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OPEN, LAPAROSCOPIC AND TRANSANAL TOTAL MESORECTAL EXCISION: A SYSTEMATIC LITERATURE REVIEW AND NETWORK META ANALYSIS

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AIM: to compare the effectiveness of different methods of total mesorectumectomy (TME).
MATERIALS AND METHODS: the systematic review performed in accordance with PRISMA practice and recommendations.
RESULTS: Forty-one papers were included in the analysis. Fourteen studies were for transanal total mesorectumectomy (TA TME) (n=480) compared with laparoscopic (LA TME), 26 – for LA TME vs open (n=6820), 1 – for open vs TA TME. There was no significant difference between open TME, LA TME and TA TME in grade 3 quality of mesorectumectomy by Quirke. The positive circular resection margin (CRM) is less often in TA TME group, then LA TME (OR=2.58, CI 1.34-4.97, p=0.005). There was significantly lower positive CRM rate in LA TME then open TME (OR=0.73, CI 0.63-0.85, p<0.0001). There were no significant differences in postoperative complications rates between LA TME and TA TME (p=0.72). Network meta-analysis showed less postoperative complications followed LA TME than open TME (OR=0.75, CI 0.65-0.84).
CONCLUSION: TA TME is comparable with laparoscopic and open TME in short term results. Rates of positive CRM, the quality of Grade 1 mesorectal excision, the conversion rate, the postoperative urinary dysfunction, may have better results in TA TME.

[Key words: rectal cancer, surgery, mesorectum, total mesorectal excision, TME, laparoscopy, transanal, TATME]

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INTRODUCTION

Total mesorectumectomy (TME) is currently the accepted standard for rectal cancer surgery. The use of TME technique can reduce the local recurrence rate from 17% to 6% and increase 5-year and 10-year survival by 50% [1]. The use of laparoscopic technique for TME in rectal resection showed comparable results of pathomorphological quality of removed specimen, the recurrence rate, 3-year and 5-year survival compared with open surgery in randomized multicenter studies [2,3,4]. Such factors as: locally advanced nature of the tumor, narrow pelvis, obesity create difficulties in performing open and laparoscopic rectal resection with TME. For laparoscopic resections, obesity and locally advanced nature of the tumor may be relative contraindications. However, a number of authors perform laparoscopic resections in locally advanced rectal cancer [5,6] and/or obesity with body mass index (BMI) ⩾30 kg/m^2 [7]. Another feature of open and laparoscopic procedures is poor visualization of the distal rectal resection boundaries.

In 2010, a method of transanal TME (the technique of rectal mobilization «from the bottom to the top») was proposed, which provides a more precise technique of mesorectumectomy in the distal rectum, especially in the anterior rectal wall.

In the studies [8,9] transanal TME demonstrated comparable results on the quality of the removed rectal specimen vs. laparoscopic and open resections [10-12]. The studies showed that TME is technically more convenient when using transanal technique in comparison with open or laparoscopic ones. According to a comparative study by Velthuis S. et al. (2014), the quality of the removed specimen of Grade 3 in the TA TME group was observed in 24 patients versus 18 in the laparoscopic TME group (p<0.05) [13].

AIM

The purpose of this meta-analysis is to compare the short term results of all TME techniques.

MATERIALS AND METHODS

Systematic review and meta-analysis were performed in accordance with the practice and recommenda-

tions of the preferred reporting items for systematic reviews and meta-analyses (PRISMA) [14]. Literature search was carried out using the electronic database of medical literature Medline for the entire period till November 9, 2018. The search terms used were: «rectal cancer», «surgery», «mesorectum», «total mesorectal excision», «TME», «laparoscopy», «transanal», «TATME». Animal studies were excluded from the study. In addition, a literature search was conducted on the bibliographic data of selected studies in order to identify unrecognized articles in the initial search. The systematic review and meta-analysis included full-text articles in English comparing the performance of total mesorectumectomy by transanal, laparoscopic or open techniques.

Statistical analyses

Statistical analysis in direct comparison of the techniques was performed using the Review Manager 5.3 program. Network meta-analysis was performed using WinBugs version 1.6.1 (NetMetaXl: Dichotomous date An Excel Tool for WinBugs). When choosing a fixed or random comparison model, the value of the DIC (deviance information criterion) parameter in WinBugs version 1.6.1 [15] was estimated. The total value of the dichotomous data is described as the odds ratio (OR) with a 95% confidence interval (CI). OR was calculated using the Peto method if one of the values of the two-field table was 0. Statistical heterogeneity among studies was assessed using χ^2 test. Statistically significant heterogeneity was considered as I^2>50% and p<0.1.

Search results

After compiling the query in PubMed, 9,722 publications were found in the Medline database. After screening, 221 full-text studies remained. At the next stage, literature reviews and clinical cases were excluded. Additionally, there was the search among the articles selected for analysis in the literature for those which allowed to identify 10 studies. As a result, the analysis includes 42 articles comparing the methods of total mesorectumectomy among themselves, of which 14 studies compare transanal TME with laparoscopic one, 26 studies compare laparoscopic TME with open one and 1 study compares the open TME technique with transanal one. One study by Perdawood, S.K. et al. [12] was excluded from the analysis, as there were duplication of data [9].

Data acquisition

The data of interest included in the analysis were: author, year of publication, study design, number of patients in the groups (transanal TME, laparoscopic TME and open TME), gender, age, BMI, history of surgical procedures, tumor size, neoadjuvant ChRT history, surgery duration, conversion rate, blood loss, intra-and postoperative complications rate and structure, TME quality, lateral and distal resection margins.

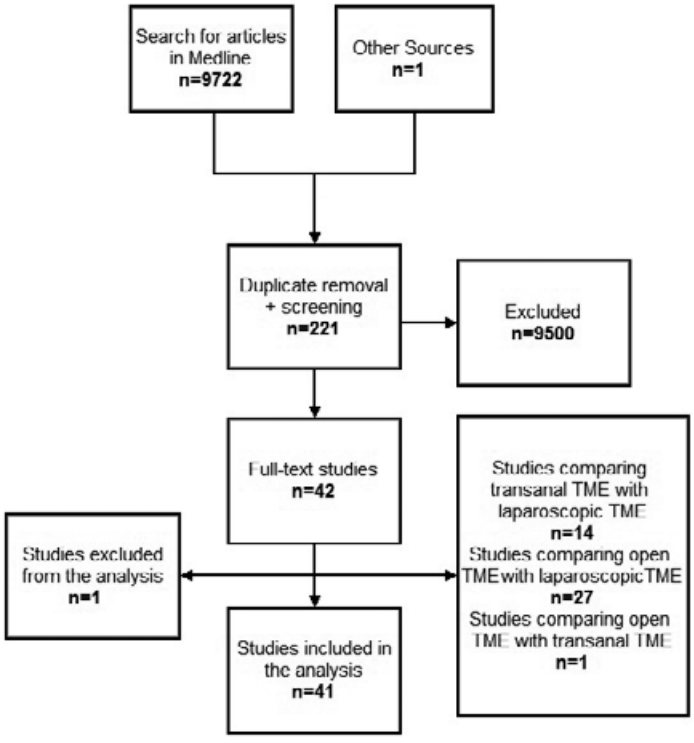

Diagram 1. *Search for literature sources*

Table 1. *Characteristics of studies comparing laparoscopic total mesorectumectomy with transanal one*

Author	Year	Period	Country	Type	Quality scale	N		Sex M/F	
						LA TME	TA TME	LA TME	TA TME
Velthuis et al. [13]	2014	2012-2013	The Netherlands	prosp	8	25	25	18/7	18/7
Denost et al. [16]	2014	2008-2012	France	rand	7	50	50	32/18	37/13
Perdawood et al. [9]	2015	2013-2015	Denmark	prosp	7	25	25	19/6	19/6
De' Angelis et al. [17]	2015	2011-2014	Germany	prosp	7	32	32	21/11	21/11
Fernandez-Hevia et al. [18]	2015	2011-2013	Spain	prosp	7	37	37	22/15	24/13
Chen et al. [11]	2015	2013-2015	China	prosp	7	100	50	76/24	38/12
Lelong et al. [8]	2016	2008-2013	France	prosp	7	38	34	22/16	23/11
Marks et al. [19]	2016	2012-2014	The USA	prosp	8	17	17	n/d	n/d
Rasulov et al. [20]	2016	2013-2015	Russia	prosp	8	23	22	14/9	11/11
Chouillard et al. [21]	2016	2011-2014	Italy	prosp	8	15	18	7/8	6/12
Chang et al. [22]	2017	2014-2017	China	prosp	7	23	23	13/10	13/10
Mege et al. [23]	2018	2014-2017	France	prosp	8	34	34	23/11	23/11
Persiani et al. [24]	2018	2007-2017	Italy	prosp	8	46	46	31/15	30/16
Veltcamp Helbach et al. [25]	2018	2009-2015	The Netherlands	prosp	7	32	32	20/12	22/10

Table 2. *Characteristics of studies comparing transanal total mesorectumectomy with open one*

Author	Year	Period	Country	Type	Quality scale	N		Sex M/F	
						TA TME	Open TME	TA TME	Open TME
Kazieva et al. [10]	2016	2013-2016	Russia	prosp	8	35	35	22/13	21/14

Inclusion and exclusion criteria

Criteria for inclusion in the analysis: rectal surgeries for cancer with total mesorectumectomy performed by one of the three described techniques, comparison of the quality of mesorectumectomy, circular and distal resection margins, comparison of the rate and structure of complications.

Exclusion criteria: data duplication.

Quality of research

All the studies were analyzed by the quality assessment system of comparative studies of Newcastle – Ottawa Score (NOS) (see tables 1, 2, 3). The quality rating was determined for each study. High-quality research is considered the one done in the presence of 7 of 9 stars level.

RESULTS

According to age, body mass index, neoadjuvant chemoradiotherapy, the presented studies had no statistically significant differences. Given that the prevalence of the tumor determines the immediate and long-term results of treatment, and may also be the cause of rejection of laparoscopic surgery, a compari-

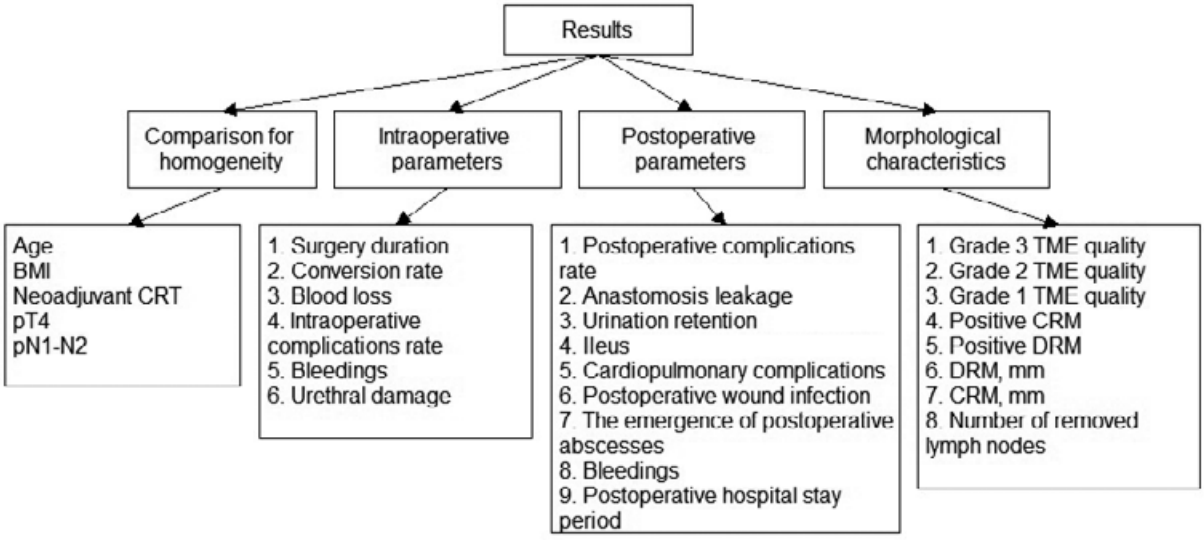

Diagram 2. *The results description structure*

Table 3. *Characteristics of studies comparing laparoscopic total mesorectumectomy with open one*

Author	Year	Period	Country	Type	Quality scale	N		Sex M/F	
						LA TME	Open TME	LA TME	Open TME
Wu et al. [26]	2016	2010-2015	China	retro	8	169	89	105/64	54/35
Baik et al. [27]	2011	2002-2005	The USA	prosp	9	54	108	37/17	62/46
Kang et al. (CoreanTrial) [28]	2010	2006-2009	Korea	rand	9	170	170	110/60-	110/60
Pas et al. (ColorII) [29]	2013	2004-2010	The Netherlands	rand	9	699	345	448/251	211/134
Stevenson et al. (ALaCaRT) [30]	2015	2010-2014	Australia	rand	9	238	235	160/78	151/84
Fleshman et al. (ACOSOGZ6051) [31]	2015	2008-2013	The USA	rand	9	242	239	156/86	158/81
Gouvas et al. [32]	2009	2004-2007	Greece	prosp	8	45	43	26/19	23/20
Kim et al. [33]	2015	2002-2011	Korea	retro	7	131	176	77/54	89/87
Cho et al. [34]	2015	2003-2008	Korea	retro	9	211	422	133/78	273/149
Kellokumpu et al. [6]	2012	1999-2006	Finland	prosp	9	100	91	65/35	65/26
McKay et al. [35]	2012	2001-2008	Australia	retro	8	157	388	n/d	n/d
Breukink et al. [36]	2005	1996-2003	The Netherlands	prosp	8	41	41	25/16	23/18
Khaikin et al. [37]	2008	2004-2006	The USA	retro	9	32	50	13/19	30/20
Laurent et al. [38]	2007	1994-2006	France	retro	9	238	233	140/98	156/77
Law et al. [39]	2006	2000-2004	China	prosp	8	98	167	68/30	112/55
Lelong et al. [40]	2006	1998-2004	France	prosp	8	104	68	n/d	n/d
Leung et al. [41]	1998	1993-1996	China	prosp	9	25	34	15/10	21/13
Liang et al. [42]	2011	2004-2008	China	rand	9	169	174	104/65	92/82
Lujan et al. [43]	2009	2002-2007	Spain	rand	9	101	103	64/39	62/39
Lujan et al. [44]	2012	no 2010	Spain	prosp	9	1387	3018	903/484	2022/996
Morino et al. [45]	2005	n/d	Italy	prosp	9	98	93	59/39	57/36
Strohlein et al. [46]	2008	1998-2005	Germany	prosp	9	114	275	72/42	163/112
Veenhof et al. [47]	2007	1999-2005	The Netherlands	prosp	9	50	50	28/22	32/18
Braga et al. [48]	2007	n/d	Italy	rand	9	83	85	55/28	64/21
Ng et al. [49]	2008	1994-2005	China	rand	8	51	48	31/20	30/18
Ng et al. [50]	2013	2001-2007	The USA	rand	8	40	40	24/16	22/18

Table 4. *Comparison of homogeneity studies*

	LA TME vs TA TME	LA TME vs Open TME
Age	OR=2,06, CI 0.39-4.50, p=0,10	OR=0,28, CI 0.95-0.40, p=0,42
BMI	OR=0,28, CI 0.42-0.98, p=0,43	OR=0,10, CI 0.46-0.26, p=0,57
Neoadjuvant chemotherapy	OR=0,81, CI 0.50-1.30, p=0,38	OR=1,09, CI 0.94-1.26, p=0,27
pT4	OR=1,49, CI 0.80-2.77, p=0,21	OR=1,01, CI 0.49-2.07, p=0,98
pN1-N2	OR=0,74, CI 0.53-1.04, p=0,08	OR=1,09, CI 0.82-1.44, p=0,56

son was made on the homogeneity of pT4 and pN1-N2, no statistically significant differences were obtained (Table 4).

Intraoperative parameters

1. The surgery duration when comparing LA TME with TA TME (Fig. 1) did not differ statistically (p=0.41), but there was a tendency that it may be less in TA TME (OR=13.64, CI 2.94-30.22, p=0.11), and when comparing LA TME with open TME (Fig. 2) it was lower in group open TME (OR=43.26, CI 29.65-56.86, p<0.00001).
2. The conversion rate into open surgery was lower in the TA TME group (Fig. 3) than in the LA TME group (OR=4.05, CI 2.11-7.76, p<0.0001).
3. Blood loss when comparing LA TME and TA TME (Fig. 4) did not differ statistically (p=0.36), but it was significantly less in LA TME (Fig. 5) in comparison with open TME (OR=116.59, CI 169.62-63.57, p<0.0001).
4. The intraoperative complications rate between LA TME and TA TME (Fig. 6) was comparable (p=0.22); when comparing LA TME with open TME (Fig. 7) no differences were also obtained (p=0.61).
5. There was no statistical difference in intraoperative bleeding rate when comparing LA TME with TA TME (Fig. 8) (p=0.35), as well as when comparing LA TME with open TME (Fig. 9) (p=0.54).
6. Comparing LA TME with open TME on the intraoperative urethra damage rate (Fig. 10), no differences were obtained (p=0.37).

Postoperative parameters

1. The postoperative complications rate (Fig. 11) did not differ when comparing LA TME with TA TME (p=0.72), but it was less in LA TME (Fig. 12) in comparison with open TME (OR=0.75,CI 0.68-0.82, p<0.00001).
2. When comparing LA TME with TA TME the anasto-

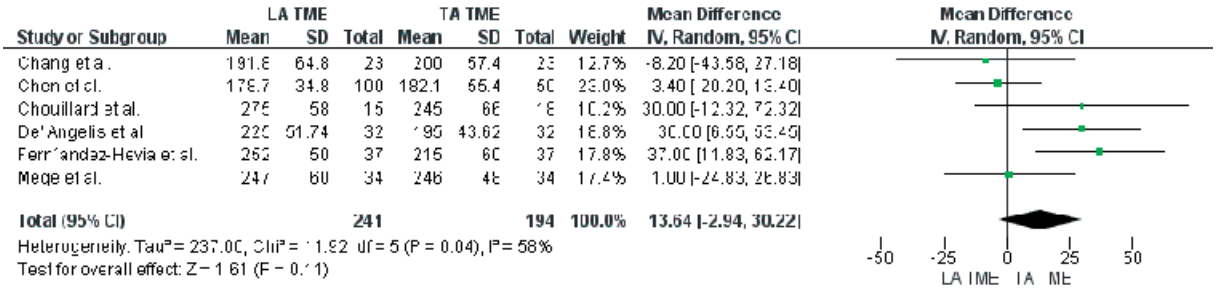

Figure 1. *Surgery duration when comparing laparoscopic TME with transanal TME*

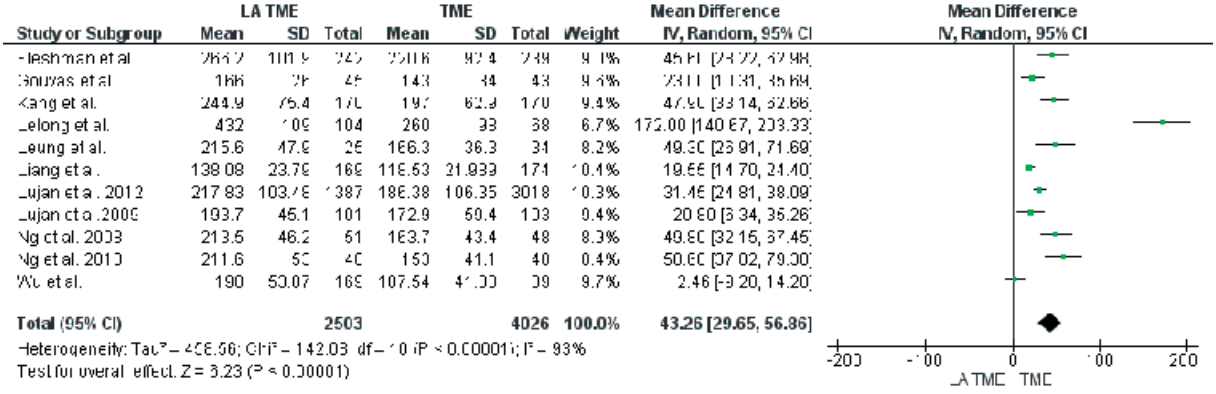

Figure 2. *Surgery duration when comparing laparoscopic TME with open TME*

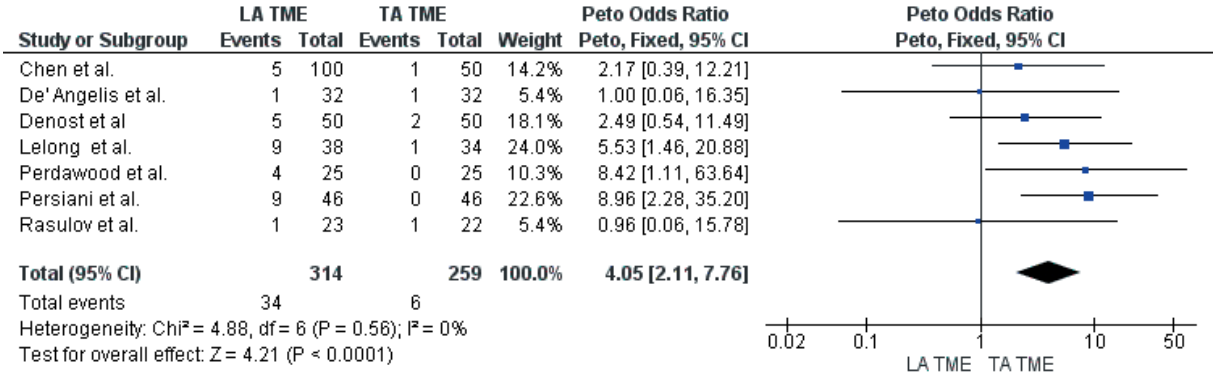

Figure 3. *Conversion rate when comparing laparoscopic TME with transanal TME*

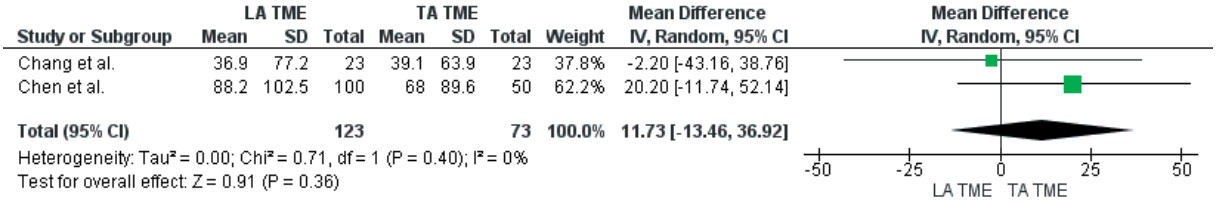

Figure 4. *Intraoperative blood loss when comparing laparoscopic TME with transanal TME*

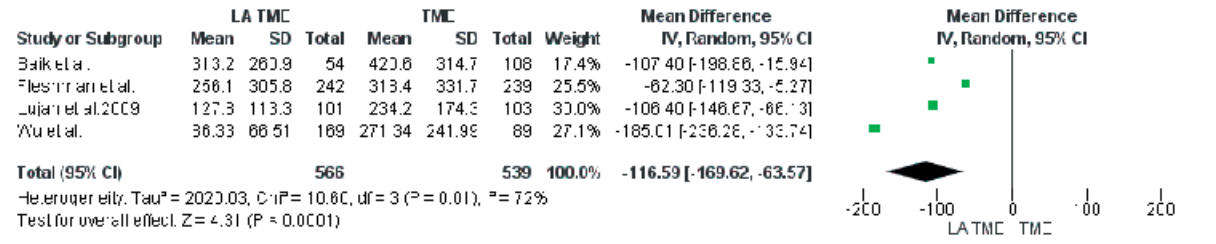

Figure 5. *Intraoperative blood loss when comparing laparoscopic TME with open TME*

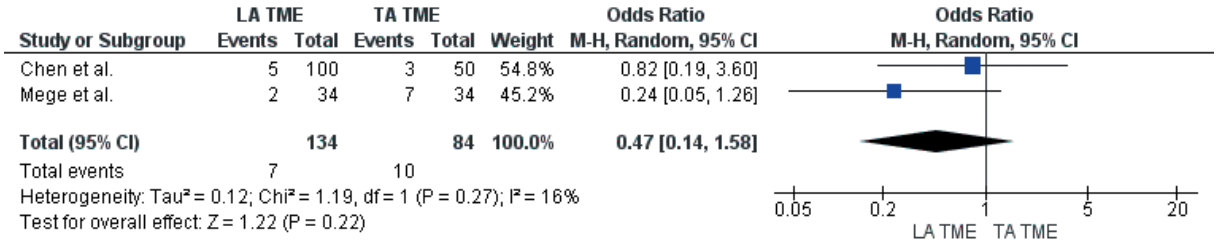

Figure 6. *Intraoperative complications rate when comparing laparoscopic TME with transanal TME*

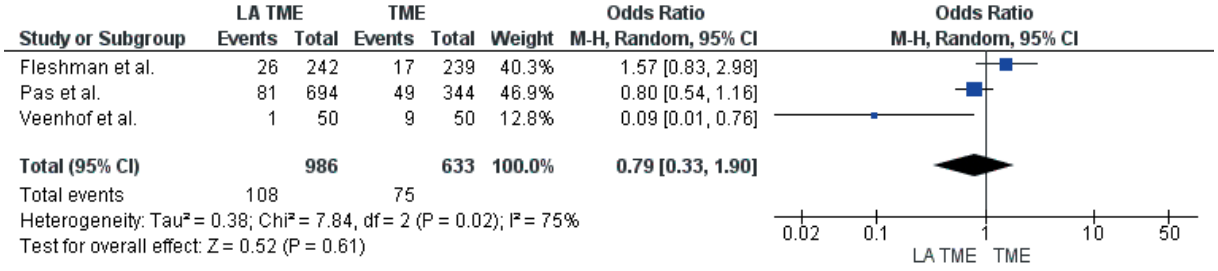

Figure 7. *Intraoperative complications rate when comparing laparoscopic TME with open TME*

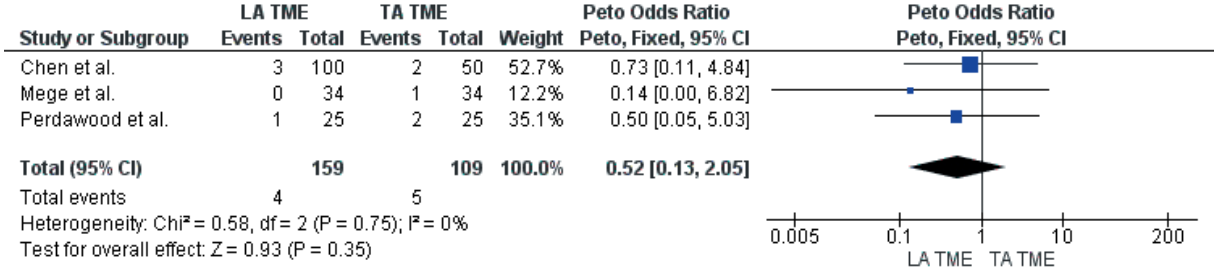

Figure 8. *Intraoperative bleeding rate when comparing laparoscopic TME with transanal TME*

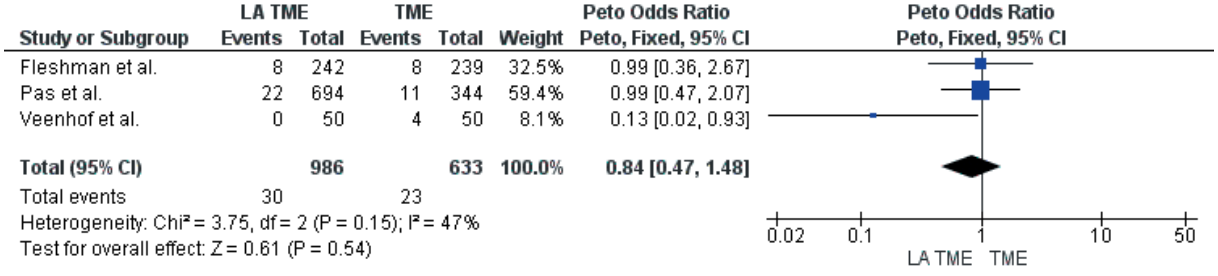

Figure 9. *Intraoperative bleeding rate when comparing laparoscopic TME with open TME*

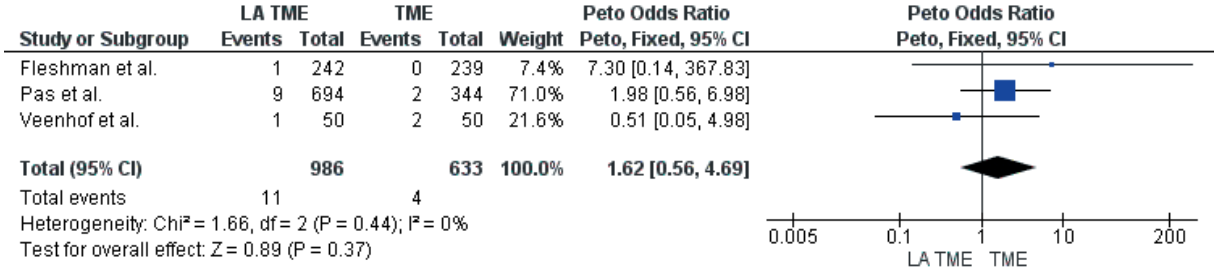

Figure 10. *Intraoperative urethral damage rate when comparing laparoscopic TME with open TME*

mosis leakage rate (Fig. 13) was close to the statistical difference, but there was a tendency to decrease it in TA TME (OR=2.04, CI 0.97-4.28, p=0.06). When comparing LA TME with open TME (Fig. (14) no statistical difference was obtained (p=0.90).

3. Postoperative urination retention is less common in TA TME (Fig. 15) in comparison with LA TME (OR=2.49, CI 1.12-5.54, p=0.03); when comparing LA TME with open TME (Fig. 16) no differences were obtained (p=0.33).

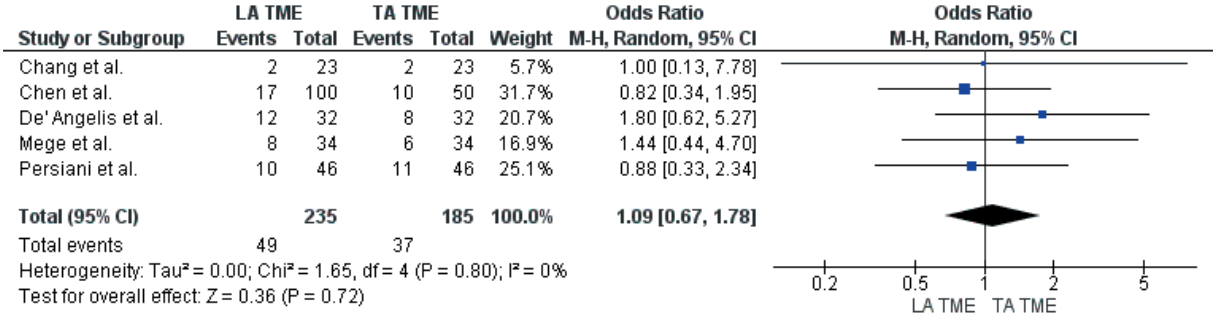

Figure 11. *Postoperative complications rate when comparing laparoscopic TME with transanal TME*

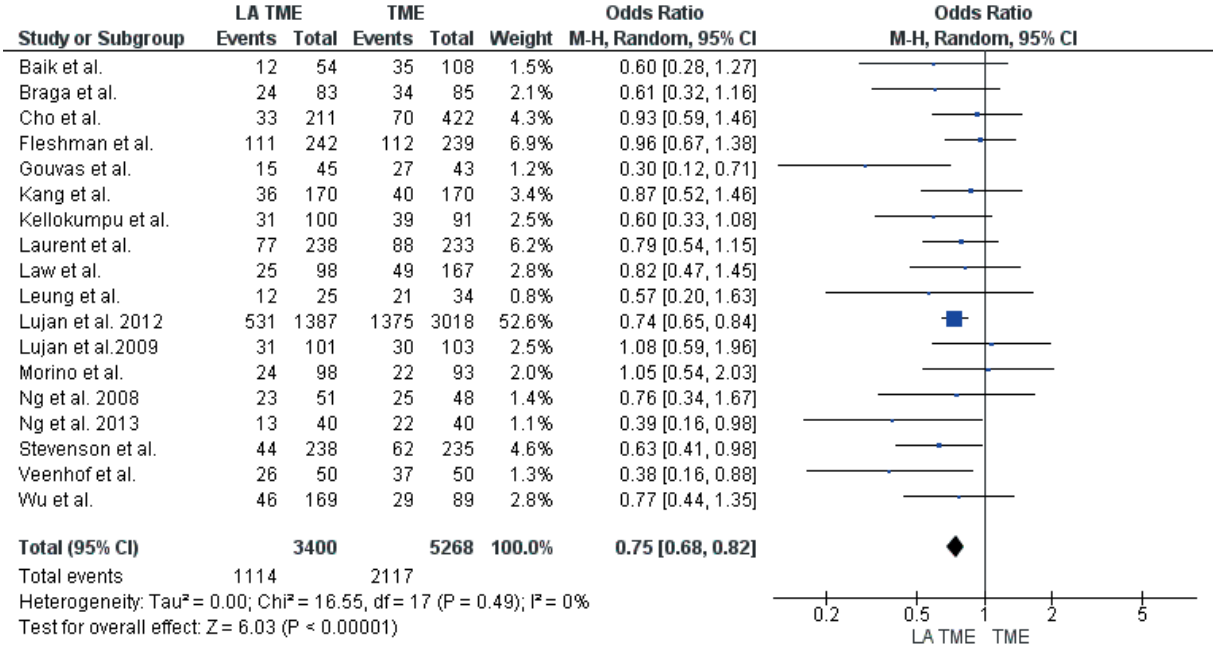

Figure 12. *Postoperative complications rate when comparing laparoscopic TME with open TME*

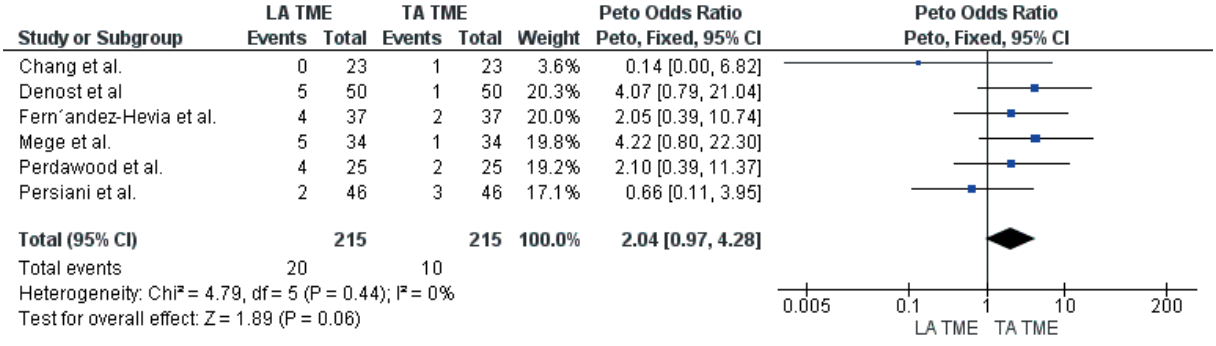

Figure 13. *Anastomosis leakage rate when comparing laparoscopic TME with transanal TME*

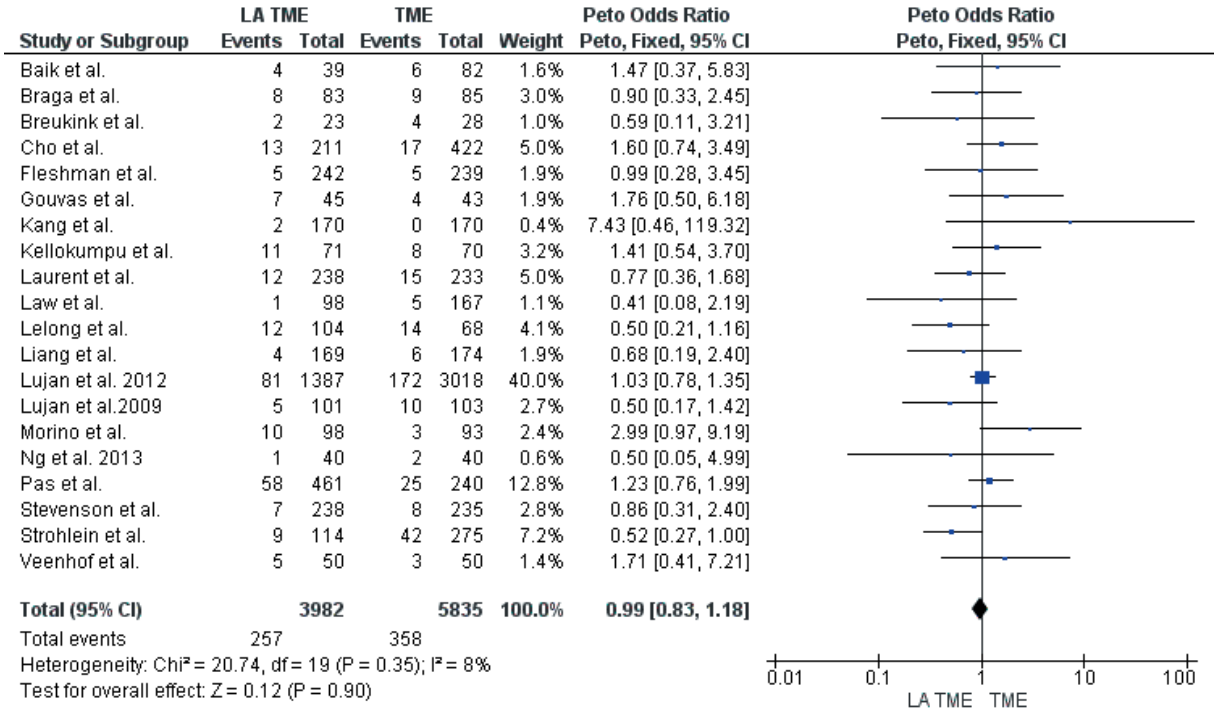

Figure 14. *Anastomosis leakage rate when comparing laparoscopic TME with open TME*

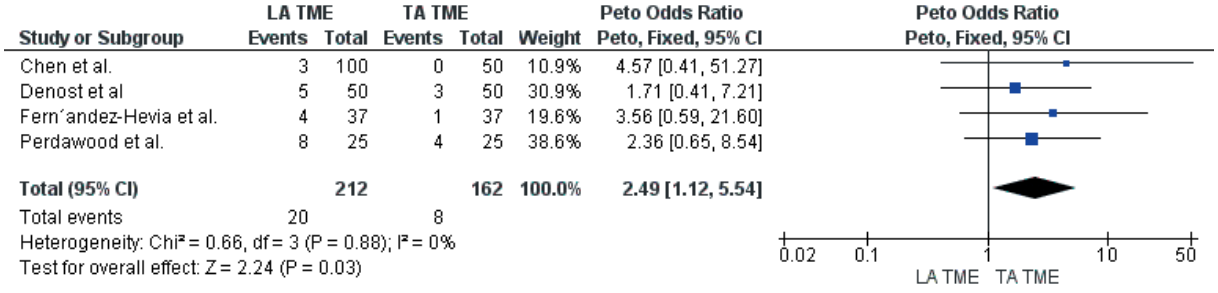

Figure 15. *Postoperative urination retention rate when comparing laparoscopic TME with transanal TME*

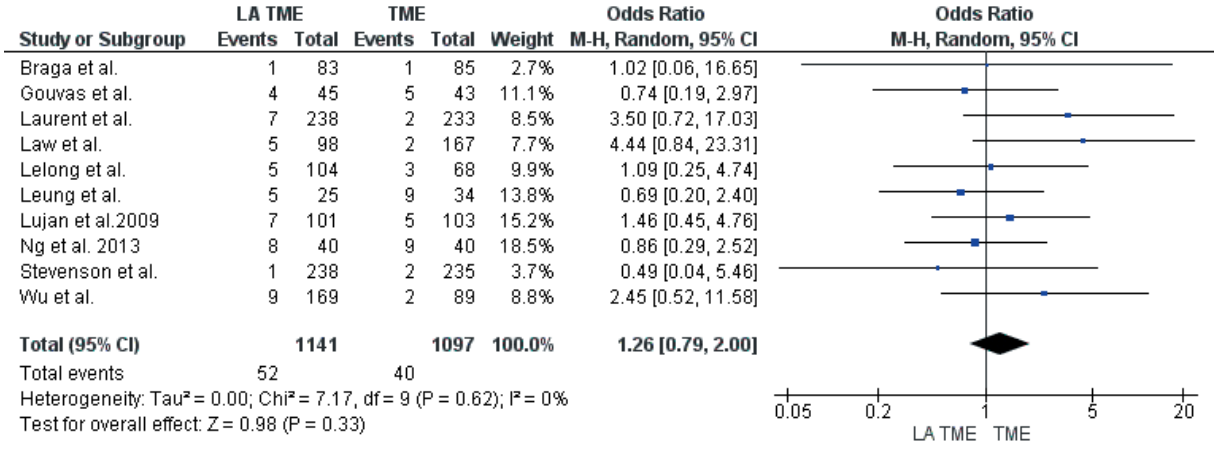

Figure 16. *Postoperative urination retention rate when comparing laparoscopic TME with open TME*

4. As for the ileus rate of the gastrointestinal tract, no differences were obtained when comparing LA TME with TA TME (Fig. 17) (p=0.39), as well as when comparing LA TME with open TME (Fig. 18) (p=0.83).
5. Cardiopulmonary complications occurring in the postoperative period were less common in LA TME (Fig. 20) in comparison with open TME (OR=0.62, CI 0.48-0.81, p=0.0004), but no statistical difference was obtained when comparing LA TME (Fig. 19) with TA TME (p=0.56).
6. Postoperative wound infection was less common in LA TME (Fig. 21) in comparison with open TME (OR=0.64, CI 0.54-0.76, p<0.00001); when comparing LA TME and TA TME (Fig. 22) no differences were obtained (p=0.65).
7. As for the postoperative abscesses rate, no difference was obtained, when both comparing LA TME with TA TME (Fig. 23) (p=0.29) and comparing LA TME with open TME (Fig. 24) (p=0.67).
8. The postoperative bleeding rate did not reach a

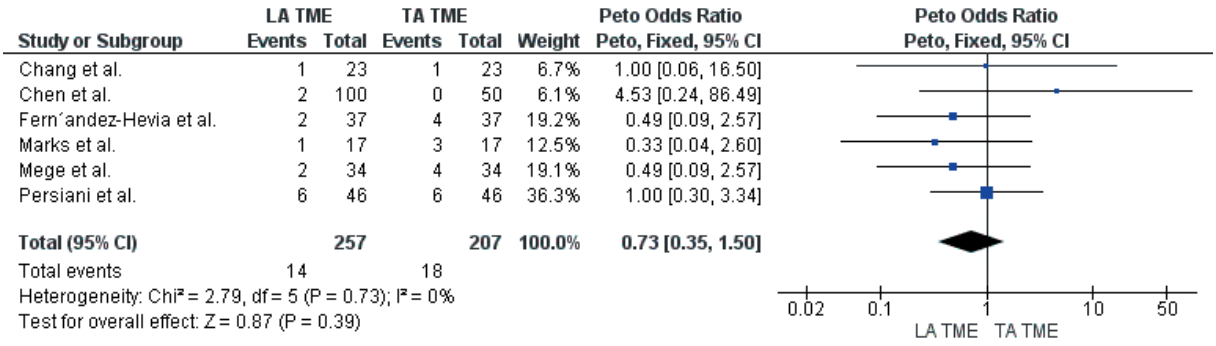

Figure 17. *Postoperative ileus rate when comparing laparoscopic TME with transanal TME*

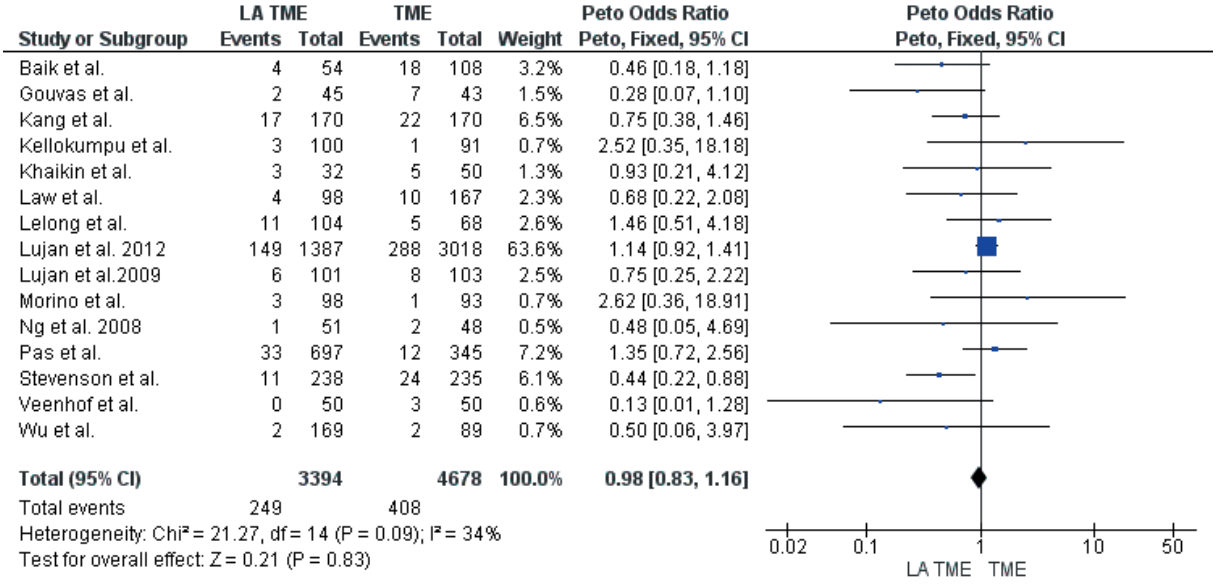

Figure 18. *Postoperative ileus rate when comparing laparoscopic TME with open TME*

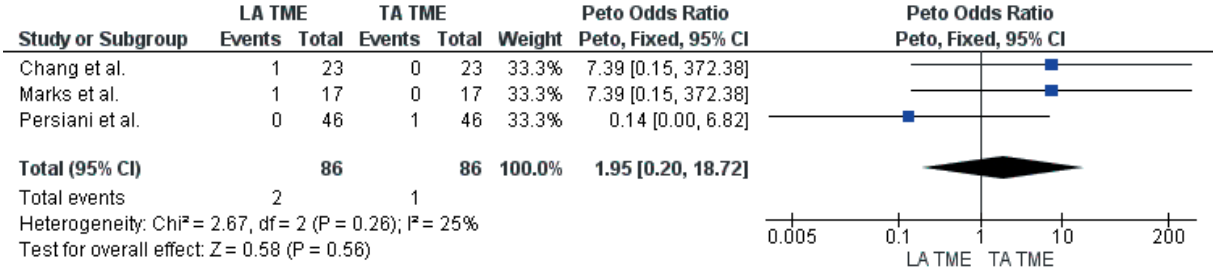

Figure 19. *Postoperative cardiopulmonary complications rate when comparing laparoscopic TME with transanal TME*

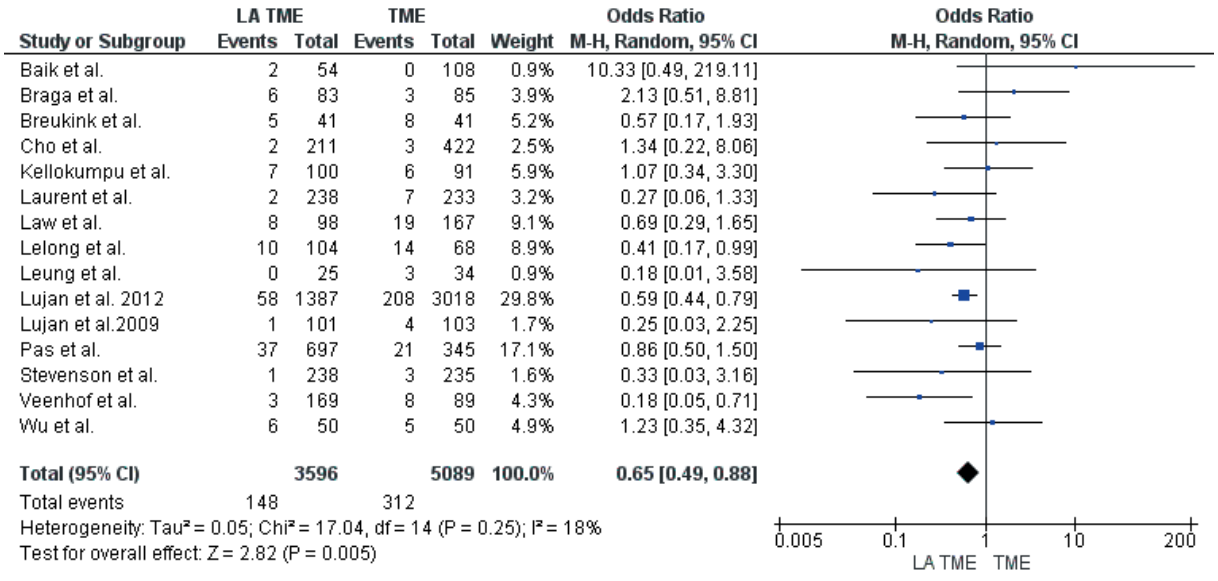

Figure 20. *Postoperative cardiopulmonary complications rate when comparing laparoscopic TME with open TME*

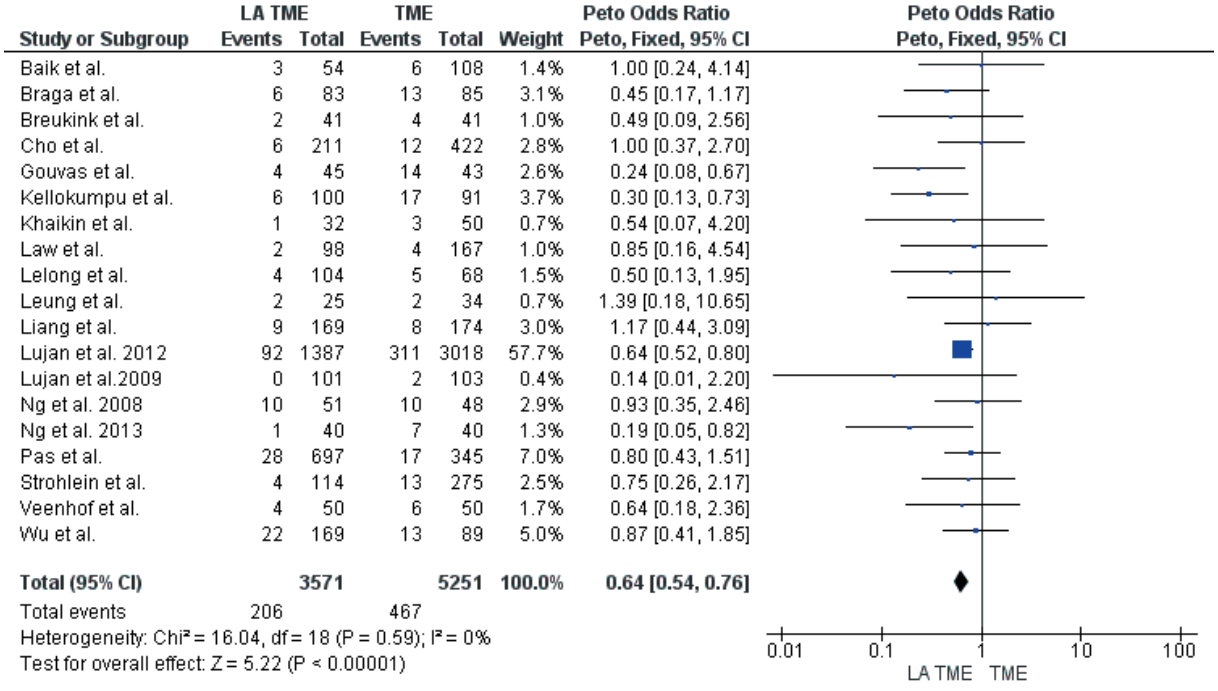

Figure 21. *Postoperative wound infection rate when comparing laparoscopic TME with open TME*

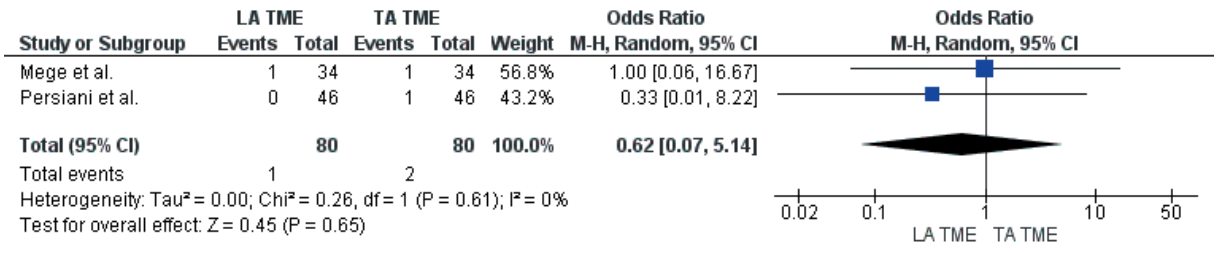

Figure 22. *Postoperative wound infection rate when comparing laparoscopic TME with transanal TME*

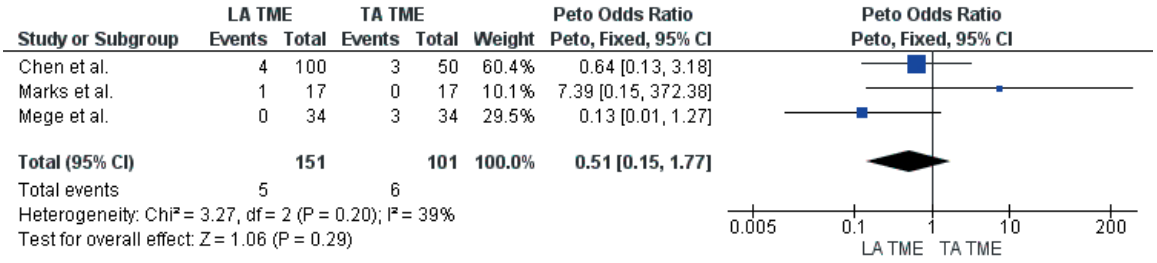

Figure 23. *Postoperative abscesses rate when comparing laparoscopic TME with transanal TME*

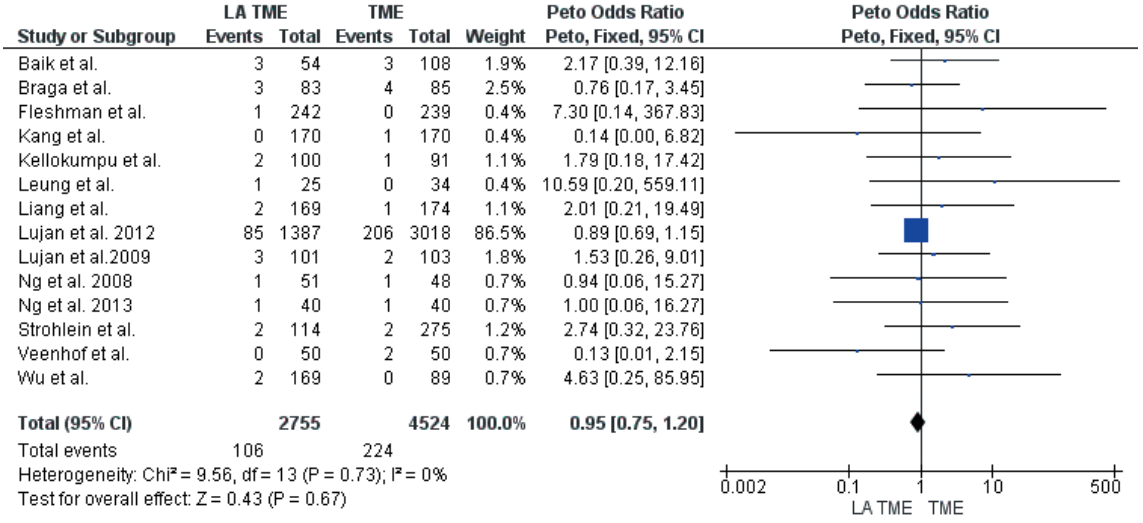

Figure 24. *Postoperative abscesses rate when comparing laparoscopic TME with open TME*

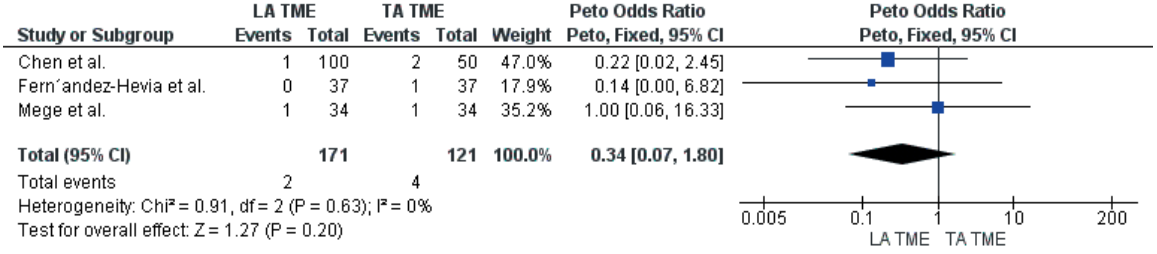

Figure 25. *Postoperative bleeding rate when comparing laparoscopic TME with transanal TME*

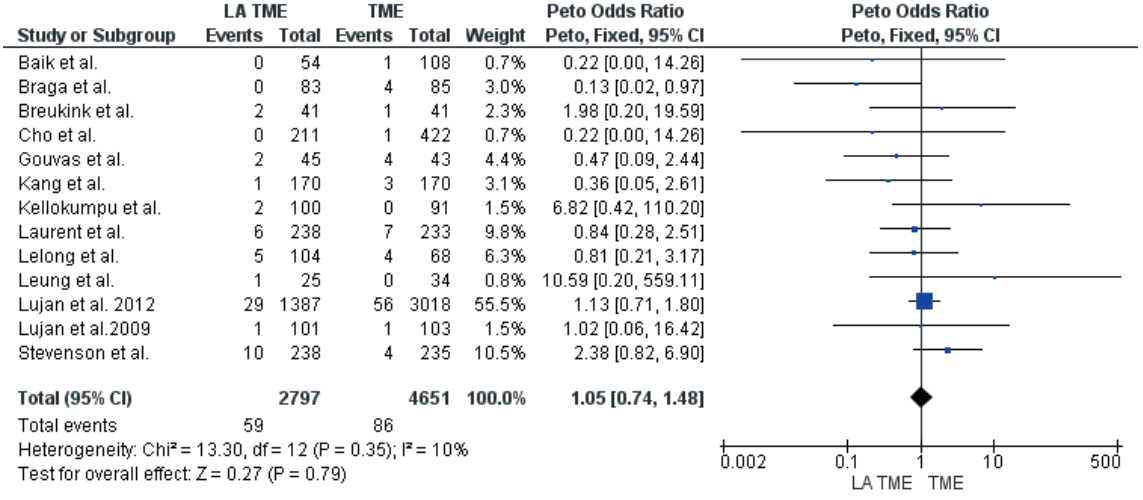

Figure 26. *Postoperative bleeding rate when comparing laparoscopic TME with open TME*

statistical difference when comparing LA TME with TA TME (Fig. 25) (p=0,20) and when comparing LA TME with open TME (Fig. 26) (p=0.79).

9. Postoperative hospital stay period was less in LA TME (Fig. 27) than in open TME (OR=2.35, CI 3.87-0.83, p=0.002); when comparing LA TME with TA TME (Fig. 28) no differences (p=0.41).

Morphological characteristics

1. The mesorectumectomy quality Grade 3 was statistically significantly more common in LA TME (Fig. 29) than in open TME (OR=1.24, CI 1.09-1.40, p=0.001); when comparing LA TME with TA TME (Fig. 30) no statistical difference was obtained (p=0.36).

2. As for the TME quality Grade 2, no difference was obtained when comparing LA TME with TA TME (Fig. 31) (p=0.95), as well as when comparing LA TME with open TME (Fig. 32) (p=0.98).

3. The worst quality of TME Grade 1 when comparing LA TME with TA TME (Fig. 33) did not reach statistical difference. However, a shift towards TA TME can show that the worst quality of mesorectumectomy will be less common in TA TME than in LA TME (OR=1.58, CI 0.93-2.70, p=0,09); when comparing LA TME with open TME (Fig. (34) no difference was obtained (p=0.83).

4. Positive CRM was less common in TA TME in comparison with LA TME (Fig. 35) (OR=2.58, CI 1.34-4.97, p=0.005); when comparing LA TME with open TME (Fig. 36) positive CRM was less common in LA TME (OR=0.73, CI 0.63-0.85, p<0.0001).

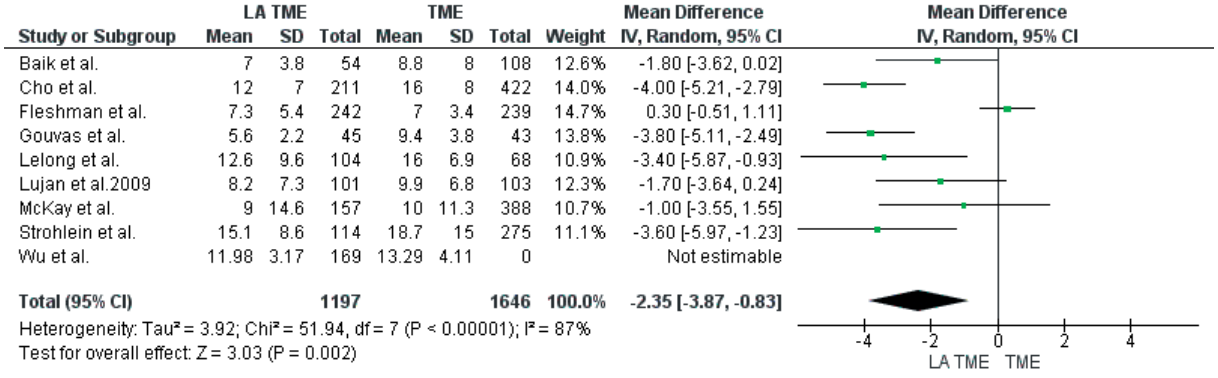

Figure 27. *Postoperative hospital stay period when comparing laparoscopic TME with open TME*

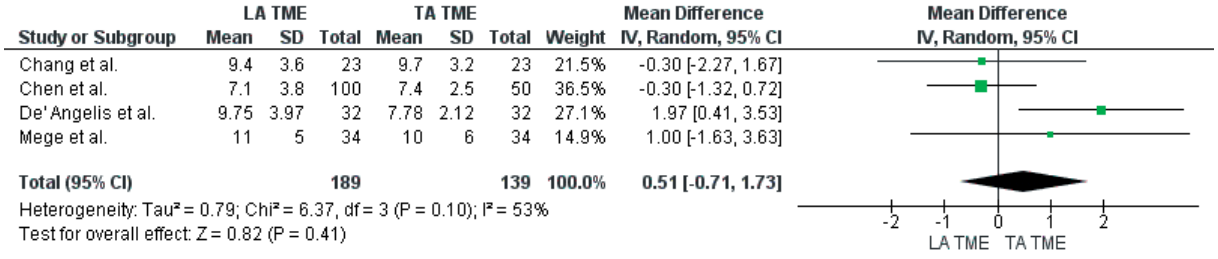

Figure 28. *Postoperative hospital stay period when comparing laparoscopic TME with transanal TME*

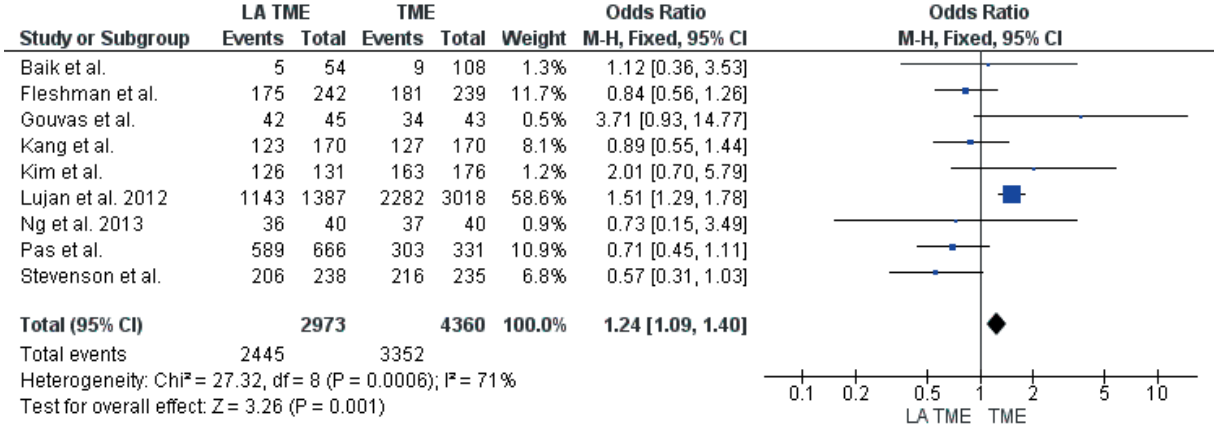

Figure 29. *TME quality Grade 3 when comparing laparoscopic TME with open TME*

Table 5. *Results*

	LA TME vs TA TME		LA TME vs Open TME	
	OR, CI	p	OR, CI	p
Intraoperative parameters				
Surgery duration	13,64 (2.94-30.22)	p=0,11	43,26 (29.65-56.86)	p<0,00001
Conversion rate	4.05 (2.11-7.76)	p<0,0001		
Blood loss	11,73 (13.46-36.92)	p=0,36	116,59 (169.62-63.57)	p<0,0001
Intraoperative complications	0,47 (0.14-1.58)	p=0,22	0,79 (0.33-1.90)	p=0,61
Bleeding	0,52 (0.13-2.05)	p=0,35	0,84 (0.47-1.48)	p=0,54
Urethral damage			1,62 (0.56-4.69)	p=0,37
Postoperative parameters				
Postoperative complications	1,09, (0.67-1.78)	p=0,72	0,75 (0.68-0.82)	p<0,00001
Anastomosis leakage	2,04 (0.97-4.28)	p=0,06	0,99(0.83-1.18)	p=0,90
Urination retention	2,49 (1.12-5.54)	p=0,03	1,26 (0.79-2.00)	p=0,33
Ileus	0,73 (0.35-1.50)	p=0,39	0,98 (0.83-1.16)	p=0,83
Cardiopulmonary complications	1,95 (0.20-18.72)	p=0,56	0,62 (0.48-0.81)	p=0,0004
Postoperative wound infection	0,62 (0.07-5.14)	p=0,65	0,64 (0.54-0.76)	p<0,00001
Postoperative abscesses rate	0,51 (0.15-1.77)	p=0,29	0,95 (0.75-1.20)	p=0,67
Bleedings	0,34 (0.07-1.80)	p=0,20	1,05 (0.74-1.48)	p=0,79
Postoperative hospital stay	0,51 (0.71-1.73)	p=0,41	2,35 (3.87-0.83)	p=0,002
Morphological characteristics				
TME quality Grade 3	0,81 (0.52-1.26)	p=0,36	1,24 (1.09-1.40)	p=0,001
TME quality Grade 2	1,01 (0.67-1.54)	p=0,95	1,00 (0.67-1.50)	p=0,98
TME quality Grade 1	1,58 (0.93-2.70)	p=0,09	1,04 (0.70-1.55)	p=0,83
Positive CRM	2,58 (1.34-4.97)	p=0,005	0,73 (0.63-0.85)	p<0,0001
Positive DRM	1,49 (0.42-5.24)	p=0,53	0,71 (0.43-1.19)	p=0,20
DRM, mm	3,05 (8.00-1.90)	p=0,23	0,07 (0.92-0.78)	p=0,87
CRM, mm	0,96 (1.30-0.62)	p<0,00001		
Number of lymphnodes removed	0,41 (1.10-1.92)	p=0,60	0,05 (0.83-0.74)	p=0,91

5. Positive distal resection margin (DRM) did not reach statistical differences when comparing LA TME with TA TME (Fig. 37) (p=0.53); when comparing LA TME with open TME (Fig. 38) no differences were also obtained (p=0.20).
6. The DRM was not statistically different when comparing LA TME with TA TME (Fig. 39) (p=0.23), and when comparing LA TME with open TME (Fig. 40) no differences were also obtained (p=0.87).
7. The circular resection margins was significantly larger in TA TME (Fig. 41) in comparison with LA TME (OR=0.96, CI 1.30-0.62, p<0.00001).
8. As for the number of removed lymphnodes, no difference was obtained when comparing LA TME with TA TME (Fig. 42) (p=0.60), as well as when comparing LA TME with open TME (Fig. 43) (p=0.91).

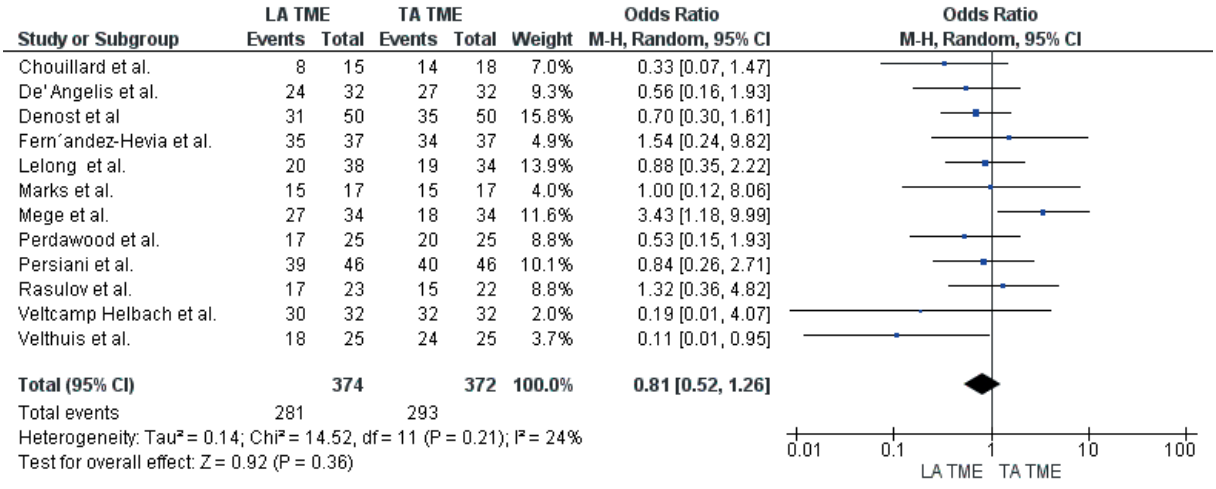

Figure 30. *TME quality Grade 3 when comparing laparoscopic TME with transanal TME*

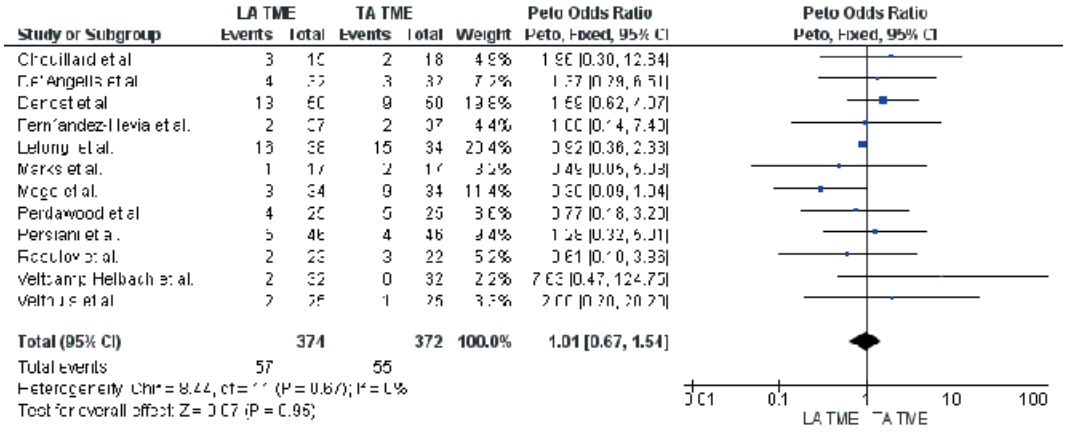

Figure 31. *TME quality Grade 2 when comparing laparoscopic TME with transanal TME*

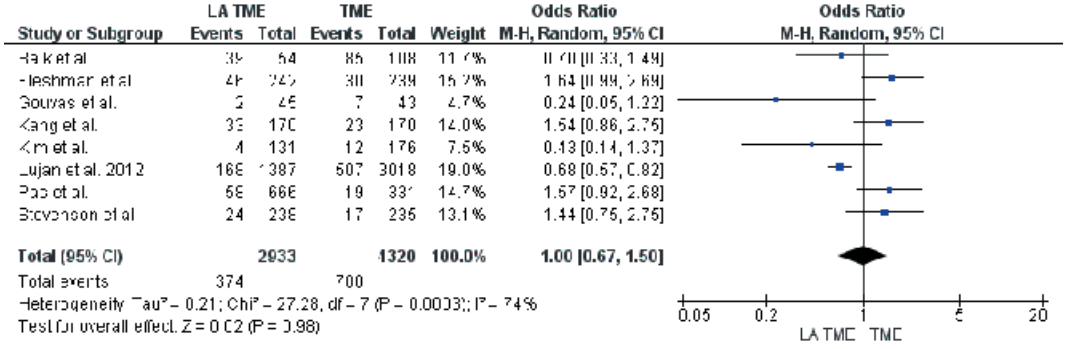

Figure 32. *TME quality Grade 2 when comparing laparoscopic TME with open TME*

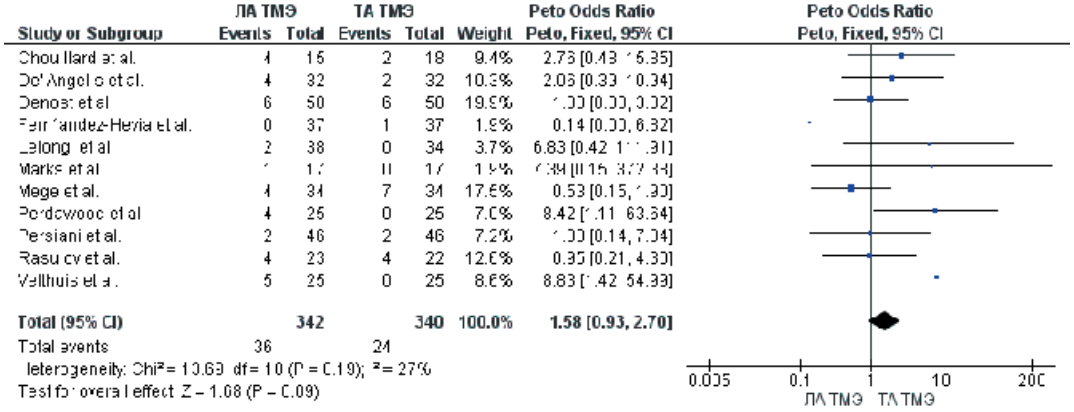

Figure 33. *TME quality Grade 1 when comparing laparoscopic TME with transanal TME*

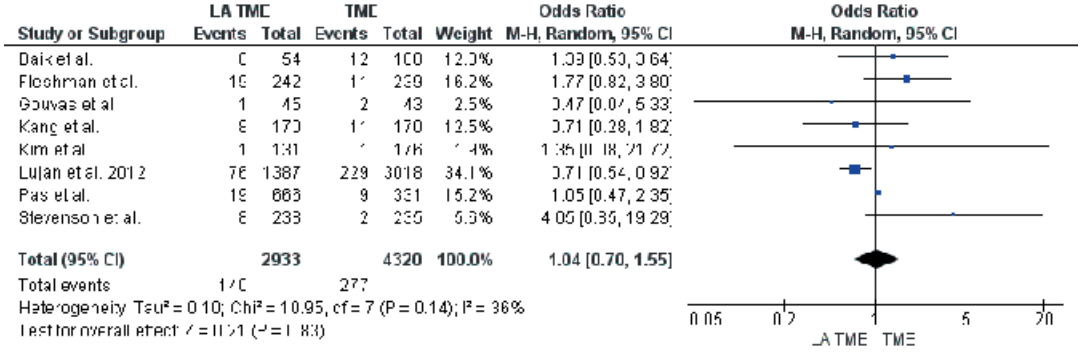

Figure 34. *TME quality Grade 1 when comparing laparoscopic TME with open TME*

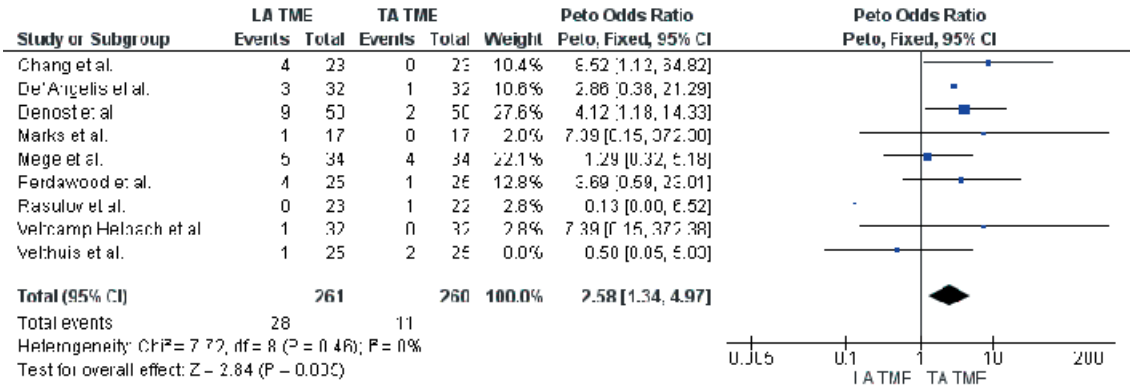

Figure 35. *Positive circular resection margins when comparing laparoscopic TME with transanal TME*

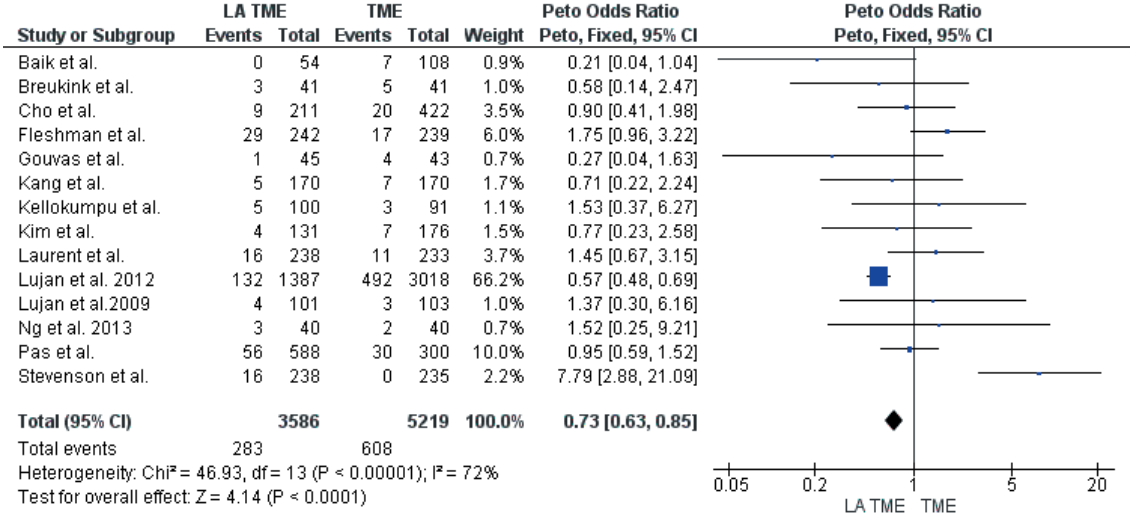

Figure 36. *Positive circular resection margins when comparing laparoscopic TME with open TME*

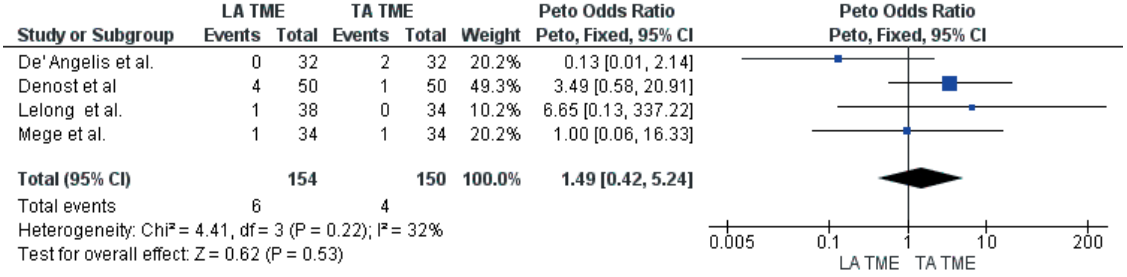

Figure 37. *Positive distal resection margins when comparing laparoscopic TME with transanal TME*

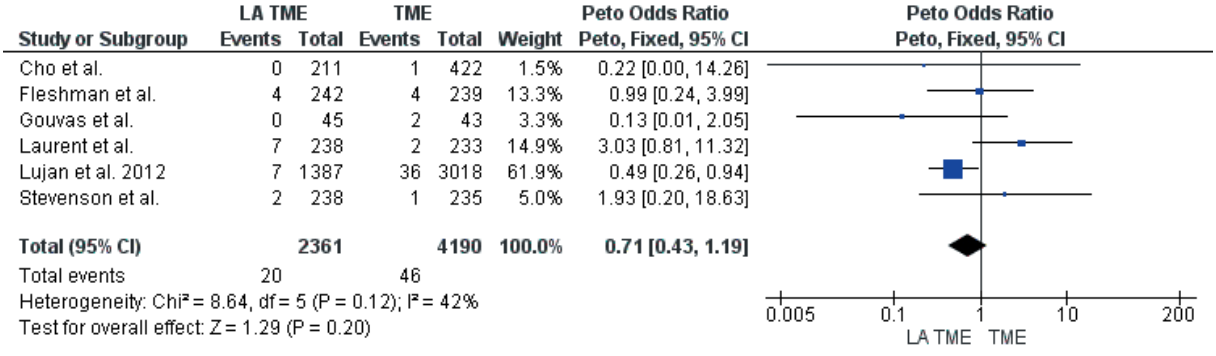

Figure 38. *Positive distal resection margins when comparing laparoscopic TME with open TME*

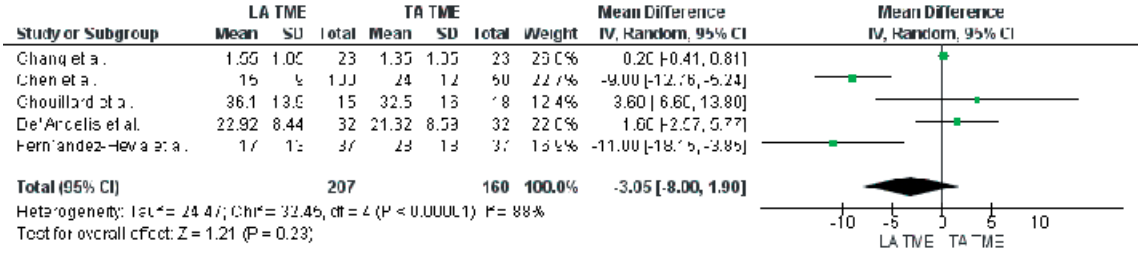

Figure 39. *Distal resection margins in mm, when comparing laparoscopic TME with transanal TME*

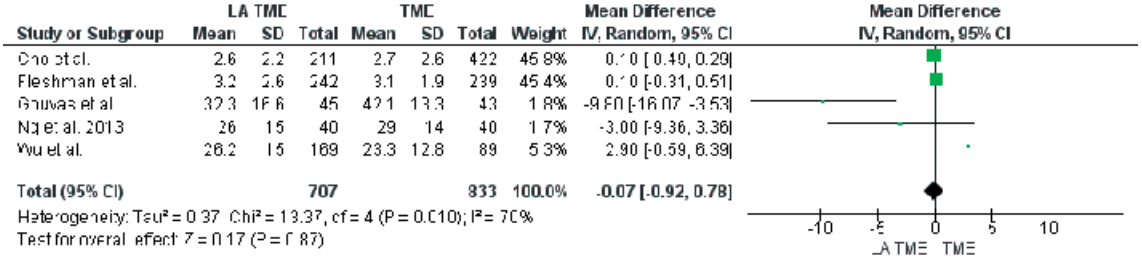

Figure 40. *Distal resection margins in mm, when comparing laparoscopic TME with open TME*

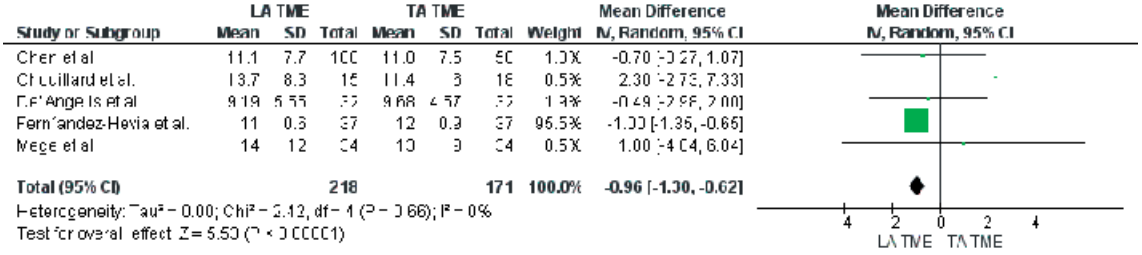

Figure 41. *Circular resection margins in mm, when comparing laparoscopic TME with transanal TME*

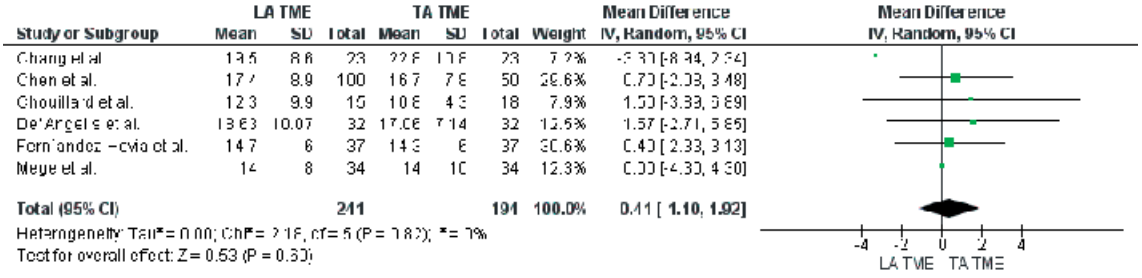

Figure 42. *Number of removed lymphnodes when comparing laparoscopic TME with transanal TME*

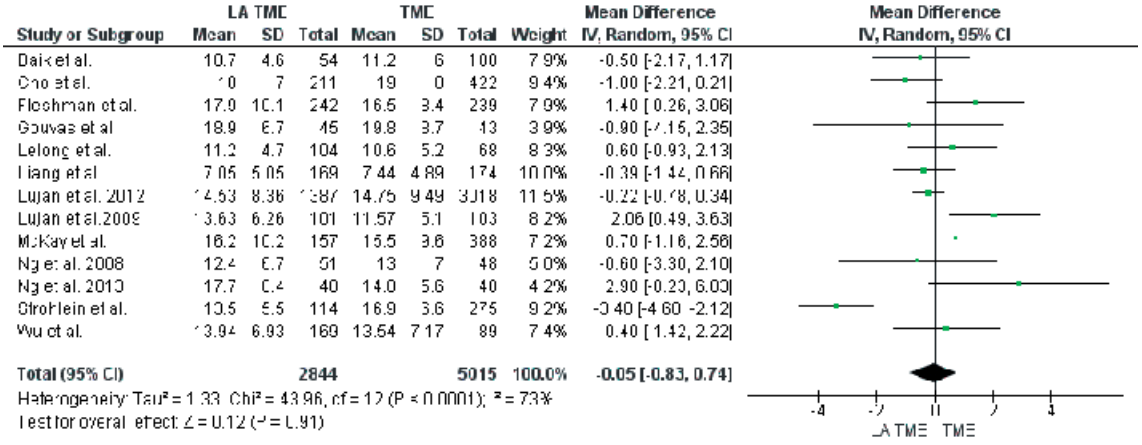

Figure 43. *Number of removed lymphnodes when comparing laparoscopic TME with open TME*

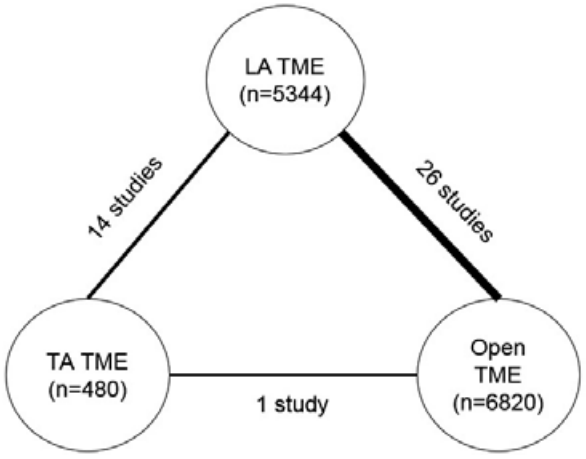

Figure 44. *Diagram of total mesorectumectomy techniques*

Network meta-analysis

It was very important to compare the advantages and disadvantages of all the three techniques at a comparable prevalence. In this regard, we conducted a network meta-analysis that will allow us to evaluate all the three techniques at the same time.

There were no statistically significant differences in the intraoperative complications rate between laparoscopic, transanal and open TME techniques (Fig. 45). No statistical differences in the intraoperative bleeding rate were obtained in the indirect comparison (Fig. 46).

The postoperative complications rate in network meta-analysis in LA TME (Fig. 47) is less by 25% than in open TME (OR=0.75, CI 0.65-0.84). Anastomosis leakage rate (Fig. 48) did not achieve a statistical difference when comparing all the three techniques. Chance of

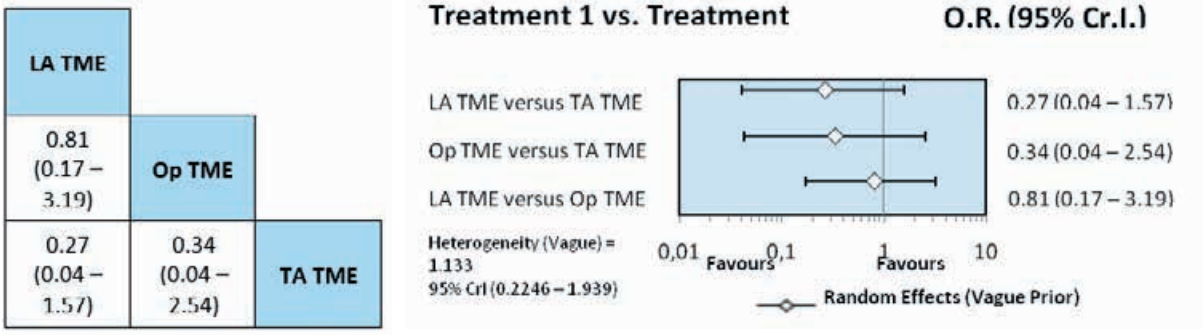

Figure 45. *Intraoperative complications rate*

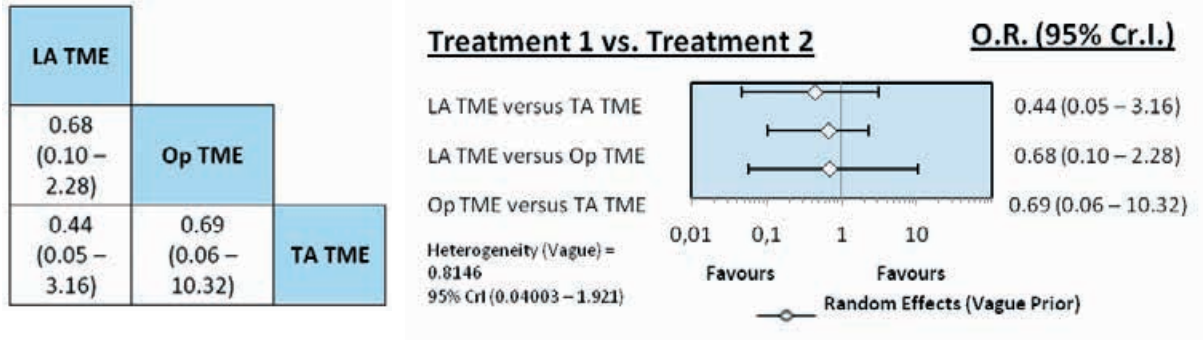

Figure 46. *Intraoperative bleeding rate*

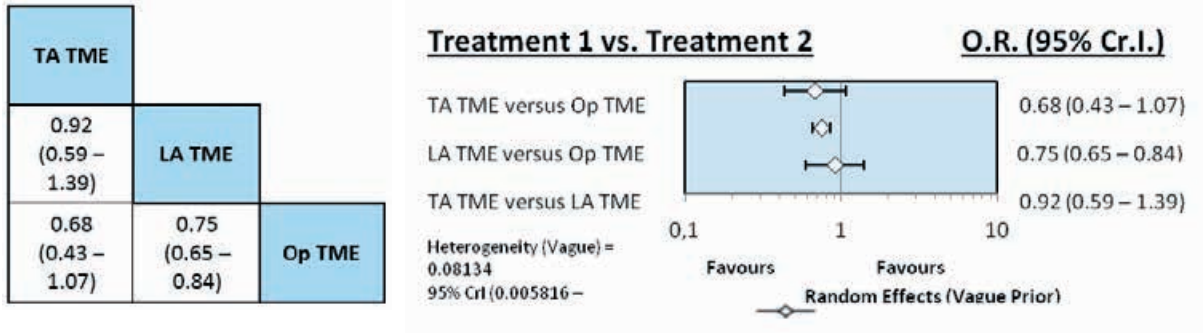

Figure 47. *Postoperative complications rate*

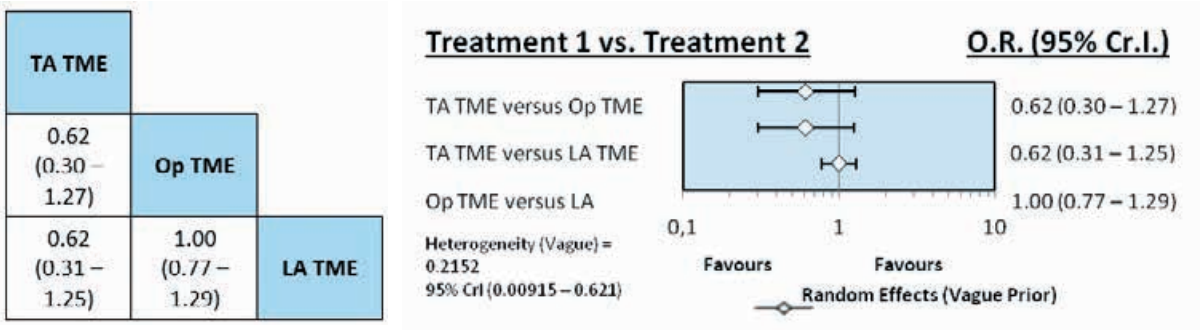

Figure 48. *Anastomosis leakage rate*

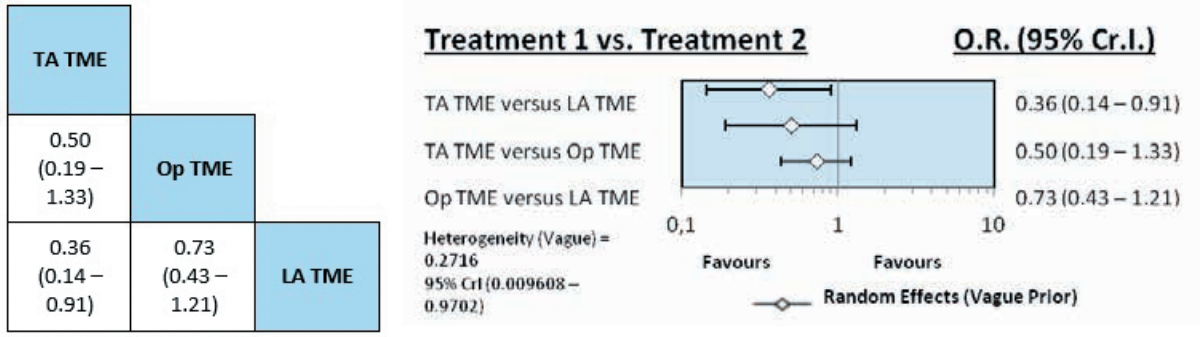

Figure 49. *Postoperative urination retention rate*

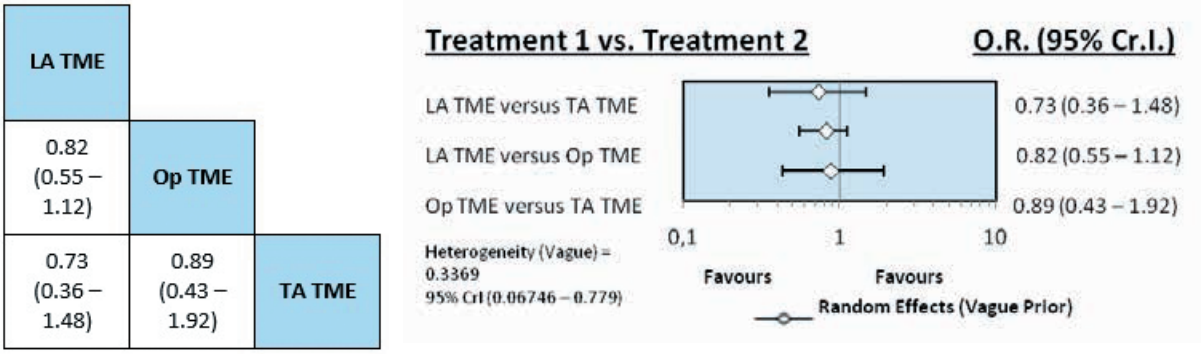

Figure 50. *The rate of postoperative ileus*

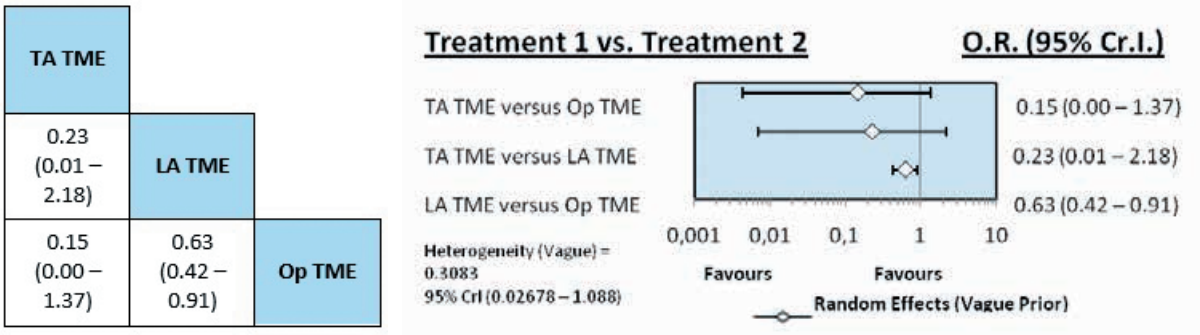

Figure 51. *Cardiopulmonary complications rate*

LA TME		
0.92 (0.44 – 1.59)	Op TME	
0.53 (0.08 – 3.37)	0.57 (0.09 – 4.16)	TA TME

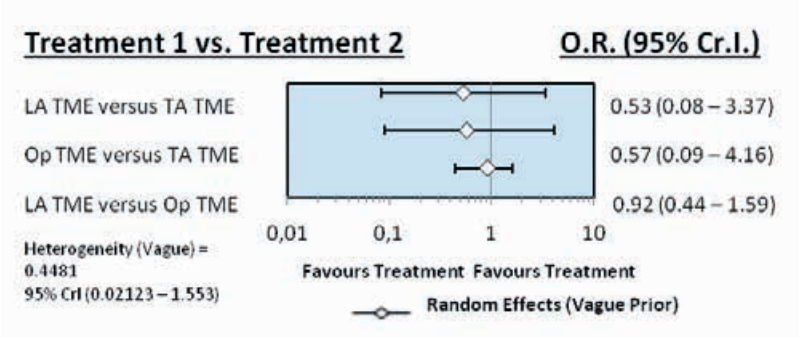

Figure 52. *Postoperative bleeding rate*

LA TME		
0.93 (0.52 – 1.58)	TA TME	
0.89 (0.52 – 1.47)	0.95 (0.47 – 2.02)	Op TME

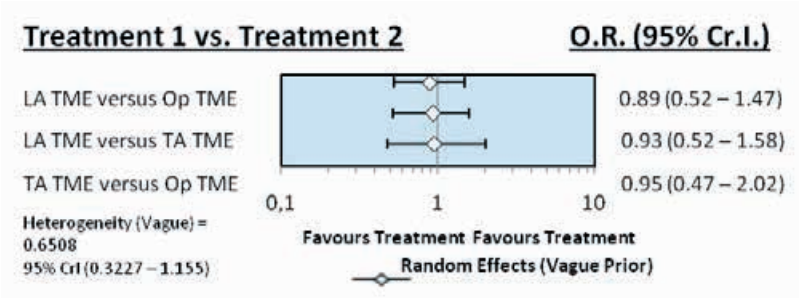

Figure 53. *TME quality Grade 3*

Op TME		
0.92 (0.60 – 1.42)	LA TME	
0.79 (0.42 – 1.55)	0.86 (0.52 – 1.46)	TA TME

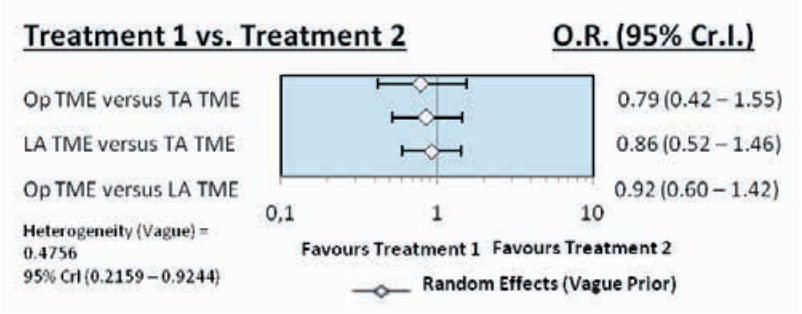

Figure 54. *TME quality Grade 2*

TA TME		
0.90 (0.33 – 2.53)	Op TME	
0.67 (0.29 – 1.40)	0.75 (0.33 – 1.41)	LA TME

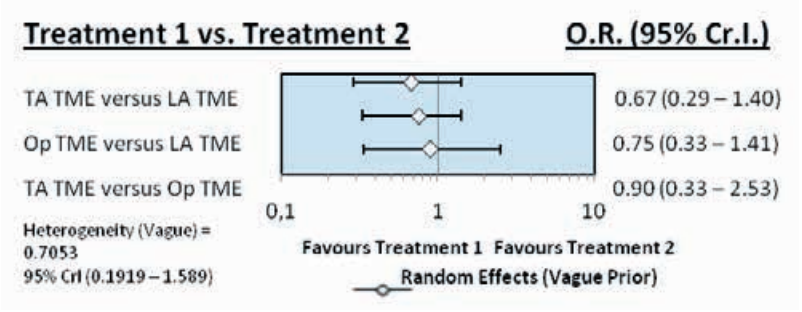

Figure 55. *TME quality Grade 1*

developing postoperative urination retention (Fig. 49) is statistically significantly lower in TA TME than in LA TME (OR=0.36, CI 0.14-0.91). There was no statistical difference in the postoperative ileus (Fig. 50). Cardiopulmonary complications were significantly less common in the LA TME group (Fig. 51) than in open TME group (OR=0.63, CI 0.42-0.91). Postoperative wound infection was by 39% less common in LA TEM (Fig. 52) in comparison with open TME (OR=0.61, CI 0.46-0.78). The postoperative bleeding rate did not reach the statistical difference in the indirect comparison.

There were no statistical differences in the mesorectumectomy quality of Grade 3 (Fig. 53) when comparing laparoscopic, transanal and open techniques. The mesorectumectomy quality of Grade 2 (Fig. 54) did not reach the statistical difference as well. The mesorectumectomy quality of Grade 1 did not differ (Fig. 55). The CRM rate did not reach the statistical difference (Fig. 56). However, a shift towards TA TME showed that with a larger number of observations, the best result could potentially be in TA TME. The DRM rate did not differ statistically in any of the techniques (Fig. 57).

DISCUSSION

The technique of transanal TME is a progress in laparoscopic surgery, which allows to solve the technical difficulties faced by the surgeon working in a narrow pelvis and in the presence of obesity in the patient both during laparoscopic and open resections. In turn, this avoids conversion, and better visualization when working on the distal rectum can provide a higher surgery radicalism.

The good quality of the removed specimen and intact CRM provide a reduction in the local recurrences rate and increase the duration of relapse-free survival [51,52].

Laparoscopic surgery for rectal cancer showed comparable with open surgery oncological results in terms of the removed specimen quality and intact resection margins, as well as in terms of survival [2,28,29,30,53]. The technique of transanal TME is quite new and requires a long learning curve.

The consensus on transanal total mesorectumectomy, held in July 2014, determined the preferred indications for this technique, namely narrow or deep pelvis, male sex, BMI>30 kg/m^2, the tumor is located not further than 12 cm from the anal margin [54]. In most studies [17,19,20,23,24,55] the average body mass index of patients did not exceed 26 kg/m^2, which may indicate the selection of patients in the process of experience accumulation in this technique and its careful application, despite its obvious advantages. No large randomized multicenter studies comparing LA TME with TA TME are published. However, published comparative studies demonstrate comparability of the results on the quality of the removed specimens and

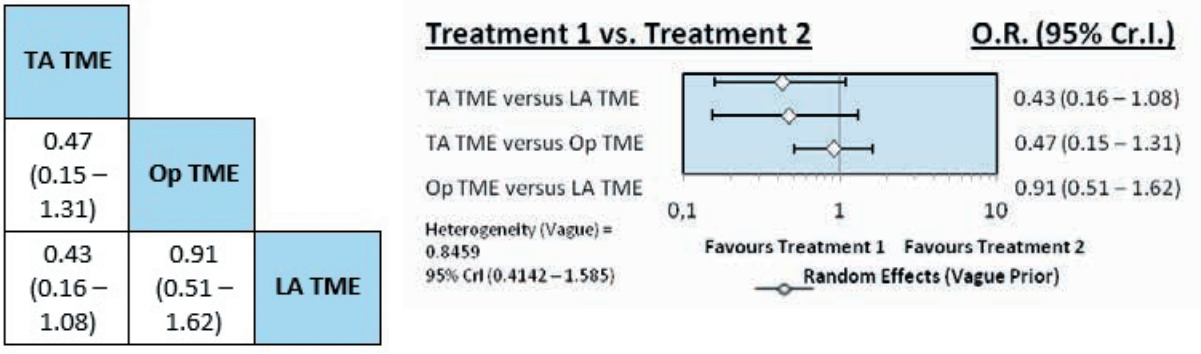

Figure 56. *Positive circular resection margin*

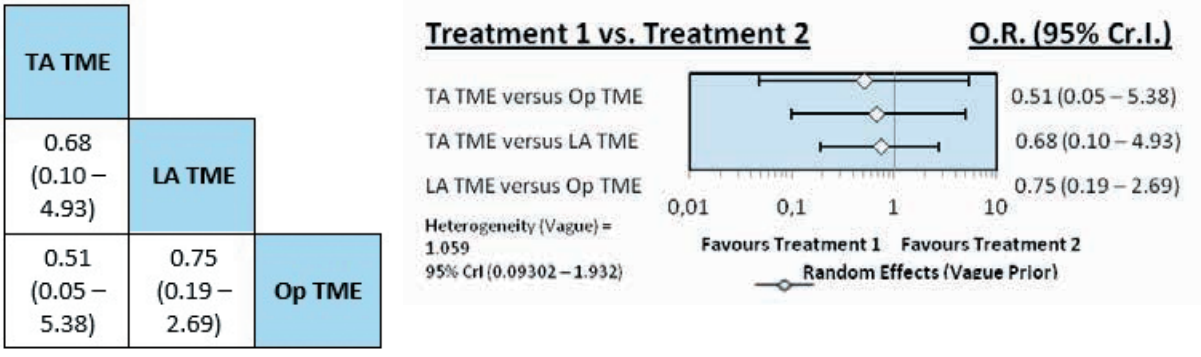

Figure 57. *Positive distal resection margin*

ensuring the resection margins [9,23,24,56], and in a randomized study by Denost et al. [16] in the TA TME group, the positive CRM was statistically significantly less common than in LA TME group. In the study by Lacy et al. [55], comprising 140 patients, the TME quality Grade 3 was in 97.1% of the patients and Grade 1- – 0.7%, positive CRM was in 6.4%. A meta-analysis of the data demonstrated that the specimen quality of Grade 3 was statistically significantly more common in LA TME than in open TME. This shift is most likely due to the fact that the nonrandomized studies included in the analysis the patients selected for the laparoscopic group. When comparing the TA TME and LA TME techniques on the quality of the removed specimens of Grade 3, no differences were obtained. Indirect comparison of all the three techniques also revealed no differences. As for the worst quality of the removed specimen, there is the trend indicating that it may be more common in LA TME than in TA TME ($p=0.09$); when comparing LA TME with open TME no differences were obtained. Network meta-analysis of the data also revealed no differences. Positive CRM in the meta-analysis was more common in LA TEM than in TA TME ($p=0.005$), but less common than in Open TME ($p<0.0001$). Network meta-analysis demonstrated that with a larger number of observations, the TA TME technique may have a lower positive CRM rate.

Better visualization in the process of the distal rectum mobilization in the transanal technique can help to reduce the conversion rate [2,8,9,12]. The data meta-analysis also showed a lower conversion rate in TA TME than in LA TME ($p<0.0001$). Intraoperative blood loss was significantly lower in laparoscopic surgeries than in open ones [28,30,50], which was associated with less surgical trauma and the use of carboxyperitoneum. Meta-analysis also showed less blood loss in LA TME than in open TME ($p<0.0001$). The intraoperative complications rate is comparable when both comparing LA TME with open TME and LA TME with TA TME. The risk of intraoperative damage of adjacent organs and massive bleeding when using minimally invasive techniques correlates with the experience and learning curve of the surgeon. Laparoscopic surgeries because of the technical features of their implementation last longer than open ones, which may be the reason for refusal to perform them in elderly patients with comorbidities. However, Wu et al. [26] did not obtain any differences in the duration of laparoscopic and open surgical procedures. Meta-analysis of the data showed a longer surgery duration in LA TME than in open TME ($p<0.0001$); when comparing LA TME with TA TME no differences were obtained.

Less surgical trauma and, as a consequence, early activation of patients with laparoscopic surgery, in comparison with open ones, in turn, is realized in a lower rate of complications that occur in the postoperative period, as shown in this meta-analysis. In LA TME, the complication rate is by 25% lower than in open TME. TA TME, as the number of observations increases, is likely to have an advantage over all the techniques. However, there is only a pronounced trend that is not reliable at the moment.

Limited working area in a small pelvis in laparoscopic surgery often requires the use of several endoscopic staplers, and the emerging angle between the suture lines in turn is a risk factor for anastomosis leakage [2]. A direct comparison of the techniques shows a tendency to reduce the anastomosis leakage rate in TA TME ($p=0.06$) in comparison with LA TME; with network meta-analysis of all the three techniques, no differences were obtained. Application of the TA TME technique provides less damage to the pelvic nerve plexus due to better visualization, which leads to a lower urination disorders rate. Urination retention in the postoperative period was less common in TA TME than in LA TME. Indirect comparison also showed a lower chance of their development in TA TME. Indirect comparison also revealed the advantages of the LA TME technique in comparison with open TME as to both cardiopulmonary complications rate and postoperative wound infection rate.

CONCLUSION

The technique of transanal TME is comparable in efficiency with laparoscopic and open ones, and in some parameters may exceed them. However, the presence of the bias in studies requires careful interpretation of the obtained data.

To determine the place of TA TME, the results of large randomized studies are necessary.

The authors declare no conflicts of interest.

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