Letter to the Editor

Which to select when evaluating risk factors for permanent stoma, COX regression model or logistic regression model?

Kang Hu, Weidong Tong

Department of General Surgery, Daping Hospital, Army Medical University, Chongqing, China

Correspondence to: Weidong Tong, MD. Department of General Surgery, Daping Hospital, Army Medical University, Chongqing 400042, China. Email: vdtong@163.com.

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We read the study by Li *et al.* with great interest (1). In this retrospective study regarding elderly patients with diverting stomas, the authors performed logistic regression to assess risk factors for permanent stoma (PS).

Despite the authors stated that they apply "logistic regressions to analyze the univariate and multivariate factors for PS", we observed that hazard ratio (HR) rather than odds ratio (OR) was reported to reflect the strength of association between independent variables and outcome variables.

In fact, HR and OR are effect estimates for COX regression models and logistic regression models respectively (2), both of which are widely used multivariate analysis methods in biomedical research. Hence, the authors should use OR rather than HR in their results as they applied logistic regression to analyze their data. Although it is only a minor error not affecting the results of logistic regression, this may lead to an interesting but also important topic of what to select when evaluating risk factors for PS-COX regression model or logistic regression model?

Although there have been several studies evaluating the risk factors for PS, authors of these studies seem to have yet reached an agreement regarding which regression model to adopt to conduct multivariate analysis. For example, Wang *et al.* performed logistic regression to identify risk factors for PS and found preoperative prognostic nutritional index independently associated with PS with an OR of 3.23 (3). Likewise, Miura *et al.* (4) utilized logistic regression and reported anastomotic leakage as independent predictor of PS with an OR of 5.86. In contrast, in the study by den Dulk *et al.* (5), published in *Lancet* in 2007, the authors employ COX regression instead of logistic regression to determine risk factors for PS and their results indicated that postoperative complications were a limiting factor for stoma reversal with an HR of 0.62. Another study by Dinnewitzer *et al.* (6) also applied COX regression and reported that anastomotic leakage and coloanal anastomosis were significantly associated with PS, with HR values of 6.10, 4.31 respectively.

According to previously published literatures, when it comes to assessing clinical factors significantly associated with PS, logistic regression appears to have been used more frequently than COX regression. However, we are inclined to consider COX regression model as a more scientific approach to identify risk factors for PS. The reasons are as follows:

First of all, COX regression is appropriate in dealing with time-to-event outcomes which is concerned with a period of follow-up, while logistic regression is suitable to an either-or clinical outcome without the need to take into the time until the occurrence of the outcome of interest (7,8). In our opinion, stoma reversal should be regarded as a time-to-event outcome rather than either-or outcome since time to stoma reversal also matters. At this point, we would give an example as following: Supposedly we conduct a study with patients aged 50 or younger, where the PS rate is similar to the study by Li *et al.*, then, considering the identical PS rate among the two different age groups, can we draw the conclusion that age do not impact stoma

reversal? Apparently the answer is no. Because in this scenario, most patients aged 50 or younger is likely to have their stoma closed within 6 months or shorter period after initial surgery, while most elderly patients underwent a stoma reversal near the end of the first year postoperatively and thus we may draw another conclusion that despite the two group having identical PS rate, stoma reversal is affected by age owing to younger patients tend to have their stoma closed significantly earlier than elderly patients. So, time to stoma reversal provide us an additionally important information than whether a stoma is reversed or not (7). In fact, Kaplan-Meier curves were frequently plotted in previous studies to assess median time to stoma reversal. Second, COX regression could process censored data while logistic regression does not allow for censored cases (2). It is well known, in clinical researches, there are usually incomplete cases due to a loss in follow-up before events of interest was observed, and these resulting incomplete data is usually referred to as censored data. Although in the study by Li *et al.*, PS was defined as "a diverting stoma that failed to have a reversal procedure follow-up for at least 1 year", what if patients died from non-disease causes in a shorter time after surgery without completing his or her schedule to receive a stoma reversal procedure within one year. One may suggest excluding these patients or ignoring the time to occurrence of event of interest. However, both these suggestions are likely to distort the results (9,10). Therefore, COX regression is a better selection because this model is capable of managing censored date (7). Of note, although COX regression is a very commonly used survival analysis in biomedical research, its application is not necessarily confined to processing data related to death. Instead, COX regression can be applied to a range of clinical outcomes of interest involving with information of time, which may take place or may not take place during observational period (11). All in all, we suggest that when examining risk factors for PS. it is more appropriate to apply COX regression rather than logistic model.

Additionally, we argue that the authors need to report more information to support their definition of PS in this article. Although den Dulk *et al.* (5) reported in their research that among patients undergoing a stoma reversal procedure, 97% have their stoma closed within the first year after the initial surgery, we believe that the results may vary with different study population, especially when all the patients in the article by Li *et al.* (1) were 70 years or older. Therefore, information about median or mean time to stoma reversal and what proportion of patients undergoing stoma reversal procedure within the first-year should be provided to support their definition.

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