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ORIGINAL ARTICLE

Recurrence and functional results after open versus conventional laparoscopic versus robot-assisted laparoscopic rectopexy for rectal prolapse: a case–control study

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Abstract
Purpose This study was designed to evaluate recurrence and functional outcome of three surgical techniques for rectopexy: open (OR), laparoscopic (LR), and robot-assisted (RR). A case–control study was performed to study recurrence after the three operative techniques used for rectal procidentia. The secondary aim of this study was to examine the differences in functional results between the three techniques.
Materials and methods All consecutive patients who underwent a rectopexy between January 2000 and September 2006 enrolled in this study. Peri-operative data were collected from patient records and functional outcome was assessed by telephonic questionnaire.
Results Eighty-two patients (71 females, mean age 56.4 years) underwent a rectopexy for rectal procidentia. Nine patients (11%) had a recurrence; one (2%) after OR, four (27%) after LR, and four (20%) after RR. RR showed significantly higher recurrence rates when controlled for age and follow-up time compared to OR, (p=0.027), while LR showed near-significant higher rates (p=0.059). Functional results improved in all three operation types, without a difference between them.
Conclusions LR and RR are adequate procedures but have a higher risk of recurrence. A RCT is needed assessing the definitive role of (robotic assistance in) laparoscopic surgery in rectopexy.

Keywords Recurrence · (Robot-assisted) laparoscopic rectopexy · Rectal procidentia/prolapse · Post-operative functional results · EMS release

Abbreviations

OR	open rectopexy
LR	laparoscopic rectopexy
RR	robot-assisted laparoscopic rectopexy
χ^2_L	loglikelihood chi-squares
95%CI	95% Confidence Intervals
K-W	Kruskal–Wallis test
ANOVA	analysis of variance
IDL score	impact on daily life-score as judged by patients (0 = high–10 = low)
EMS	Endopath Multifeed Stapler® 10 mm shaft (Ethicon Endo-Surgery, Inc., Cincinnati, OH, USA)

Introduction

Rectal procidentia frequently occurs in older women. The male-to-female ratio is 1:6 with a peak incidence between

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50 and 60 years of age [1]. Patients usually present with obstructed defecation or fecal incontinence.

Controversy exists regarding the preferred surgical technique for the treatment of rectal procidentia. The transabdominal procedure is generally considered more effective in healthy patients compared to perineal procedures [2–5]. Laparoscopic repair [6–9] seems as effective as open surgery with possible advantages such as faster recovery, less blood loss, lower medical costs, and less post-operative pain [10–13]. Therefore, many authors have advocated this approach as the preferential technique [10, 11, 14].

At our hospital robot-assisted laparoscopic rectopexy (RR) has been performed since 2003. The DaVinci robot combines the advantages of the laparoscopic technique, such as faster recovery and less post-operative pain, with the advantages of open surgery, namely the high-quality three-dimensional vision, restoration of the eye–hand–target axis and the use of an advanced instrument offering seven degrees of freedom in handling [15–17]. However, there is a suspicion of a higher recurrence rate in the minimal invasive procedure as compared to the conventional procedure most likely due to the differences in fixation of the rectum to the promontory. This study was performed to investigate the effectiveness of laparoscopic rectopexy (LR) and RR compared to open rectopexy (OR) in terms of recurrence rates. The secondary goal was to determine the difference in functional outcome. This was done by measuring differences between these procedures in terms of constipation, fecal incontinence, and the impact on the patients' daily life.

Materials and methods

Eighty-two patients underwent a rectopexy for rectal procidentia at the University Hospital Maastricht between January 2000 and September 2006. They were non-randomly assigned to open, conventional laparoscopic, or robot-assisted rectopexy. The inclusion criterion for rectopexy was full thickness rectal prolapse in all cases. Exclusion criteria for the study were age under 18 or patient unfit for surgery. Patients with a "hostile abdomen" after extensive abdominal surgery were deemed eligible for an OR only. Previous abdominal surgery was not considered a contra-indication for LR or RR, nor was previous anti-prolapse surgery. All operations were performed by the same team with all extensive experience in advanced minimal invasive techniques, including laparoscopic d'Hoore rectopexy. Patients were post-operatively asked to participate in a structured interview. Results of the questionnaire were used for analysis after informed consent was obtained.

Procedure

In the first 42 patients, a Well's procedure was performed. After rectal mobilization a posterior mesh rectopexy was performed (first described by Wells in 1959) [18]. Since July 2004, the general policy in our department shifted from a modified Well's procedure towards a D'Hoore ventral mesh rectopexy in order to minimize the risk for autonomic neural damage and therefore post-operative constipation [6]. Ventral mobilization of the rectum was performed with fixation of the mesh to the promontory through suture or staple. The mesh was then sutured on the ventral side of the stretched rectum. In females, this procedure included fixation of the mesh to the top of the vagina or uterus.

LR and RR were performed as previously described by our unit [19]. In RR, we used the four-armed DaVinci® surgical system (Intuitive Surgical Inc., CA, USA). The patient is positioned in a French steep Trendelenburg position. The four-armed robotic cart is positioned between the legs of the patient. The port placement is similar in LR and RR. A 12 mm port is placed in the infra-umbilical position for the camera. Three 5 mm ports are placed in LR, and 7 mm robotic ports are placed in RR and controlled by the surgeon from behind the console. Another 12 mm trocar is placed supra-pubically to allow the assistant to retract the bladder and use the EMS stapler to fix the mesh to the promontory. Dissection and fixation is done as described by D'Hoore [6].

Discharge criteria were equal for all patients. Patients resumed oral feeding within 24 h if tolerated. Laxatives were given when indicated. Discharge was only approved after sufficient recovery, no intravenous analgesia, defecation, and adequate oral intake.

Measurements

The primary outcome of the study was the recurrence rate after the various surgical techniques. Secondary outcome parameters were complications, post-operative recovery, functional results, and quality of life.

The standardized Wexner constipation score was used to investigate the level of constipation before and after the operation [20]. The Parks–Browning classification was used to grade fecal incontinence [21].

The impact of the surgical procedures on daily life was scored on an ordinal scale (0 is unbearable/maximally incapacitated to 10 which is no impact at all), further referred to as the IDL score.

Statistics

Metric data, if normally distributed, are presented as means and standard deviations and categorical data as frequencies and percentages. To test for normality of distributions the Kolmogorov–Smirnov test is used. In univariate statistics for recurrence loglikelihood chi-squares, odds ratios and its 95% confidence intervals (CI) are presented for (risk) factors and variables examined in the study (Table 1). A multivariate logistic regression analysis is used to search for statistical significance of effects belonging to these risk factors and variables. Backward elimination technique and change in loglikelihood chi-squares is used to find the best-fitting model. The final model for recurrence containing only statistically significant effects is presented as a table with net odds ratios and 95% CI (Table 2). To test for differences in operating time between the three types of operations the univariate overall analysis of variance (ANOVA) F ratio is used, and p values for separate t tests are Bonferroni-adjusted in multiple comparisons. To test for differences in post-operative hospital stay between the three types of operations the Kruskal–Wallis (K-W) test is used. For the analysis of (differences in) pre-operative and post-operative Wexner-scores (or IDL scores) paired t tests and repeated measures ANOVA were done and F ratios, df's and p values are presented. Statistical analysis was performed using SPSS 15 (SPSS Inc., Chicago, USA). A p value of less than 0.05 was defined as being statistically significant.

Results

A total of 82 patients (71 females, 87%) with a mean age of 56.4 years (range, 21–88) were included and underwent an OR (n=47, 57%), LR (n=15, 18%), or RR (n=20, 24%) for rectal procidentia. Eighty-two patients were eligible for follow-up. Seventy-two (90%) patients answered the questionnaire (M–F=10:62). Reasons for not taking part were: inaccessibility (four), psychological illness (three), and unwilling (one). Two patients died during follow-up as a result of non-related causes.

Table 1 Univariate relationships between having a recurrence and relevant (clinical) parameters (n=82)

Parameter	Category	N	%rec	X_L^2	p value	Odds ratio	95% CI
Operation type	OR	47	2.1	9.652	0.008*	–	–
	LR	15	26.7			16.73	1.68–164.88
	RR	20	20.0			11.50	1.195–110.641
Operation type dichotomy	Open	47	2.1	9.438	0.002*		
	Minimally invasive	35	22.9			13.63	1.62–114.98
Follow-up time (years)	–	–	–	0.116	0.734	1.07	0.73–1.56
Procedure	Well's	40	12.5	0.186	0.666	0.737	0.183–2.966
	D'Hoore	42	9.5				
Gender	Female	71	7	6.152	0.013*	7.543	1.636–34.774
	Male	11	36.4				
Age (years)				8.948	0.003*	0.928	0.881–0.978
Age (categorized)[a]	≤40	10	50.0			15.500	2.336–102.848
	40–60	39	5.1			0.838	0.111–6.298
	>60	33	6.1	12.015	0.002*	–	–
ASA	1	29	13.8	0.646	0.724	–	–
	2	37	10.8			0.758	0.172–3.328
	3	16	6.3			0.417	0.042–4.085
Abdominal surgery in history	No	28	21.4	4.476	0.034*	0.216	0.049–0.941
	Yes	54	5.6				
Constipation in history	No	53	11.3	0.018	0.892	0.904	0.209–3.917
	Yes	29	10.3				

%rec percentage of recurrence

*p<0.05 Statisticallly significant

[a] Reference group is age >60 years of age

Table 2 Final model logistic analysis results for recurrence (n=82)

	Odds ratio	p value	95.0% CI
Follow-up time	1.54	0.103	0.92–2.59
Operation		0.081	
LR vs. OR	13.94	0.059	0.90–215.58
RR vs. OR	24.41	0.027	1.45–410.65
Age	0.93	0.024	0.87–0.99

Pre-operative characteristics

Forty-one (50%) patients had fecal incontinence (including grade 4 incontinence in 35 patients). Other complaints were constipation (n=29, 35%). Fifty-one of the 71 women (72%), have had a hysterectomy. Indication for previous hysterectomy was prolapse of the uterus in 25 patients (35%).

Operative characteristics

Mean operation time was 77±33 in OR, 119±31 in LR, and 154±47 min in RR (ANOVA F=33.37 by 2 and 79 df; p< 0.001). Bonferroni-adjusted p values for multiple tests are: OR–LR p=0.001, OR–RR p<0.001, LR-RR p=0.020. Median follow-up time in the study was 1.95 years (mean 2.6; range 0.2–8.0). There was no statistical significant difference in operation time between the Well's and the D'Hoore's rectopexy (99 versus 107 min; p=0.192).

Thirty-five patients had a rectopexy through EMS fixation. Five patients (14.3%) in this group had a recurrence. Three out of five (60%) had documented failure of the fixation. In contrast, four out of 47 patients (8.5%) in the sutured group had a recurrence. None was documented as a release of the suture from the promontorium.

Post-operative characteristics

Patients were discharged from the hospital after a median of 3 days (range 1–30, SD 3.94). Mean length of stay per operation type were: OR 5.7 days (range 2–30), LR 3.5 days (range 1–14), and RR 2.6 days (range 1–6; p<0.001).

After surgery, there was a large number of complications (42.7%): urine retention (3.7%), cystitis (20.7%), wound infection (4.9%), bowel obstruction (6.1%), and incisional hernia (2.4%).

Recurrences

Nine (11%) of the 82 patients developed a recurrence. Recurrences (Table 1) were more frequent after both minimal invasive rectopexy types compared to open surgery (respectively LR 27% and RR 20% versus OR 2%; p=0.008). Recurrence occurs significantly more often in younger patients in childbearing age (p=0.003), especially below the age of 40 (50% vs. 6% above the age of 60; p=0.002). Males are more likely to get a recurrence (p= 0.013), and fixation of the vaginatop (in patient with previous hysterectomy) protects against recurrence (p= 0.009).

Patients under the age of 40 were more likely to undergo conventional laparoscopic procedures (six out of ten). From the age of 40 OR is significantly more present (44% in the age 40–60 years and 73% above 60).

Logistic regression analysis was performed with backward elimination procedure using—next to operation type—age, previous abdominal surgery, and previous uterus surgery as possible risk factors for recurrence. Multivariate analysis was repeated for all patients (n=82), using—next to operation type and follow-up time—gender, age, and previous abdominal surgery as risk factors. The final model now includes—next to operation type and follow-up time—only age. Results of this model are presented in Table 2.

Functional results

The mean Wexner score decreased from 13.4±7.5 to 10.3± 7.1 post-operatively (p<0.001). The mean IDL score decreased from 8.3±1.5 to 4.8±2.7 post-operatively (p= 0.041). Repeated measures ANOVA was performed to test for differences in IDL- and Wexner-trends for the three operation types. To test for homogeneity of the decrease in Wexner score over the different operation types the F ratio is 0.001 by 2 and 69 degrees of freedom (p=0.999). The F ratio for decrease in IDL differences between the three operation types is 1.183 by 2 and 69 degrees of freedom (p= 0.313). Therefore, no differences were found for either

Table 3 Means and standard deviations (SD) of both pre- and post-operative Wexner- and IDL scores for the three types of surgery examined (n=72)

	pre-wex		post-wex		pre-IDL		post-IDL		
Operation type	Mean	SD	Mean	SD	Mean	SD	Mean	SD	N
OR	14.30	6.603	11.15	6.762	8.25	1.581	5.10	2.468	40
LR	13.08	8.939	10.00	9.205	8.42	1.379	3.92	3.343	12
RR	11.90	8.309	8.70	6.375	8.35	1.309	4.75	2.552	20
Total	13.43	7.477	10.28	7.089	8.31	1.460	4.81	2.646	72

decrease in Wexner score or IDL score between the three operation types (Table 3).

Urinary incontinence increased after rectopexy (22 patients suffered from stress, urge, or mixed incontinence before versus 27 patients after the operation). Fecal incontinence was still present in 27 patients (33%). In 15 of the 42 (36%) patients the fecal incontinence improved after rectopexy. Fifty percent of the patients needed laxatives during admission. Twenty-nine percent of the patients were still using laxatives at time of the questionnaire. The use of the rectal irrigation pump for intractable constipation and/or fecal incontinence increased from 4% during hospital stay to 21% at time of the questionnaire.

Discussion

In this study we compared conventional laparoscopic, robot-assisted rectopexy, and open rectopexy. However, it remains difficult to really determine the influence of either technique on the outcome in a limited population. Open surgery seems to lead to less recurrences. Several reasons may explain the disappointing results after minimal invasive rectopexy. A possible explanation might be the use of different fixation instruments or techniques.

Besides the differences in results due to technical failure, there is a possibility that OR leads to more adhesions, resulting in a more firm fixation of the rectum to the promontory and subsequently less recurrences. However, if recurrence rates are statistically corrected for age, the differences in recurrence rate for the various operative techniques become statistically non-significant. One explanation of this difference in outcome between females in childbearing age and older patients might be the fact that there was no combined rectovaginopexy with fixation of the top of the vagina in the younger group.

LR and RR result in a significant increased operating time compared to OR, respectively 42 and 77 min more. Increased time consumption in robot-assisted advanced laparoscopy was described before [13, 22, 23] in contrast to the beneficial effect of robotic assistance on time consumption in the performance of laparoscopic training drills [15, 24, 25]. Probably, part of this increase in time consumption is due to the relative extensive effort exchanging robotic instruments and due to still relative limited experience with robotic surgery at this moment.

The use of laparoscopic techniques leads to similar functional results when comparing the different parameters measured as described before, such as the constipation, incontinence, and IDL scores pre- and post-operatively.

Conclusion

Minimal invasive techniques (laparoscopic and robotic assistance) for rectopexy can be performed safely with similar functional results but possibly at the expense of higher recurrence rates. Fixation of the top of the vagina or uterus results in better fixation and therefore less recurrences. Rectovaginopexy was performed mainly on older patients.

Well-powered randomized controlled trials are needed to eliminate selection bias and assess the definite role of (robotic assistance in) laparoscopic surgery in rectopexy.

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