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Comparisons of postoperative outcomes of laparoscopic versus open surgery using inverse probability of treatment weighting analysis: an evidence from Iran

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Abstract

Background Colorectal cancer has created a significant burden worldwide, including in Iran. Open and laparoscopic surgery are important treatment methods for this disease. The aim of this study is to compare postoperative outcomes of laparoscopic versus open surgery in Iran, with a particular emphasis on controlling confounding factors.

Methods To control confounding factors in between-group comparisons of observational studies, a method based on propensity scores was used. The current study was conducted on 916 patients with colorectal cancer in the city of Shiraz between the years 2011 to 2022. The required data regarding treatment outcomes, type of surgery, demographic characteristics, and clinical factors related to cancer was extracted from the Colorectal Cancer Research Center of Shiraz University of Medical Sciences. To control confounding factors, we used the Inverse Probability of Treatment Weighting (IPTW) as one of the analytical approaches based on Propensity Score analysis. After IPTW analysis, univariate logistic regression was used for treatment effect estimation. Stata 17 was used for statistical analysis.

Results After controlling for 24 clinical and demographic covariates, negative post-operative outcomes were significantly lower in laparoscopic than open surgery. There were significant differences between the two groups of surgery in the percentages of death due to cancer ($P < 0.01$), recurrence ($P < 0.01$), and metastasis ($P < 0.05$). The treatment effect univariate logistic regression analysis indicated that laparoscopic surgery reduced the risk of negative postoperative outcomes including death due to cancer ($OR = 0.411$, $P < 0.01$), recurrence ($OR = 0.343$, $P < 0.01$) and metastasis ($OR = 0.611$, $P < 0.05$) compared to open surgery.

Conclusions In terms of postoperative outcomes including cancer-related mortality, recurrence, and metastasis, the laparoscopic surgery outperformed open surgery. Therefore, further development of laparoscopic surgery can lead to better health outcomes for the population and optimize the utilization of healthcare resources.

Keywords Colorectal cancer, Laparoscopy, Surgery, Laparotomy, Treatment outcome, Propensity score

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cancer, although there was no difference in 1-month and 12-month mortality, laparoscopic surgery was associated with lower length of stay and hospitalization costs than open surgery [28]. In a new 2023 meta-analysis of 6 studies, they showed that long-term quality of life was not different between the two groups of patients [29].

The conclusion of the literature is that laparoscopic surgery is definitely better in short-term outcomes. However, in long-term outcomes, some studies do not show any differences and some, especially recent researches, are in favor of the laparoscopic treatment.

Limitations and strengths

In this study, due to the lack of access to data, we were unable to examine further outcomes such as survival analysis. Additionally, the elimination of missing values led to a decrease in sample size. However, one strength of the current study is that we controlled for the effects of 24 clinical and demographic variables, which provides a reasonable level of confidence in the estimated treatment effects.

Conclusion

The findings of the current study indicate that, in terms of surgical outcomes including cancer-related mortality, recurrence, and metastasis, the laparoscopic surgery outperformed open surgery. Therefore, further development of laparoscopic surgery can lead to better health outcomes for the population and optimize the utilization of healthcare resources. However, the long-term outcomes of laparoscopic versus open surgery should be further considered in the future studies.

Abbreviations

GBD	Global Burden of Disease
IPTW	Inverse Probability of Treatment Weighting
PS	Propensity Score
RCT	Randomized Controlled Trial
WHO	World Health Organization

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Author contributions

Z.J, H.KH, F.B and S.P conceived and designed the study. Z.J, M.P, H.KH, and F.B acquired the data. Z.J, M.B and S.P performed the data analysis and interpretation. Z.J, M.P, M.B and S.P drafted the article. All authors contributed to the critical revision of the article and approved the final version prior to submission.

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Data availability

The datasets gathered and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The project was found to be in accordance to the ethical principles and the national norms and standards for conducting medical research. The study protocol was approved by the Ethics Committee of Shiraz University of Medical Sciences under code IR.SUMS.REC.1402.001 Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. Kocarnik JM, Compton K, Dean FE, Fu W, Gaw BL, Harvey JD, et al. Cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life years for 29 cancer groups from 2010 to 2019: a systematic analysis for the global burden of Disease Study 2019. *JAMA Oncol*. 2022;8(3):420–44.
2. Organization WH. Global cancer observatory. International agency for research on cancer. World Health Organization; 2020.
3. Collaborators GCC. Global, regional, and national burden of colorectal cancer and its risk factors, 1990–2019: a systematic analysis for the global burden of Disease Study 2019. *Lancet Gastroenterol Hepatol*. 2022;7(7):627.
4. Marley AR, Nan H. Epidemiology of colorectal cancer. *Int J Mol Epidemiol Genet*. 2016;7(3):105.
5. Xi Y, Xu P. Global colorectal cancer burden in 2020 and projections to 2040. *Translational Oncol*. 2021;14(10):101174.
6. Reza M, Blasco J, Andradas E, Cantero R, Mayol J. Systematic review of laparoscopic versus open surgery for colorectal cancer. *J Br Surg*. 2006;93(8):921–8.
7. Harder VS, Stuart EA, Anthony JC. Propensity score techniques and the assessment of measured covariate balance to test causal associations in psychological research. *Psychol Methods*. 2010;15(3):234.
8. Austin PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivar Behav Res*. 2011;46(3):399–424.
9. Olmos A, Govindasamy P. A practical guide for using propensity score weighting in R. *Practical Assess Res Evaluation*. 2015;20(1):13.
10. Group CCLoORS. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcome of a randomised clinical trial. *Lancet Oncol*. 2009;10(1):44–52.
11. Ma Y, Yang Z, Qin H, Wang Y. A meta-analysis of laparoscopy compared with open colorectal resection for colorectal cancer. *Med Oncol*. 2011;28(4):925–33.
12. Bonjer HJ, Deijen CL, Abis GA, Cuesta MA, Van Der Pas MH, De Lange-De Klerk ES, et al. A randomized trial of laparoscopic versus open surgery for rectal cancer. *N Engl J Med*. 2015;372(14):1324–32.