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Advantages and disadvantages of laparoscopic access for pelvic exenteration in patients with locally advanced rectal cancer (a meta-analysis and a systematic review)

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ABSTRACT *AIM: pelvic exenteration is a surgical procedure for locally advanced pelvic organ cancer in order to achieve optimal resection margins. The expediency of performing such operations with laparoscopic access is controversial. A meta-analysis was done to evaluate the effectiveness of laparoscopic pelvic exenterations for rectal cancer.*

MATERIALS AND METHODS: a systematic review was conducted in accordance with PRISMA practices and recommendations. Literature search was carried out in the electronic medical literature databases PubMed and eLibrary. According to a meta-analysis of 4 original studies, the results of treatment of 220 patients who underwent laparoscopic exenteration and 311 patients who underwent open surgery were evaluated.

RESULTS: significant differences were obtained in the reduction of intraoperative blood loss by 427 ml, 95% CI, p = 0.0004, and postoperative hospital stay by 2 days, 95% CI, p = 0.003 in the laparoscopic group. Comparable data were obtained for the operation time, p = 0.45, for the positive margin of resection (OR 0.85; 95% CI 0.19–3.93; p = 0.84), for the postoperative morbidity (OR 0.62; 95% CI 0.23–1.86; p = 0.34) and for surgical site infections (OR 0.56; 95% CI 0.18–1.64; p = 0.29).

CONCLUSION: laparoscopic exenterations are comparable in operation time to open procedure, reduce intraoperative blood loss and postoperative hospital stay days.

KEYWORDS: *rectal cancer, exenteration of the pelvic organs, laparoscopy*

CONFLICT OF INTEREST: *the authors declare no conflict of interest*

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INTRODUCTION

The progressive development of neoadjuvant treatment of rectal cancer over the past 10 years has reduced the need for combined high-volume operations with resection of neighboring organs, but has not completely eliminated them [1–3]. Performing exenterations of the pelvic organs remains relevant in patients with locally advanced rectal cancer in order to achieve optimal resection margins [4]. Exenterations are understood as total or partial removal of the pelvic organs [3–5]. These operations are associated with a low 5-year survival rate of 25–50%, poor quality of life for patients and a high rate of postoperative morbidity ranging from 25% to 100% [3,4,6]. Laparoscopic access in patients with rectal cancer is effective and safe, leading to shorter postoperative hospital stay, the lower rate of intraoperative and postoperative morbidity, with comparable oncological results [6–10]. According to the literature, performing exenterations of the pelvic organs with laparoscopic access is also acceptable and safe for the patient [1,8,9,11,12]. Given the sufficient

Table 1. *Characteristics of the studies included in the meta-analysis*

Author	Year	Laparoscopic	Open	Type	NOS*
Zhuang M.	2023	54	51	retro	9
Tang J.Q.	2023	82	91	retro	8
KaziM.	2021	61	97	retro	8
Kumar A.N.	2020	23	72	retro	9

*Note: *NOS — Newcastle-Ottawa Scale*

number of studies comparing laparoscopic and open exenterations, this meta-analysis was done.

MATERIALS AND METHODS

The meta-analysis was performed in accordance with the practice and recommendations of "The preferred reporting items for systematic reviews and meta-analyses (PRISMA)" [13]. The quality of retrospective studies was assessed using the analog scale of the Newcastle-Ottawa Scale (Table 1). The meta-analysis includes full-text articles in English, which reflect the results of treatment of patients with local advanced rectal cancer using laparoscopic technologies in the volume of pelvic organ exenterations. A search for literature data in the MedLine database (PubMed) for the query 'pelvic exenteration' and 'rectal cancer' found 866 articles. As a result of using filters and manually selecting studies, including using bibliographic data unrelated to the topic, the results of four original retrospective studies were analyzed (Fig. 1).

As a result of a search for studies in the eLibrary database, no similar studies comparing open and laparoscopic exenterations were found.

Statistical Analysis

The statistical analysis was performed using the Review Manager 5.4.3 and R Studio software (Rv. 4.4.0 RCoreTeam, Vienna, Austria) using the meta, metafor and metamedian libraries. The heterogeneity of the included studies was assessed by I^2. Heterogeneity was considered moderate at $I^2 < 50\%$, and at $I^2 \geqslant 50\%$, high heterogeneity of the data included in the meta-analysis was noted, in both cases a random effects model was used. The total value for dichotomous data is described by the odds ratio with a 95% coincidence interval and calculated using Mantel-Haenszel's method. The difference in medians or averages was based on the available primary data within each group for the total number of people, a measure of the central trend (median or average) and variation (interquartile range (IQR), or range, including the standard deviation

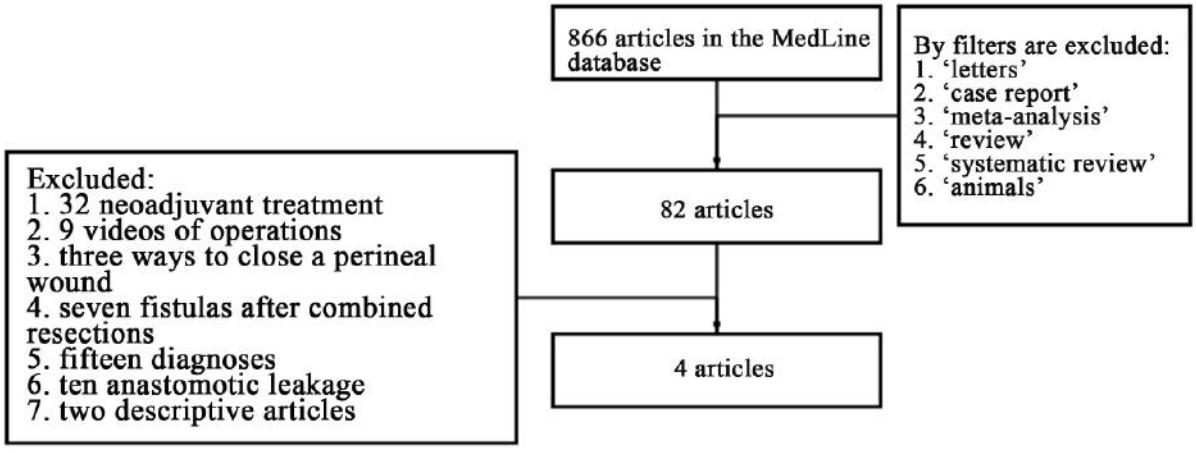

Figure 1. *Search tree in the MedLine database (PubMed)*

(SD)), indicating a 95% coincidence interval (CI). Statistically significant differences were considered at $p < 0.05$.

RESULTS

The results of the treatment of 531 patients who underwent multivisceral rectal resections for cancer were analyzed, with 311 — open and 220 — laparoscopic.

With high heterogeneity of data, $I^2 = 97.5\%$ the median operation time did not differ significantly, but was 60.2 minutes longer in the laparoscopic surgery group (95% CI: 96.7–217.2, $p = 0.45$), respectively (Fig. 2).

The median intraoperative blood loss was significantly lower by 427 ml (95% CI: –662 — –192) in the laparoscopic surgery group, $p = 0.0004$ and $I^2 = 82.7\%$ (Fig. 3).

The overall incidence of grade I-IV Cl-Dindo postoperative morbidity did not reach significant differences — 77/220 (35%) versus 151/311 (48%) in the open group: OR = 0.62 (95% CI: 0.23–1.86), $p = 0.34$ (Fig. 4).

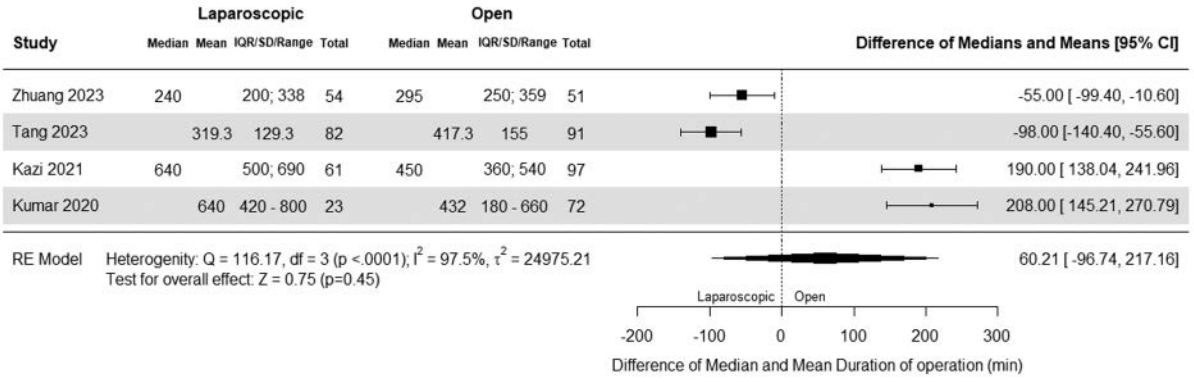

Figure 2. *Forest plot of the meta-analysis — duration of the operation*

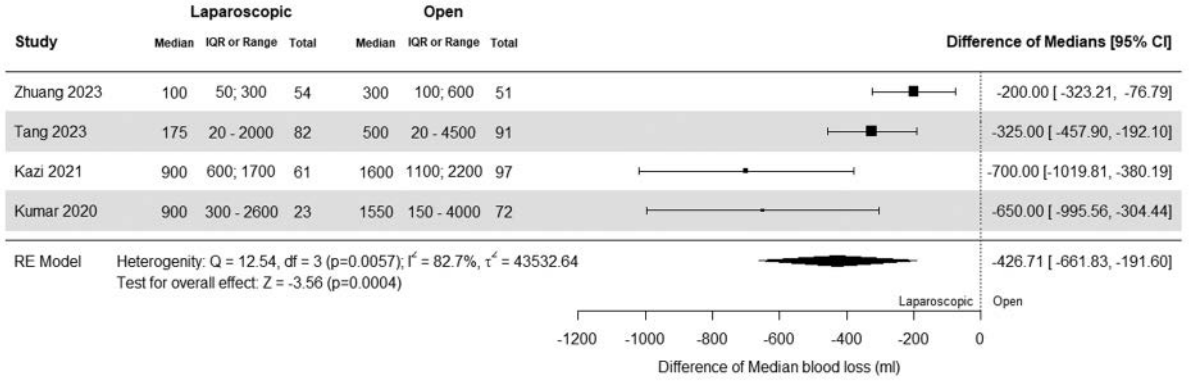

Figure 3. *Forest plot of meta-analysis — intraoperative blood loss*

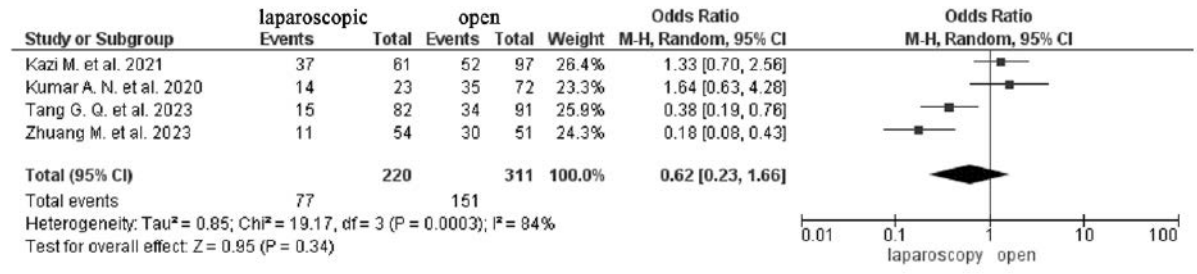

Figure 4. *Forest plot of the meta-analysis — the overall of postoperative morbidity*

The incidence of surgical site infections (SSI) also did not differ in the laparoscopic group — 40/220 (18%) compared with the open 92/311 (30%); OR = 0.56 (95% CI: 0.18–1.64), $p = 0.29$ and $I^2 = 79\%$, respectively (Fig. 5).

The length of hospital stay in the postoperative period was statistically significantly lower by 2 hospital stay days (95% CI: –1 — –4) in the laparoscopic surgery group, $p = 0.003$, with low heterogeneity of data $I^2 = 0\%$ (Fig. 6).

There was no significant difference in the rate of pathomorphological positive resection margins: 26/220 (12%) in the laparoscopic group versus 31/311 (10%) in the open surgery group: OR = 0.85 (95% CI: 0.19–3.93), $p = 0.84$ and $I^2 = 80\%$ (Fig. 7).

DISCUSSION

Pelvic exenteration is still the surgery of choice for locally advanced pelvic tumors and is most often performed by oncogynecologists for cancers of the cervix, vagina, and ovaries [14–16]. This surgery type is one of the most difficult due to the tumor lesion of several organs and the narrow anatomical space of the pelvis [17]. The improvement of surgical techniques for performing such procedures has reduced early postoperative mortality,

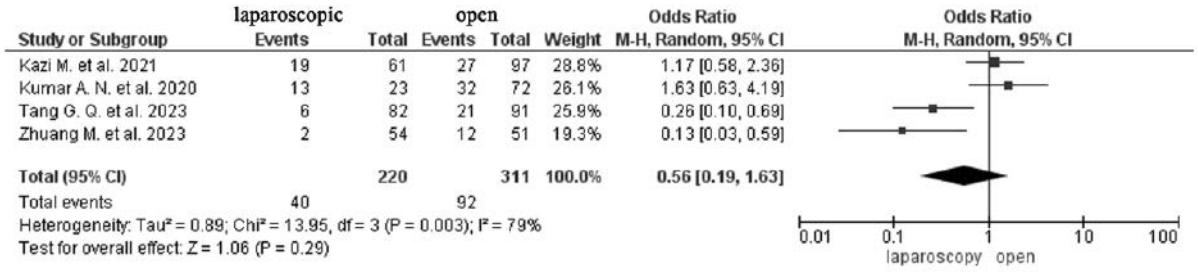

Figure 5. *Forest plot of meta-analysis — frequency of infections of the surgical area*

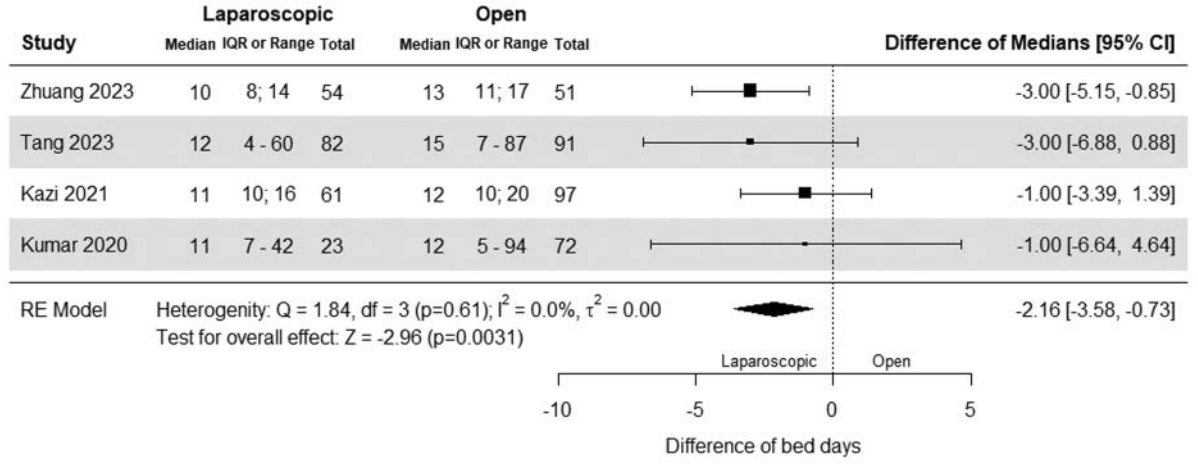

Figure 6. *Forest plot of meta-analysis — postoperative hospital stay days*

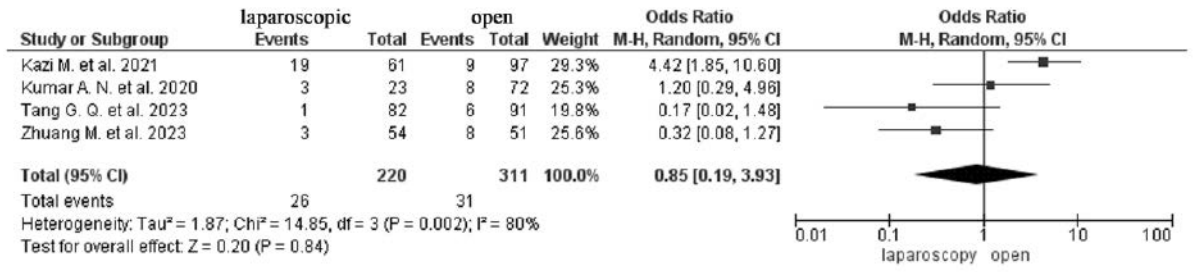

Figure 7. *Forest plot of meta-analysis — R0 resection rate*

but the morbidity rate remains high [11,18]. In 2003, Pomel et al. described, for the first time, the possibility of laparoscopic exenteration of the pelvic organs in case of recurrence of cervical cancer [19]. Since then, gynecologists have increasingly resorted to minimally invasive operations, but they strictly select patients based on tumor prevalence, avoiding laparoscopic surgery involving the lateral walls of the pelvis and sacrum. The meta-analysis of 170 patients performed by the PelvEx group showed that laparoscopic and robotic exenterations for female genital cancer lead to less blood loss, shorter hospital stay and less pain intensity, while increasing the operation time by 83 minutes [1]. However, there are currently no prospective multicenter studies comparing the advantages and disadvantages of minimally invasive exenterations. Despite the advantages shown, combined procedures for malignant neoplasms in women and men look incomparable due to the different anatomy of the pelvis [20].

The use of minimally invasive technologies in colorectal surgery is also a priority task related to improving the results of surgical treatment of patients [6]. However, the meta-analysis conducted by Hoshino, N. et al., which included 20,000 patients who underwent laparoscopic and open low anterior rectal resections performed for cancer, showed no significant differences in blood loss, incidence of anastomosis failure, and overall and disease-free survival, but the rate of positive resection margin was significantly lower in the laparoscopic surgery group OR 0.75 CI (0.65–0.85), $p < 0.001$, overall complication rate OR 0.76, CI (0.67–0.87), $p < 0.001$ [21]. Our meta-analysis comparing laparoscopic and open exenterations performed for locally advanced rectal cancer showed that with a comparable operation time and the rate of pathomorphological positive resection margin, minimally invasive procedures had a number of advantages due to reduced intraoperative blood loss and postoperative hospital stay. Comparable data were obtained on the incidence of postoperative morbidity and surgical site infection. However, the data obtained should be treated with caution due to the small number of studies that were retrospective in nature. In addition, all the studies included in the analysis were stretched over a period of 5 to 15 years due to the small number of such operations and the strict selection of indications for them [8,9,11,12]. The heterogeneity of the analyzed data should be noted, since in colorectal surgery it is not customary to divide exenterations into anterior, posterior and total [4,5]. So, in the study by Zhuang M. et al., the results of predominantly posterior pelvic exenterations with removal of the rectum, organs of the reproductive system, and preservation of the bladder were analyzed. In the three other studies, there was no distribution between infra-levatory and supra-levatory exenterations, whereas these are two different groups of patients with greater trauma during infra-levatory procedures and different morbidity rates [1,4,7].

Comparable data on oncological radicality between laparoscopic and open pelvic exenterations have shown the safety of minimally invasive techniques. However, there are currently no studies comparing late outcomes and cost-effectiveness [1]. Despite the data obtained, the widespread introduction of minimally invasive multivisceral resections is currently unlikely, since the number of patients considered suitable for such operations is small, the experience of surgeons is limited, and the learning process remains hard [22].

CONCLUSION

Performing laparoscopic exenterations of the pelvic organs in patients with locally advanced rectal cancer reduces postoperative hospital stay time and intraoperative blood loss with comparable other early outcomes.

AUTHORS CONTRIBUTION

Concept and design of the study: *Artyom A. Balkarov, Stanislav V. Chernyshov, Evgeny G. Rybakov*

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Statistical processing: *Artyom A. Balkarov*

Writing of the text: *Artyom A. Balkarov, Stanislav V. Chernyshov*
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