Risk calculator score in colorectal surgery: which model?

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Abstract

Colorectal cancer is the most common cancer diagnosed throughout the world, especially in developed countries. Various complications and major risks are reported when performing a surgical procedure for colorectal cancer. In this background, numerous scoring systems have been developed to forecast morbidity and mortality from colorectal surgery (CRS). These scoring systems play an important role not only in patient outcomes after the completion of the surgical procedure, but also in validating the clinical practices. The current study evaluated different disease risk scoring systems, such as ACPGBI, CR-POSSUM POSSUM, American College of Surgeons National Surgery Quality Improvement Program (ACS NSQIP), AFC, and P-POSSUM, in order to scrutinize the best scoring system that can accurately predict morbidity, mortality, and 30-day mortality rates in CRS.

Introduction

In developed countries, colorectal cancer has been categorized as the most commonly found cancer because out of 147,950 large bowel cancers, 104,610 are colon cancer. While rest of the patients are diagnosed with rectal cancer and their mortality rate stands at 8% of all cancer-related deaths. This high prevalence rate is due to the complicated colorectal cancer surgery (CRS) procedure and the significant risks associated with it. Owing to this, various research investigations have been conducted of scoring systems that can forecast the mortality from CRS procedures. These systems are helpful in improving post-surgery patient outcomes and enhancing the clinical practices followed for CRS procedures. CRS scoring systems for surgical patients include the American College of Surgeons National Surgery Quality Improvement Program (ACS NSQIP), Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM), and Portsmouth-POSSUM, which is a modified version of POSSUM. Furthermore, Colorectal POSSUM (CR-POSSUM) is specifically applicable for patients who are undergoing colorectal surgery [1].

European nations have developed much simpler CRS scoring systems in recent years. For instance, Association Française de Chirurgie (AFC) developed a risk prediction model containing 4 variables with an aim to forecast mortality due to colorectal surgery. Another scoring model was developed called Identification of Risk in Colorectal Surgery (IRCS) in which the authors involved 5 variables. In spite of the presence of numerous scoring systems, there is no one universally accepted instrument that can forecast the risks involved in perioperative morbidity and mortality. The POSSUM AND P-POSSUM systems have been the forerunners but produce doubts in their output, i.e. some of the variables, like operating variables, can only be determined post-surgery. A 21-factor online Risk Calculator (RC) was developed by the American College of Surgery National Surgical Quality Improvement Program (ACS NSQIP) with the help of unique operative risk data, sourced from a database of 1,414,006 patient cases associated with 1557 CPT codes. Although this is an easily applicable system for almost all types of surgery, it is not a unique system developed for CRS. Both the POSSUM and P-POSSUM scoring systems have been developed to predict the patient outcomes

after surgery. However, as mentioned above, these scoring systems too are not CRS-specific and are highly complex in nature. These procedures generally have 6 operative measures and 12 physiological parameters. In this scenario, both the POSSUM and P-POSSUM systems end up in over-prediction of morality among CRS patients [2].

POSSUM was upgraded to CR-POSSUM with specific reference to CRS in the past decade. This scoring system leverages 4 operative measures and 6 physiological parameters to predict mortality. The original POSSUM model is the only model that can predict morbidity, whereas P-POSSUM and CR-POSSUm have been successful in mortality prediction only. In the meta-analysis of scoring systems [3], the POSSUM model achieved highly accurate prediction in the case of post-operative morbidity in colorectal cancer patients. In the same study, it was established that both the CR-POSSUM and ACPGBI scores accurately predicted 30-day post-operative mortality in colorectal cancer patients. To provide special attention to patients who have undergone surgery for colorectal cancer, a novel scoring system was proposed by the Association of Coloproctology of Great Britain and Ireland (ACPGBI) in 2003. In this scoring system, the following operative variables are considered: ASA grade, operative urgency, age, cancer resection, and Dukes' stage [4]. In the current study research, in-hospital predictive performance upon validation population was measured between the IRCS model and the CR-POSSUM model, and the respective scores were 0.83 (95% CI: 0.79–0.87) and 0.76 (95% CI: 0.71–0.81) [5].

Aim

To analyse the CR-POSSUM model, POSSUM, P-POSSUM, AFC, IRCS, and the American College of Surgeons National Surgery Quality Improvement Program (ACS NSQIP) risk calculators to predict operative morbidity and mortality during and after surgery for colorectal cancer and the importance of the ability to predict 30-day complications.

Material and methods

The researchers systematically reviewed the literature sourced from different databases such as Google Scholar, Embase, PubMed, Medline, etc. The articles were selected based on the criteria that it dealt with importance of scoring system in CRS. Various search terms were used such as "ACS NSQIP", "POSSUM","P-POSSUM", "CR-POSSUM", "AFC", "IRCS", and "ColoRectal cancer Surgery (CRS)". For manuscript selection based on the criteria, 2 independent investigators were involved.

Inclusion criteria for the study are as follows: comparison of risk scores devised for CRS disease; studies published in English language; and clear outcomes of the scores. The current research work excluded studies with intraoperative data, non-comparative studies, low-quality studies, reviews, case reports, and abstracts.

Outcomes of interest

To compare and contrast different CRS scoring systems, the authors used several criteria such as patient outcomes, mortality, and major morbidity.

Outcomes

The research included several operative studies from the ACS National Surgical Quality Improvement Program (NSQIP) database published between 2005 and 2017 on colorectal cancer with abdominal-colonic (AC) and pelvic-rectal (PR) cohorts. The current study considered post-operative length of stay (LOS), 30-day mortality, and major surgical complications as outcomes of interest. The authors found that major complications were reported in patients who underwent PR operations compared to the AC procedure. Although NSQIP was used for CRS, numerous critical variables were missing from this procedure which include crucial oncologic data pertaining to colorectal cancer [6].

Conversely, both NSQIP RC as well as CR-POSSUM achieved accurate prediction in terms of morality, in a centre observational study conducted among 86 consecutive CRS patients in India. Furthermore, the study also observed no prominent differentiation among the parameters considered for the study. Although CR-POSSUM demanded operative findings when calculating the score, it produced highly accurate information with regards to colorectal surgery. On the other hand, the ACS-NSQIP risk calculator comprehended the information before surgical intervention. In another study conducted among 903 colon- and rectal-cancer surgical patients, the authors compared 3 scores: POSSUM, P-POSSUM, and Cr-POSSUM, to predict mortality. The study found 1.0% in-hospital patient mortality for CRS among 9 out of 903 patients. Furthermore, the prediction values of 3 models, i.e. POSSUM, P-POSSUM, and Cr-POSSUM, were 5.6%, 2.8%, and 4.8%, respectively. These values were found to be notably higher compared to the actual mortality observed in the cohort. In a Spanish prospective multicentre cohort study conducted among 3915 patients recruited from 22 hospitals, the researchers compared 2 scoring systems: IRCS and CR-POSSUM.

The study results inferred that CR-POSSUM is efficient in terms of in-hospital mortality prediction by

achieving 73.6–75% for in-house mortality during recalibration and in-house mortality was 1.5% whereas 30-day mortality was 1.7%. The researchers concluded that CR-POSSUM is a better prediction tool for 30-day mortality (within the range 0.7% to 11.3%) while IRCS should be preferred for in-hospital mortality prediction. The IRCS risk score model was tested in a study conducted in the Netherlands. In this study, the authors predicted in-hospital mortality among patients who underwent elective and emergency colorectal surgery. As per the study outcomes, the IRCS model's predictive performance, i.e. 0.83 (95% CI: 0.79–0.87), was found to be superior to CR-POSSUM, which achieved 0.73 (95% CI: 0.71–0.81).

In another study conducted in the Netherlands, the authors compared the predicted mortality and morbidity values with the physiological and operative scores to enumerate the POSSUM, P-POSSUM, CR-POSSUM, and ACPGBI systems and found that the superior performer was ACPGBI among patients who had elective resection of colorectal malignancy [7]. A prospective multicentre study was conducted in France among 1049 consecutive patients. The study revealed that the AFC score is a pertinent postoperative mortality predictive score with extremely high sensitivity and specificity values. The study arrived at a postoperative mortality rate of 4.6% with benefits like only 4 risk factors. The AFC score can be determined quickly, i.e. rapid risk score, which makes its application easy and widespread in day-to-day practices [8].

Discussion

As mentioned earlier, there is no single universally accepted scoring system available for CRS. Though non-specific to CRS, the ACS Risk-Calculator was able to predict complications in general surgical procedures. However, it can also be applied in the case of CRS. The IRCS scoring system was found to be a better prediction tool for in-house mortality after CRS. Because the model requires fewer variables, this characteristic increases the application of the model in terms of identification of patients at risk. If POSSUM and CR-POSSUM are compared, it can be understood that both the systems have limitations and fail in achieving standard outcomes despite using volumes of data.

When it comes to 30-day operative mortality, POSSUM is the best performer. It can be summarized that POSSUM, P-POSSUM, and Cr-POSSUM can predict postoperative mortality with great accuracy. However, Cr-POSSUM and IRCS are easy to apply because both models require fewer patient parameters. Furthermore, when compared with observed mortality, POSSUM, P-POSSUM, and Cr-POSSUM's predicted mortality values were high. On the other hand, modified P-POSSUM and Cr-POSSUM models achieved highly accurate prediction in terms of the in-patient mortality rate of colorectal cancer patients. The current study used the Colorectal Pre-operative Surgical Score (CrOSS) to predict in-hospital mortality among patients undergoing CRS. CrOSS is simple and easy to implement because it has only 4 pre-operative variables: heart failure, age, urgency of surgery, and albumin [1–4].

Conclusions

Various research investigations have argued that both the POSSUM and P-POSSUM scoring systems tend to over-predict both mortality and morbidity among young patients and those who have undergone elective colorectal procedures. When comparing IRCS and CR-POSSUM, in-hospital mortality is accurately predicted by the former while the latter is a superior candidate for 30-day mortality prediction. Although several risk scoring systems are available, they cannot be applied for pre-operative prediction for colorectal cancer patients. In this background, it is still challenging to assess and develop a universally accepted scoring system for the prediction of post-operative mortality risk in CRS patients.

Conflict of interest

The authors declare no conflict of interest.

References

1. Hariharan S, Chen D, Ramkissoon A, et al. Perioperative outcome of colorectal cancer and validation of CR-POSSUM in a Caribbean country. Int J Surg 2009; 7: 534-8.
2. Bromage SJ, Cunliffe WJ. Validation of the CR-POSSUM risk-adjusted scoring system for major colorectal cancer surgery in a single center. Dis Colon Rectum 2007; 50: 192-6.
3. Vather R, Zargar-Shoshtari K, Adegbola S, Hill AG. Comparison of the possum, P-POSSUM and Cr-POSSUM scoring systems as predictors of postoperative mortality in patients undergoing major colorectal surgery. ANZ J Surg 2006; 76: 812-6.
4. Sharp SP, Malizia R, Skancke M, et al. A NSQIP analysis of trends in surgical outcomes for rectal cancer: what can we improve upon? Am J Surg 2020; 220: 401-7.
5. Ren L, Upadhyay AM, Wang L, et al. Mortality rate prediction by Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM), Portsmouth POSSUM and Colorectal POSSUM and the development of new scoring systems in Chinese colorectal cancer patients. Am J Surg 2009; 198: 31-8.
6. Er S, Sevim Y, Özden S, et al. A novel simplified scoring system for predicting mortality in emergency colorectal surgery: prediction model development. Sao Paulo Med J 2019; 137: 132-6.
7. Leung E, McArdle K, Wong LS. Risk-adjusted scoring systems in colorectal surgery. Int J Surg 2011; 9: 130-5.

8. Teeuwen PHE, Bremers AJA, Groenewoud JMM, et al. Predictive value of POSSUM and ACPGBI scoring in mortality and morbidity of colorectal resection: a case-control study. J Gastrointest Surg 2011; 15: 294-303.