The American Journal of Surgery (2017) 214, 373-377

The American Journal of Surgery®

The effect of a simple intraprocedural checklist on the task performance of laparoscopic novices

Michael El Boghdady, M.B.Ch.B., M.D., M.H.P.E.*, Benjie Tang, M.B.Ch.B., M.D., Iain Tait, M.B.Ch.B., Ph.D., Afshin Alijani, M.B.Ch.B., M.D., F.R.C.S.

Cuschieri Skills Centre, Ninewells Hospital and Medical School, University of Dundee, Level 5, Dundee, UK

KEYWORDS:
Checklist;
Laparoscopic;
Task performance;
Training

Abstract

BACKGROUND: Surgical checklists are used for error reduction. Checklists are infrequently applied during procedures and have been limited to lists of procedural steps as aid memoires. We aimed to study the effect of a self-administered checklist on the laparoscopic task performance of novices during a standardized task.

METHODS: Twenty novices were randomized into 2 equal groups, those receiving paper feedback (control group) and those receiving paper feedback and the checklist (checklist group). Subjects performed laparoscopic double knots, repeated over 5 separate stages. Human reliability assessment technique was used for error analysis.

RESULTS: 2,341 errors were detected during the 5 stages. During the first stage, the errors were not significantly different between the 2 groups. The checklist group committed significantly fewer errors as compared with the control group during all the later 4 stages ($P < .01$).

CONCLUSIONS: The simple intraprocedural checklist significantly improved the laparoscopic task performance and the learning curve of laparoscopic novices.

A checklist has been defined as a comprehensive list of important actions, or steps to be taken in a specific order. It is also used to reduce errors by compensating for potential limits of human memory and attention. It is not believed that checklists prevent all human error and/or accidents, but it can decrease errors if it is systematically followed.[1] The introduction of a surgical safety checklist by the WHO has significantly reduced the morbidity and mortality of surgery.[2] Checklists are infrequently applied during procedures and have been limited to lists of procedural steps as aid memoires.[3,4] A common standardized format for training and error reduction is postprocedural paper feedback[5]; however, the main limitation of paper feedback is its retrospective postprocedural nature requiring the information being retrieved from memory, often resulting in the loss of finer aspects to feedback.

There were no relevant financial relationships or any sources of support in the form of grants, equipment, or drugs.

The authors declare no conflicts of interest.

Ethical approval: Approval was granted by local research ethics committee before the commencement of this study.

* Corresponding author. Tel.: +44-1382-383400; fax: +44-1382-646042.

E-mail addresses: michael_boghdady@hotmail.com, m.elboghdady@dundee.ac.uk

Manuscript received May 25, 2016; revised manuscript July 6, 2016

0002-9610/$ - see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2016.07.019

We aimed to develop a simple performance based self-administered intraprocedural checklist and to study its effect on the surgical performance of novice surgeons when applied during a standardized laparoscopic task.

Methods

A standardized intraprocedural checklist was formulated by consensus among master surgeons who ranked the technical factors influencing the laparoscopic task performance via a link to an online questionnaire. Factors that were taken into account for the design of the checklist included: simplicity, to be short and quick to apply repeatedly, generic items which were nonspecific to any procedure, and with greater emphasis on items influencing the performance rather than only aid memoires for steps of the tasks. The checklist was piloted on 10 novices during laparoscopic knot tying before the commencement of this study. Based on the results of the total number of errors, the power calculation suggested 20 subjects should enable the detection of 20% difference of median total number of errors with 80% power at 5% level.

Following the completion of the pilot study, 20 consented novices from medical students and junior doctors without any previous laparoscopic experience were randomly allocated in 2 equal groups using an online randomizer software. The control group received a standardized postprocedural paper feedback alone, and the checklist group received the postprocedural paper feedback in addition to the standardized checklist. A beeping sound was used at 20-second intervals to remind novices to apply the checklist that was displayed beside the laparoscopic monitor at eye level. A standardized paper feedback was applied to both arms of the trial, as the current gold standard, to study the effect of the checklist.

Each candidate was given a 10 minutes introductory training to perform the task of double square knots. The task was divided into 4 subtasks: (1) creation of a C-shaped configuration of the suture thread for creating the first double throw; (2) configuration of the first double throw; (3) creation of a reverse C-shaped configuration for creating the second double throw; and (4) configuration of the reverse double throw.

Every participant performed the laparoscopic task on a synthetic material in 5 separate stages. The duration of every stage was 3 minutes and was followed by a 3-minute rest. The tasks were in a Laparoscopic Endo trainer (26,348 SZABO-BERCI-SACKIER laparoscopic trainer) using 2 needle holders (26173KAF, KOH Macro Needle Holder, 5 mm diameter, 3 cm length, Karl Storz) and a telescope (26003BA, Hopkins, 30°, 10 mm diameter, 31 cm length, Karl Storz).

Novices were randomized by using an online randomizer. Unedited video recordings were analyzed by the Human Reliability Technique.[6] The unedited videos were analyzed for surgical task performance by the main assessor who was blind to the categorizations of the arms.

Endpoints were total number of errors during each task, error frequency also known as error probability for each task (total number of errors per total number of knots), error types, and number of completed knots. Nonparametric Mann–Whitney U and Wilcoxon tests were used for statistical analysis. Comparative data were presented as median (interquartile range [IQR]).

Results

Fourteen master surgeons ranked the technical factors influencing the laparoscopic task performance via an online questionnaire. This revealed the following order from the most to the least important: 1-exposure, 2-bimanual coordination, 3-degree of force, 4-direction of force, 5-following the steps of the task, and 6-Speed (Fig. 1).

Exposure was the highest ranked factor; however, it was excluded in this study due to the standardization of the obtained optical view. In addition, direction of force was excluded because it could not be taught to novices with no previous laparoscopic experience. A pilot study on 10 novices revealed that "speed" was practically the most important factor that improved their performance, therefore it was ordered first on the checklist. The components of the checklist were worded as shown in Fig. 2.

Twenty laparoscopic novices were included in this study. Eight were males and 18 were right handed (Fig. 3). 2,341 errors were detected in 141 tasks and 408 subtasks during the 5 stages. There were 1,422/2,341 errors (60.75 %) in the control group (those who received paper feedback only); as compared with 919/2,341 errors (39.25%) in the checklist group (those who received both the checklist and paper feedback). During the first stage, the errors were not significantly different between the two groups. The checklist group committed significantly fewer errors as compared with the control group during all the later 4 stages ($P < .01$) (Fig. 4).

The checklist group had an enhanced learning curve as the last 4 stages showed significant fewer errors compared with the first stage ($P < .05$). The control group showed no improvement. Error probability was significantly higher in the control group compared with the checklist group (median [IQR] 32.6 [25.89] vs 11.7 [10.72] [$P < .01$]).

Individual error types during each step of the laparoscopic task were identified. The checklist group performed better with fewer errors for all the error types. Although, there was no significant difference in each of "the lack of supination," "tissue bite," and "out of vision"; the differences in all the rest of error types were highly statistically significant ($P < .01$) (Table 1). Number of completed knots was not statistically different between the 2 groups.

Comments

Our simple performance based intraprocedural checklist appears to have a significant accelerating effect on the