, Swanstrom L, Varadarajulu S, Chiu PW. Asian-Chinese patient perceptions of natural orifice transluminal endoscopic surgery cholecystectomy. *Dig Endosc.* 2014;26(3):458–466. doi:10.1111/den.12192
10. Behnia-Willison F, Nguyen T, Rezaeimotlagh A, Baekelandt J, Hewett PJ. Middle Eastern women's attitudes and expectations towards vaginal natural orifice transluminal endoscopic surgery (vNOTES): a survey-based observational study. *Surg Endosc.* 2021;35:6865–6872. doi:10.1007/s00464-020-08193-0
11. Pucher PH, Sodergren MH, Lord AC, Teare J, Yang GZ, Darzi A. Consumer demand for surgical innovation: a systematic review of public perception of NOTES. *Surg Endosc.* 2015;29(4):774–780. doi:10.1007/s00464-014-3769-2
12. Available from: <https://www.globalmediainsight.com/blog/uae-population-statistics/>. Accessed December 15, 2022.
13. Benhidjeb T, Gericke C, Spies C, Miller K, Schneider A, Muller F. Perception der "natural orifice surgery": Ergebnisse einer Umfrage bei weiblichem Ärzte-und Pflegepersonal [Perception of natural orifice surgery. Results of a survey of female physicians and nursing staff]. *Chirurg.* 2011;82(8):707–713. German. doi:10.1007/s00104-011-2079-7
14. Atallah S, Martin-Perez B, Keller D, Burke J, Hunter L. Natural-orifice transluminal endoscopic surgery. *Br J Surg.* 2015;102(2):e73–92. doi:10.1002/bjs.9710
15. Cabral JF, Braga IC, Branco F, Cavadas V, Ferreira AF, Ramos MS. What about vaginal extraction of the kidney? Results of an online survey. *Int Braz J Urol.* 2016;42(1):78–82. doi:10.1590/S1677-5538.IBJU.2015.0170
16. Weigt A, Rauchfuss F, Dittmar Y, Settmacher U, Scheuerlein H. "Minimal access surgery" Ein Meinungsbild bei Chirurgen in Mitteldeutschland [Minimal access surgery: a survey among surgeons in Central Germany]. *Chirurg.* 2015;86(6):587–594. German. doi:10.1007/s00104-014-2853-4
17. Kim MC, Kim KH, Jang JS, Kwon HC, Kim BG, Rattner DW. Patient perception of natural orifice transluminal endoscopic surgery in an endoscopy screening program in Korea. *Yonsei Med J.* 2012;53(5):960–967. doi:10.3349/ymj.2012.53.5.960
18. Wang ZK, Yang YS, Haider KG, Li W. Chinese physician perception of natural orifice transluminal endoscopic surgery. *Dig Dis Sci.* 2013;58(8):2167–2176. doi:10.1007/s10620-013-2637-6
19. Lehmann KS, Zornig C, Arlt G, et al. "Natural orifice transluminal endoscopic surgery" in Deutschland Daten aus dem deutschen NOTES-Register [Natural orifice transluminal endoscopic surgery in Germany: data from the German NOTES registry]. *Chirurg.* 2015;86(6):577–586. German. doi:10.1007/s00104-014-2808-9
20. Benhidjeb T, Kosmas IP, Hachem F, Mynbaev O, Stark M, Benhidjeb I. Laparoscopic cholecystectomy versus transvaginal natural orifice transluminal endoscopic surgery cholecystectomy: results of a prospective comparative single-center study. *Gastrointest Endosc.* 2018;87(2):509–516. doi:10.1016/j.gie.2017.09.039
21. Peri L, Musquera M, Vilaseca A, et al. Perioperative outcome and female sexual function after laparoscopic transvaginal NOTES-assisted nephrectomy. *World J Urol.* 2015;33(12):2009–2014. doi:10.1007/s00345-015-1573-9
22. Mofid H, Emmermann A, Alm M, von Waldenfels HA, Felixmuller C, Zornig C. Is the transvaginal route appropriate for intra-abdominal NOTES procedures? Experience and follow-up of 222 cases. *Surg Endosc.* 2013;27(8):2807–2812. doi:10.1007/s00464-013-2812-z
23. Bulian DR, Trump L, Knuth J, Cerasani N, Heiss MM. Long-term results of transvaginal/transumbilical versus classical laparoscopic cholecystectomy--an analysis of 88 patients. *Langenbecks Arch Surg.* 2013;398(4):571–579. doi:10.1007/s00423-013-1071-8
24. Noguera JF, Cuadrado A, Dolz C, Olea JM, Garcia JC. Prospective randomized clinical trial comparing laparoscopic cholecystectomy and hybrid natural orifice transluminal endoscopic surgery (NOTES) (NCT00835250). *Surg Endosc.* 2012;26(12):3435–3441. doi:10.1007/s00464-012-2359-4
25. Borchert D, Federlein M, Ruckbeil O, Burghardt J, Fritze F, Gellert K. Prospective evaluation of transvaginal assisted cholecystectomy. *Surg Endosc.* 2012;26(12):3597–3604. doi:10.1007/s00464-012-2378-1
26. Ghezzi F, Cromi A, Uccella S, Bogani G, Serati M, Bolis P. Transumbilical versus transvaginal retrieval of surgical specimens at laparoscopy: a randomized trial. *Am J Obstet Gynecol.* 2012;207(2):112 e111–116. doi:10.1016/j.ajog.2012.05.016
27. Hensel M, Schemikau U, Schmidt A, Arlt G. Surgical outcome and midterm follow-up after transvaginal NOTES hybrid cholecystectomy: analysis of a prospective clinical series. *J Laparoendosc Adv Surg Tech A.* 2011;21(2):101–106. doi:10.1089/lap.2010.0508
28. Bulian DR, Knuth J, Cerasani N, et al. Transvaginal hybrid NOTES cholecystectomy--results of a randomized clinical trial after 6 months. *Langenbecks Arch Surg.* 2014;399(6):717–724. doi:10.1007/s00423-014-1218-2
29. Thomaidis P, Weltermann NJ, Seefeldt CS, et al. Transvaginal Hybrid-NOTES procedures-do they have a negative impact on pregnancy and delivery? *Langenbecks Arch Surg.* 2021;406(6):2045–2052. doi:10.1007/s00423-021-02105-z
30. Peterson CY, Ramamoorthy S, Andrews B, Horgan S, Talamini M, Chock A. Women's positive perception of transvaginal NOTES surgery. *Surg Endosc.* 2009;23(8):1770–1774. doi:10.1007/s00464-008-0206-4
31. Strickland AD, Norwood MG, Behnia-Willison F, Olakkengil SA, Hewett PJ. Transvaginal natural orifice transluminal endoscopic surgery (NOTES): a survey of women's views on a new technique. *Surg Endosc.* 2010;24(10):2424–2431. doi:10.1007/s00464-010-0968-3
32. Hucl T, Saglova A, Benes M, et al. Patient and physician perception of natural orifice transluminal endoscopic appendectomy. *World J Gastroenterol.* 2012;18(15):1800–1805. doi:10.3748/wjg.v18.i15.1800

International Journal of Women's Health

Dovepress

Publish your work in this journal

The International Journal of Women's Health is an international, peer-reviewed open-access journal publishing original research, reports, editorials, reviews and commentaries on all aspects of women's healthcare including gynecology, obstetrics, and breast cancer. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/international-journal-of-womens-health-journal>