The American Journal of Surgery (2016) 212, 609-614

The American Journal of Surgery®

Association of Women Surgeons

Error tolerance: an evaluation of residents' repeated motor coordination errors

Katherine E. Law, M.S.[a], Eran C. Gwillim, M.D.[b], Rebecca D. Ray, Ph.D.[b], Anne-Lise D. D'Angelo, M.D.[b], Elaine R. Cohen, M.Ed.[b], Rebekah M. Fiers, B.S.[b], Drew N. Rutherford, M.S.[c], Carla M. Pugh, M.D., Ph.D.[a,b,*]

[a]*Department of Industrial and Systems Engineering, School of Engineering, University of Wisconsin-Madison, 3214 Mechanical Engineering Building, 1513 University Avenue, Madison, WI 53706, USA;* [b]*Department of Surgery, School of Medicine and Public Health, University of Wisconsin-Madison, 600 Highland Avenue, Clinical Science Center, K6/100, Madison, WI 53792, USA;* [c]*Department of Health Professions, University of Wisconsin-La Crosse, 3062 Health Science Center, La Crosse, WI, USA*

KEYWORDS:
Assessment;
Technical skills;
Simulation;
Human factors;
Error;
Surgery education

Abstract

BACKGROUND: The study investigates the relationship between motor coordination errors and total errors using a human factors framework. We hypothesize motor coordination errors will correlate with total errors and provide validity evidence for error tolerance as a performance metric.

METHODS: Residents' laparoscopic skills were evaluated during a simulated laparoscopic ventral hernia repair for motor coordination errors when grasping for intra–abdominal mesh or suture. Tolerance was defined as repeated, failed attempts to correct an error and the time required to recover.

RESULTS: Residents (N = 20) committed an average of 15.45 (standard deviation [SD] = 4.61) errors and 1.70 (SD = 2.25) motor coordination errors during mesh placement. Total errors correlated with motor coordination errors (r[18] = .572, $P = .008$). On average, residents required 5.09 recovery attempts for 1 motor coordination error (SD = 3.15). Recovery approaches correlated to total error load (r[13] = .592, $P = .02$).

CONCLUSIONS: Residents' motor coordination errors and recovery approaches predict total error load. Error tolerance proved to be a valid assessment metric relating to overall performance.
© 2016 Elsevier Inc. All rights reserved.

Understanding and defining medical competency has become a subject of great interest since the Accreditation Council for Graduate Medical Education developed the 6 core competencies.[1,2] Professional competency is considered "the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served".[2] To determine competency in surgical residents, validated and reliable objective action-based assessments such as task specific and global assessment scales are frequently used.[1]

Funding for this study was provided by two grants: The US Army Medical Research Acquisition Activity grant entitled "Psycho-Motor and Error Enabled Simulations: Modeling Vulnerable Skills in the Pre-Mastery Phase" W81XWH-13-1-008, and the NIH F32 Research Fellowship Award entitled "Automated Performance Assessment System: A New Era in Surgical Skills Assessment" 1F32EB017084-01.

The authors declare no conflicts of interest.

A subset of this data was presented at the 9th Annual Meeting of the Consortium of ACS-Accredited Education Institutes (ACS-AEI Consortium Meeting).

* Corresponding author. Tel.: +1 608-263-5218; fax: +1 608-252-0912.
E-mail address: pugh@surgery.wisc.edu

Manuscript received February 1, 2016; revised manuscript June 30, 2016

0002-9610/$ - see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2016.07.003

Operative performance is typically judged through technical skill and intraoperative decision-making.[3–6] However, studies that assessed these skills advocate for more detailed investigations and suggest using a multidisciplinary approach for designing and implementing training and assessment technologies.[7] Error-enabled surgical simulation trainers were designed for surgical residents to operate independently and practice the error management process.[3] This process includes making, detecting, and recovering from errors.[8] The simulations were designed using a cognitive task analysis approach, which involves the use of interviews to explore how experts approach error management and intraoperative decision-making.[9,10]

The overarching goal of our work has been to incorporate human factors theory and error-based assessment[11,12] into an analysis framework that may prove useful in evaluating intraoperative errors.[6] Human factors theory seeks to identify and "understand interactions among humans and other elements of a system…in order to optimize human well-being and overall system performance".[13] For example, we previously analyzed general surgery residents' ability to detect and recover from errors across 2 laparoscopic ventral hernia (LVH) repair procedures and determined strategies for error detection and recovery changed during the second procedure.[14] Utilizing a framework grounded in this perspective, we have been able to parse out errors and connect them to cognitive processes.[3,6,14] Furthermore, incorporating error analysis of technical skills into resident performance assessments may highlight resident training needs and allow for explicit evaluation of the error management process.

The aim of this study was to implement a human factors error framework to further investigate residents' intraoperative skills. Action errors, a type of technical error, were identified in an earlier study.[6] Common types of action errors observed included manual coordination failures, dropping instruments, or leaving instruments unattended. Failures in manual coordination and were observed repeatedly and warranted further investigation to understand their prevalence. We hypothesize that coordination errors will correlate with overall cognitive and technical error load, or the total number of errors committed, and provide validity evidence for this variable as a performance metric. Error tolerance was defined and measured by the number of failed attempts and the time required to correct an error.

Methods

Setting and participants

A secondary analysis was performed using audio- and video-recorded simulations of a LVH repair procedure. Participants included 20 senior surgery residents (PGY 4 to 5) from various general surgery residency programs in the United States. Convenience sampling methods were used to recruit participants during a course on advanced laparoscopic hernia surgery. All residents at the course participated in the study and provided written consent. This study was granted exempt status by the University of Wisconsin Institutional Review Board.

Laparoscopic ventral hernia simulation

Residents were given 30 minutes to complete a simulated LVH repair procedure[3] with surgical faculty acting as surgical assistants. The simulator contained a midline, 10 × 10 cm ventral hernia located 5 cm above the umbilicus. Residents were aware that the procedures were audio and video recorded for later analysis. However, residents did not know the specifics of how their performance would be evaluated.

The LVH simulation model is a box-style trainer, as shown in Fig. 1, designed to emphasize anatomical relevance and intraoperative decision-making. The simulator skin included layers representative of the abdominal wall, skin, subcuticular tissue, and peritoneum. Simulated organs, including bowel and omentum, were layered within the abdominal cavity to provide additional realism.[7]

Research protocol

A multidisciplinary team (human factors engineering, surgery, education) of 3 researchers (K.L., A.D., and E.C.,) reviewed the audio- and video-recordings using Multimedia Video Task Analysis (University of Wisconsin-Madison) to code and quantify errors committed during the repair.[6] Error occurrence and duration, procedure step, and the error management process for each error were also identified during this process. Consensus agreement was used by the 3 researchers to code each event. This methodology involved unanimous agreement of the researchers.[15,16] Any event that did not initially reach consensus was discussed further. Following a discussion, if any event could still not achieve

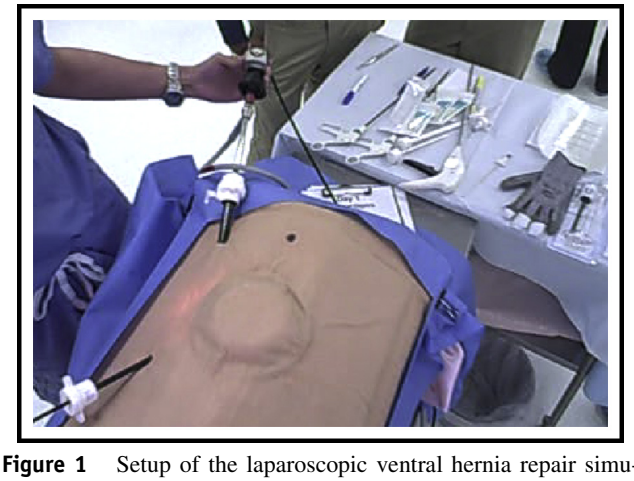

Figure 1 Setup of the laparoscopic ventral hernia repair simulator and equipment presented to participants.

Download English Version:

https://daneshyari.com/en/article/4278047

Download Persian Version:

https://daneshyari.com/article/4278047

Daneshyari.com