Int Urogynecol J (2012) 23:1679–1685
DOI 10.1007/s00192-012-1671-9

ORIGINAL ARTICLE

Comparison of two classification systems for vesicovaginal fistula

T. Capes · E. J. Stanford · L. Romanzi · Y. Foma · E. Moshier

Received: 21 July 2011 / Accepted: 11 January 2012 / Published online: 25 January 2012

Abstract
Introduction and hypothesis This study aims to compare the prognostic value of two obstetric fistula classification systems.
Methods Prospective analysis of 202 patients evaluated for obstetric fistula (OF) at the General Referral Hospital of Panzi, Bukavu, DRC, from April through December 2009. Fistula classification using both Goh's and Waaldijk's systems, as well as preoperative, surgical, and follow-up assessment were included. Receiver operating characteristics (ROC) curves were used to compare the accuracy of the two systems to discriminate successful closure from persistent fistula.
Results Two hundred two women underwent fistula repair. Ten were lost to follow-up. At longest follow-up, 181 patients (88.3%) had successful fistula closure. On multivariate analysis, the independent variables of multiparity and a primary or secondary repair were more likely to have a successful closure. In Waaldijk's system, no single component was more predictive of successful closure than another. In Goh's system, type 4 fistulae were more likely to have failed closure compared to those with type 1 or 2 (p=0.0144). When comparing ROC curves, Goh's system had significantly better ability to predict successful closure than the Waaldijk's system, p=0.0421.
Conclusions Waaldijk and Goh are the two most commonly used obstetric fistula classification systems. In this series of OF patients at Panzi Hospital in the Democratic Republic of Congo, Goh's classification system demonstrated a significantly better prediction of OF closure than the Waaldijk's system.

Keywords Democratic Republic of Congo · Fistula classification · Goh · Obstetric fistula · Vesicovaginal fistula · Waaldijk

T. Capes (✉)
Aurora Center for Continence and Pelvic Floor Disorders,
8905 W Lincoln Ave, #405,
West Allis, WI 53227, USA
e-mail: tracy.capes@aurora.org

E. J. Stanford
Delta County Memorial Hospital,
Delta, CO, USA

L. Romanzi
New York Presbyterian–Weill Cornell Medical Center,
New York, NY, USA

Y. Foma
FSS/UAC,
Cotonou, Benin

E. Moshier
Department of Preventive Medicine,
Mount Sinai School of Medicine,
New York, NY, USA

Introduction

Vesicovaginal fistula is a preventable condition affecting millions of women worldwide, mostly in developing nations, a result of lack of access to emergency obstetric care. Surgery is the primary treatment with reported success rates ranging from 65–100% [1–5]. Various obstetric fistula (OF) classification systems exist, with none compared in head-to-head analysis of utility in predicting successful surgical repair. Ideally, classification systems provide clinicians and patients with important predictive information and facilitate triage, effective communication between surgeons, and meaningful comparison of treatment techniques.

Currently, there are at least 12 OF classification systems [6]. Most evaluate size, degree of vaginal scarring, location, and organs involved (bladder, rectum, ureter, uterus). Few, if

any, of the systems are supported by outcome-based studies. The two most commonly used systems are Waaldijk's and Goh's classifications [7, 8]. The Waaldijk's system categorizes vesicovaginal fistula by involvement of the urethra, its closing mechanism, and fistula size [7]. Goh's system classifies based on distance from the external urethral meatus, fistula size, and severity of vaginal fibrosis [8] (Fig. 1). This study compares the Waaldijk's and Goh's obstetric fistula classification systems abilities to predict successful surgical fistula closure.

Methods

This is a prospective collection of data on 202 patients evaluated for obstetric fistula at the General Referral Hospital of Panzi, Bukavu, DRC from April 2009 through December 2009. Approval for the study was obtained from the director of the fistula program, as there was no ethics committee at the hospital at the commencement of the study.

Preoperative evaluation of patients used a standardized form in English and French, completed by one of each of the authors, that included demographic and fistula classification using both systems. Staging was completed by one of each of the authors. Classification occurred at initial outpatient examination and confirmed in the operating room during exam under anesthesia. Fistula repair included vaginal or abdominal techniques at the discretion of the surgeon. Postoperative fistula ward care occurred per established hospital protocol, including transurethral catheter for a minimum of 14 days. On postoperative day 14, the catheters were removed on morning rounds followed by spontaneous voiding trial for an additional 2 days to ensure proper bladder emptying. A closed fistula was considered a successful repair. Total length of stay at the hospital grounds varied according to transportation availability. Patients reporting urinary leakage during the postoperative period were reevaluated by the same surgeon in the clinic or operating room to assess for persistent/recurrent fistula or residual urinary incontinence.

Statistical analyses were performed using SAS/STAT Version 9.2 (SAS Institute Inc., Cary, NC). Multiple logistic regression models were used to estimate odds ratios (OR) and 95% confidence intervals (CI) comparing odds of successful fistula closure among groups of patients with various demographic, preoperative, and surgical characteristics. Receiver operating characteristics curves (ROC) were generated from these logistic regression models, and areas under the ROC curves were estimated and compared using PROC LOGISTIC. Specifically, areas under the ROC curves were

Fig. 1 Waaldijk's and Goh's classification systems

Waaldijk

I Not involving the closure mechanism
II Involving the closing mechanism

A Without (sub) total urethral involvement ext. urethral meatus
a Without circumferential defect
b With circumferential defect urethral meatus

B With (sub) total urethral involvement
a Without circumferential defect
b With circumferential defect urethral meatus

Goh

Type I	Distal edge of fistula >3.5cm from external urethral meatus
Type 2	Distal edge of fistula 2.5 - 3.5cm from external urethral meatus
Type 3	Distal edge of fistula 1.5 -< 2.5cm from external urethral meatus
Type 4	Distal edge of fistula < 1.5cm from external urethral meatus

a	Size <1.5cm in the largest diameter
b	Size 1.5 - 3cm in the largest diameter
c	Size >3cm in the largest diameter

i	None or only mild fibrosis (around fistula and/or vagina) and /or vaginal length >6cm, normal bladder capacity
ii	Moderate or severe fibrosis (around fistula and/or vagina) and/or reduced vaginal length and /or bladder capacity
iii	Special consideration, e.g. post-radiation, ureteric involvement, circumferential fistula, previous repair

used to compare the abilities of the Waaldijk's and Goh's classification systems to predict successful fistula closure. All hypothesis testing was conducted at the 0.05 level of significance.

Results

Of the 215 patients presenting for evaluation, 102 (52.0%) patients reported fistula after vaginal delivery, 77 (39.3%) after a Cesarean section, and 13 (6.6%) after a vacuum-assisted vaginal delivery (VAVD), all subsequent to prolonged, severely obstructed labor. Thirteen patients with fistula after gynecologic procedure were excluded from analysis. Of those included, 180 had vesicovaginal fistula, 7 had ureterovaginal fistula, 12 had uterovaginal fistula, and 16 had rectovaginal fistula, of which 6 were isolated rectovaginal that were not included in classification analysis. Mean (+SD) age at presentation was 31.14±13.22 years, and mean age at first delivery was 19.0 years. Patient characteristics including length of labor, marital status, and surgical variables are shown in Table 1. In addition, 19 patients reported a history of sexual violence, none of which directly caused the vaginal fistula. Median follow-up time after repair was 14 days (range 7–43 days). At the time of longest follow-up, 176 patients (89.8%) had a successful fistula closure, 23 (11.7%) failed repair, and 12 had missing data. Thirty-two (15.8%) patients demonstrated residual urinary incontinence.

In multivariate analysis, individual demographic, preoperative, and surgical characteristics were evaluated followed by analysis and comparison of the two classification systems. In covariate analysis, neither mode of delivery nor surgical

Table 1 Preoperative and surgical characteristics

Patient characteristics, n=196	Total (%)
Primiparous	81 (41.3)
Type of delivery	
Vaginal	102 (52.0)
Vaccuum-assisted vaginal delivery	13 (6.6)
Cesarean delivery	77 (39.3)
Missing data	4 (2.1)
Marriage status	
Married	107 (54.5)
Separated	35 (18.0)
Widowed	16 (8.2)
Single	14 (7.1)
Missing data	24 (12.2)
Days in labor	
≤1	36 (18.4)
≥2	131 (66.8)
Missing data	29 (14.8)
Place of delivery	
Home	41 (20.9)
Hospital	143 (73.0)
Missing data	12 (6.1)
Repair approach	
Vaginal	167 (85.2)
Abdominal	23 (11.7)
Missing data	6 (3.1)
Repair type	
Primary	141 (71.9)
Secondary	31 (15.8)
Tertiary or greater	18 (9.2)
Missing data	6 (3.1)
Number of repair layers	
Single	177 (90.3)
Two	6 (3.1)
Missing data	13 (6.6)

Table 2 Effect of mode of delivery and parity on outcome

	Fistula closed		Wald chi-square p value
	Yes n=161 (%)	No n=23 (%)	
Mode of delivery			0.3064
Vaginal/VAVD	94 (58.39)	16 (69.57)	
Cesarean	67 (41.61)	7 (30.43)	
Parity[a, b]			**0.0191**
1	60 (37.04)	15 (65.22)	
2	29 (17.90)	4 (17.39)	
≥3	73 (45.06)	4 (17.39)	

[a] Parity ≥3 vs. 1 OR 4.56, CI 1.44–14.48, p=0.0100

[b] Parity 2 vs. 1 OR 1.81, CI 0.55–5.95, p=not significant (NS)

Table 3 Surgical characteristics

	Fistula closed		Wald chi-square p value
	Yes n=165 (%)	No n=23 (%)	
Type of repair			**0.0314**
Primary or secondary	153 (92.73)	18 (78.26)	
Tertiary or above	12 (7.27)	5 (21.74)	
Repair approach			0.4039
Vaginal	143 (86.67)	22 (95.65)	
Abdominal	21 (12.73)	1 (4.35)	
Combined	1 (0.61)	0 (0)	

Primary or secondary vs. tertiary or above OR 3.54; 95% CI 1.12–11.21, p=0.0314. Abdominal vs. vaginal OR 2.25, 95% CI 0.39–12.93, NS. Combined vs. vaginal OR 0.46, 95% CI 0.005–42.52, NS. Combined vs. abdominal OR 0.21, 95% CI 0.002–25.23, NS

approach (abdominal vs. vaginal approach) was associated with successful closure. However, higher parity and first and second repair were both significant predictors of successful closure (Tables 2 and 3). Primary and secondary repairs were more likely to be successful (OR=3.54, 95% CI 1.12–11.21, p=0.0314), and parous women were more likely to have successful closure (OR=3.19, 95% CI 1.28–7.96, p=0.0131).

Predicted probabilities were determined for each combination of outcomes for both classification systems (Tables 4 and 5). In addition, modeling of both systems including all covariates and classification components was done separately for each system and then compared to each other. For Goh's system, a designation of type 1 or 2 (distance from the external urethra meatus) is significantly more predictive of a successful closure than a designation of type 4. In Waaldijk's systems, there is no individual parameter which demonstrated prediction of successful closure. In multivariate analysis, both parity and number of previous repairs significantly improved the predictive ability of successful fistula repair only for the Waaldijk's system. None of the covariates improved the predictive ability of the Goh's system. In the final model, the Goh's classification system demonstrated significantly better prediction of successful closure than the Waaldijk's system, p=0.0421 (Table 6).

Discussion

From the earliest days of fistula repair, surgeons have classified fistulae, mostly including anatomic description and size. Originally, Sims suggested a simple anatomic classification of four types [9]. This was expanded upon by Mahfouz, who

Table 4 Goh's prognostic probabilities

Type 1–4	a, b, c	i, ii, iii	Predicted probability	Lower 95% CL	Upper 95% CL
1	a	i	97.84%	72.41%	99.87%
1	a	ii	96.15%	51.98%	99.83%
1	a	iii	97.18%	64.90%	99.84%
1	b	i	97.95%	70.84%	99.89%
1	b	ii	96.34%	55.22%	99.82%
1	c	i	93.58%	43.23%	99.64%
1	c	iii	91.74%	36.80%	99.53%
2	a	i	94.13%	85.68%	97.73%
2	a	ii	89.84%	63.70%	97.80%
2	a	iii	92.43%	79.40%	97.48%
2	b	i	94.40%	80.58%	98.56%
2	b	ii	90.29%	66.63%	97.74%
2	b	iii	92.77%	76.65%	98.05%
2	c	i	83.76%	58.12%	95.04%
2	c	ii	73.99%	35.89%	93.53%
2	c	iii	79.70%	52.49%	93.31%
3	a	i	86.25%	65.04%	95.48%
3	a	iii	82.68%	61.72%	93.39%
3	b	i	86.84%	62.59%	96.30%
3	b	ii	78.44%	46.87%	93.75%
3	b	iii	83.39%	63.53%	93.54%
3	c	i	66.86%	33.26%	89.09%
3	c	ii	52.66%	18.17%	84.79%
3	c	iii	60.56%	34.08%	82.02%
4	a	i	72.85%	38.51%	91.99%
4	a	iii	67.13%	34.09%	88.97%
4	b	i	73.84%	40.25%	92.20%
4	b	ii	60.88%	24.51%	88.18%
4	b	iii	68.23%	40.11%	87.33%
4	c	i	46.32%	14.68%	81.23%
4	c	iii	39.65%	14.21%	72.26%
1	a	i	97.84%	72.41%	99.87%

CL confidence limit

Table 5 Waaldijk's prognostic probabilities

Type I, II	a, b	Predicted probability	Lower 95% CL	Upper 95% CL
I	a	93.02%	85.33%	96.83%
II	a	83.72%	69.59%	92.04%
II	b	76.32%	60.40%	87.19%

CL confidence limit

described ureteric fistula and Moir who included circumferential fistulae [10]. These initial descriptive papers provided no correlation to treatment outcome. One of the first papers to describe both a classification system and outcome, as defined by closure and continence, was by McConnachie [11]. In this system, fistulae were given a "grade" based on scarring, surgical access, and sphincter involvement as well as a "type" defined on size. Results demonstrated a lower cure rate with increasing grade or greater tissue scarring and sphincter involvement. McConnachie recommended that this system be used to select surgical technique, anticipate prognosis, and compare between different centers. Subsequent publication by Bird utilized Moir's system to report outcomes, reporting an association between urethral involvement and failed closure as well as persistent incontinence in patients successfully closed, without fistula recurrence [12, 13].

In 1968 and 1969, two additional classification systems were published by Lawson and Hamlin and Nicholson, respectively, both introduced new terminology [14, 15]. Lawson's system is based on four types, including "juxta-urethral" and "juxta-cervical," reporting a higher rate of closer among juxta-cervical compared to juxta-urethra. Hamlin's system described six types of fistula, introducing "simple" and "difficult" vocabulary to infer complexity of the surgery required to treat the fistula. These new terms were not clearly defined and therefore subjective, as a simple fistula to one surgeon may be difficult to another. In addition, a large fistula may involve both the urethra and the cervix, making a designation of "juxta-urethral" or juxta-cervical" an individual assessment.

In response to the lack of standardized terminology and a system that reliably demonstrates outcome prediction, both Waaldijk and Goh proposed classification systems that incorporated these important parameters. Waaldijk's system is based on a retrospective analysis of 775 patients evaluated and repaired by the author [7]. The classification system is organized according to anatomic location and surgical approach/results (Table 1). Closure rates and residual incontinence rates decrease as the fistula type increases from type I through type IIBb. Goh's system utilizes fixed reference points (type 1–4), size of fistula (a–c), and other influential parts such as vaginal length, scarring, and previous attempt at repair (i–iii) (Table 1). In a prospective study of 987 women, Goh et al. demonstrated the ability of the classification system to both predict successful closure and subsequent continence, with type 1, sizes b and i, more likey to be closed as well as continent after treatment [8]. Given the comparative strength of these two systems in contrast to previous examples, they are the two most widely used by contemporary fistula surgeons.

Thus far, the obstetric fistula literature lacks an objective comparison of classification systems. Recent articles by Arrowsmith and Goh et al. highlight the need for a standardized outcome-based classification system with well-defined terminology [6, 16]. This study is the first to address to prospectively compare the two most utilized OF classification systems with regard to treatment outcome. Analysis includes additional potential confounding points not included in either system that carried the potential to confound the results of either system as a whole.

Of the covariates, higher parity was significantly associated with successful closure. These findings are consistent with a recent publication by Muleta et al. of 14,928 women in which multiparous patients had smaller fistulas, less involvement of the urethra or bladder neck, less scarring, more successful repairs, and less residual incontinence after

Table 6 Goh vs. Waaldijk

Final model, n=163		Odds ratio	95% Confidence limits		Wald chi-square p value	AUC	
Goh's system	Type 3 vs. 1, 2	0.29	0.08	1.10	**0.0282**	0.7088	0.7721
	Type 4 vs. 1, 2	0.11	0.02	0.56			
	b vs. a	1.06	0.24	4.61	0.1453	0.6549	
	c vs. a	0.30	0.06	1.45			
	ii vs. i	0.55	0.10	2.96	0.7820	0.6147	
	iii vs. i	0.79	0.23	2.75			
Waaldijk's system	Type II vs. I	1.38	0.28	6.87	0.6917	0.6388	0.6388
	b vs. a	0.74	0.19	2.85	0.6611	0.6192	
Full model						0.7793	

AUC area under the curve. The Goh's system has significantly better predictive ability of successful fistula closure than the Waaldijk's system, p=0.0421

repair [17]. Several other publications echo these findings [6, 18–20]. We also found a significant difference in the rate of successful closure between primary and secondary repairs compared to three or more, consistent with prior studies verifying that initial repair is the optimal setting for greatest likelihood of successful OF closure [5, 18–24].

This data set further reports the predictive probability of closure for each combination of components for the two classification systems compared. In Goh's original paper, the predictive probability was reported for each component separately. In contrast, our model includes the weight of each component, demonstrating probabilities that are slightly lower. This is likely due to inclusion of other components, reflecting a more accurate percentage and/or due to the smaller number of patients in this data set. Similar findings occurred with Waaldijk's system, with probabilities slightly lower. The predictive probability table provides a practical clinical tool to predict successful closure using either of these two systems (Tables 4 and 5).

When analyzing Waaldijk and Goh separately, findings in this data set are consistent with previous reports, wherein Goh's system type 4 predicted failed closure [8]. These data also support previous observations that size and extent of tissue induration and fibrosis influence repair success. However, in the Waaldijk's system, these data did not demonstrate an independent variable for predicting repair success or failure.

This study is the first to directly compare two classification systems in the same OF patient group. In this data set, the Goh's system demonstrated significantly better prediction of successful OF closure than did the Waaldijk's system. This difference may be due to the focus on urethral involvement and closure function in the Waaldijk's system whereas the Goh's system includes size, vaginal induration, fibrosis and scarring, and bladder capacity.

There are several limitations to our study. First is the relatively small sample number of patients and short length of follow-up. Additionally, the statistical difference may not correlate to a clinically relevant difference when the systems are used in the field. Finally, this study used fistula closure as the outcome measure for systems comparison and not residual incontinence, an issue of equal relevance to OF patients and surgeons. Among OF patients successfully closed, 15.8% suffered persistent urinary incontinence. This data set was too small to accurately include residual incontinence in closed fistula as a secondary outcome measure. In order for one system to be universally adopted, a larger study including multiple OF treatment centers with longer follow-up is needed.

In conclusion, Waaldijk and Goh are the two most commonly used obstetrical fistula classification systems. Independently, the variable of primiparity is correlated with less successful fistula repair. When compared, Goh's classification system has a significantly better ability to predict OF closure than the Waaldijk's system. Ideally, this information will be followed by a larger study in multiple centers with longer follow-up, in order to unify fistula surgeons with a single classification system with the best prognostic function, thereby facilitating standardization of terminology, accurate comparison of surgical techniques and OF centers, improved triage, and optimize patient counsel and consent.

Acknowledgments We are grateful to Dr. Charles Ascher-Walsh for his conceptual support, advice, and guidance.

Conflicts of interest None.

References

1. Hancock B, Browning A (2005) Practical obstetric fistula surgery. Royal Society of Medicine Press Ltd., London
2. Goh J, Browning A, Berhan N, Chang A (2008) Predicting the risk of failure of closure of obstetric fistula and residual incontinence using a classification system. Int Urogynecol J 19:1659–1662
3. Murray C, Goh J, Fynes M, Carey M (2002) Urinary and faecal incontinence following delayed primary repair of obstetric genital fistula. BJOG 109:828–832
4. Waaldijk K (2004) The immediate management of fresh obstetric fistula. Am J Obstet Gynecol 191(3):795–799
5. Kirschner C, Yost K, Du H, Karshima J, Arrowsmith S, Wall L (2010) Obstetric fistula: the ECWA Evangel VVR Center surgical experience from Jos, Nigeria. Int Urogynecol J 21:1525–1533
6. Goh J, Stanford EJ, Genadry R (2009) Classification of female genitor-urinary tract fistula: a comprehensive review. Int Urogynecol J 20:605–610
7. Waaldijk K (1985) Surgical classification of obstetric fistula. Int J Gynaecol Obstet 49:161–163
8. Goh JTW, Browning A, Berhan B, Chang A (2008) Predicting the risk of failure of closure of obstetric fistula and residual urinary incontinence using a classification system. Int Urogynecol J 19 (12):1659–1662
9. Sims J (1952) On the treatment of vesico-vaginal fistula. Am J Med Sci 53:59–82
10. Mahfouz N (1929) Urinary and recto-vaginal fistulae in women. J Obstet Gynaecol Br Emp 36:581–589
11. McConnachie E (1958) Fistulae of the urinary tract in the female. SA Med J 32:524–527
12. Moir JC (1956) Personal experience in the treatment of vesicovaginal fistulas. Am J Obstet Gynecol 71:476–491
13. Bird GC (1967) Obstetric vesico-vaginal and allied fistulae. J Obstet Gynaecol Br Common 74:749–752
14. Lawson JB (1968) Birth-canal injuries. Proc R Soc Med 61:22–24
15. Hamlin R, Nicholson E (1969) Reconstruction of the urethra totally destroyed in labor. BMJ 2:147–150
16. Arrowsmith S (2007) The classification of obstetric vesico-vaginal fistulas: an evidence-based approach. Int J Gynaecol Obstet 99: S25–S27
17. Muleta M, Rasmussen S, Kiserud T (2010) Obstetric fistula in 14,928 Ethiopian women. Acta Obstet Gynecol Scand 89(7):945–951
18. Lewis A, Kaufman M, Wolter C, Philips S, Maggi D, Condry L, Dmochowski R, Smith J (2009) Genitourinary fistula experience in Sierra Leone: review of 505 cases. J Urol 181(4):1725–1731

19. Rijken Y, Chilopora G (2007) Urogenital and rectovaginal fistulas in southern Malawi: a report on 407 reports. Int J Gynecol Obstet 99:S85–S89
20. Wall L, Karshima J, Kirschner C, Arrowsmith S (2004) The obstetric vesicovaginal fistula: characteristics of 899 patients from Jos, Nigeria. Am J Obstet Gynecol 190:1011–1019
21. Nardos R, Browning A, Chen C (2009) Risk factors that predict failure after repair of obstetric vesicovaginal fistulae. Am J Obstet Gynecol 20(5):578e1–578e4
22. Roenneburg M, Genadry R, Wheeless C (2006) Repair of obstetric vesicovaginal fistulas in Africa. Am J Obstet Gynecol 195:1748–1752
23. Browning A (2006) Risk factors for developing residual urinary incontinence after obstetric fistula repair. BJOG 116:482–485
24. Hilton P, Ward A (1998) Epidemiological and surgical aspects of urogenital fistulae: a review of 25 years' experience in southeast Nigeria. Int J Pelvic Floor Dysfunc 9(4):189–194