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ORIGINAL ARTICLE

Development and validation of a new method for evaluating the log-roll technique in trauma patients

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ABSTRACT

Background: Secondary spinal injury induced in trauma patients during transfer is of major concern. The log-roll technique is used to transfer immobilize patients in many trauma centers. Healthcare trainees require a reliable objective tool for ensuring high competency and safety when handling trauma patients. This study aimed to develop and validate a novel method for assessing and evaluating the log-roll technique.

Methods: This experimental validation study was conducted at the clinical skill lab of the Faculty of Medicine of Umm Al-Qura University from March 2018 to July 2019. A log-roll technique assessment sheet was developed using revised input from 20 content experts, current guidelines, and relevant literature. Simulated trials were filmed and reviewed by 10 content experts using the index and reference tests. Content validity, concurrent validity, internal consistency, and reliability were tested against the modified Global Rating Scale (GRS).

Results: The current sheet was valid, reliable, and internally consistent compared to the GRS. The concurrent validity coefficient between the two scales was 0.75 ($p < 0.01$), internal consistency coefficients were >0.64 ($p < 0.01$), and reliability coefficient was >0.75 ($p < 0.01$).

Conclusion: The log-roll technique assessment sheet is a valid and reliable tool for testing trainee competency at performing the log-roll technique. This tool might be helpful for training healthcare professionals to handle trauma patients.

Keywords: Assessment tool, log-roll technique, spine trauma, trauma training.

Introduction

Spinal cord injury commonly results from trauma due to road traffic accidents, falls from heights, and sports injuries [1,2]. Of all trauma patients, it is estimated that 3% have spinal fracture. Of those, approximately 12% have spinal cord damage [3], with 25% experiencing neurological deterioration during transfer and initial management [4]. Thus, to avoid secondary injury during transfer, a great deal of care and minimal mobilization are needed.

Considering the complex multidimensional motion and complicated biomechanics, many techniques and maneuvers have been described in the literature to minimize spinal motion during the care and transfer of trauma patients. Of such techniques, the most recognized is the log-roll technique [5]. Log-rolling (moving the patient in a single motion) is essentially used to minimize thoracic and lumbar spine motion [6,7]. Log-rolling a trauma patient is described in the advanced trauma life support (ATLS) [8].

Poor handling of trauma patients could have fatal consequences [9]. Although critically, there is no proper way to guarantee adequate spine immobilization competency of trauma care professionals.

Studies have shown that factors contributed towards the log-roll success, including communication, team

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synchrony, time efficiency, and alignment [10-12]. All concluded that the success of spinal immobilization as well as the prevention of further injury could be ensured with proper training and practice [10,13]. However, a reliable method of evaluating healthcare professional competency is still required.

In 1997, Martin et al. [14] described a tool for evaluating the basic skills needed of trainees in trauma care. However, no current tool assesses the skills needed for managing trauma patients with a potentially serious spine injury.

Thereby, a log-roll assessment sheet was developed and validated for assessing and evaluating the log-roll technique performed by medical professionals to further ensure high-quality trauma care.

Subjects and Methods

This experimental validation study was conducted at the clinical skill lab of the Faculty of Medicine of Umm Al-Qura University from March 2018 to July 2019. The assessment sheet was developed using an open-ended detailed questionnaire about how the log-rolling process should be conducted. The questionnaire included questions about biomechanics, communication, and key points required to achieve a successful log-roll. Twenty physicians and surgeons from different fields caring for trauma patients answered the questionnaire. All answers were reviewed and filtered with statements repeated in 60% of the answers were included in the final checklist. After the careful review of submitted answers, expert opinion, clinical observation, and the current literature, consensus was reached on the criteria for the log-roll technique.

The Global Rating Scale (GRS) was developed by Martin et al. [14] in 1997 to objectively assess technical skills for trainees in primary care, including trauma care. To complement the log-roll assessment checklist, the GRS was customized to better suit a simulated setting without changing the tool content or overall ranking of potential candidates.

The trauma patient was simulated by healthy volunteers who consented to participate in the study. Twenty healthcare professionals with various levels of training were recruited (four junior medical students, four senior medical students, four junior general surgery residents, four senior general surgery residents, and four paramedics) to participate in the study. Subjects were divided into five groups of four each of the same training level and specialty. Each group was asked to perform the four-person log-roll technique on the volunteers. All participating groups were filmed while performing the technique, while the participants were deidentified.

To test tool reliability and validity, a panel of 10 content experts reviewed each filmed log-roll. Each reviewer was asked to rate the log-roll technique using both the assessment sheet and the modified GRS, and inter- and intra-rater scores were compared [15,16].

Content validity, an expert's judgment of the model and its proposed goals, was assessed by 20 content experts. To calculate internal consistency and concurrence, the total score was compared to the six dimensions of the log-roll technique assessment sheet and the total GRS score of the respective rater using the Pearson correlation coefficient. Values of $p < 0.01$ were considered significant.

Reliability was calculated using single-measure intra-class correlation coefficients (Cronbach alpha). Inter-rater reliability was measured among all 10 raters. A coefficient of reliability >60% was considered significant.

Results

The instrument's validity was verified by; (1) The use of logical validity (content validity), in which the assessment sheet was presented to a group of 20 reviewers with experience and competence to elicit their opinions about its validity and clarity. Statements that obtained an agreement rate ≥ 80% were adopted. The final assessment tool comprised four main dimensions, including six sub-dimensions of the log-rolling technique competency assessment. (2) The validity of internal consistency of the sub-scale dimensions was validated using Pearson's correlation coefficient applied to the scores of 10 specialized physicians after viewing the five videos to assess the competencies of the log-roll team and individual member. The validity of the internal consistency of the assessment tool was verified using correlation coefficients between the sub-dimension and total scores. All Pearson correlation coefficients between the sub-dimension and total scores were statistically significant ($p < 0.01$), reflecting the validity of the log-roll technique (Table 1).

(3) To further confirm the tool's validity, the Pearson correlation coefficient between the physicians' assessment scores for each team using the log-roll technique competency assessment sheet and the modified GRS (Table 2) was done. The Pearson correlation coefficient between the two assessment tools was 0.75 ($p < 0.01$), reflecting the scale's concurrent validity.

The tool's reliability was verified using Cronbach's alpha coefficient, which was 0.787, reflecting a high degree of reliability (>60%) and the means and standard deviations of the physicians' assessment scores were calculated using the log-roll technique competency assessment. The average competency of all scores was 65.73%, which was considered marginal.

Discussion

The spine moves in three axes: sagittal, flexion extension; coronal, right and left lateral flexion; and transverse, right and left lateral rotation [17]. Considering the complicated biomechanics of the spine, transferring trauma patients without moving the spine could be challenging [18].

When handling trauma patients, it is essential that healthcare workers ensure spinal immobilization in cases of spinal injury. However, the cutoff value for maximum safe spine immobilization during trauma is unknown, which makes minimizing spinal motion as much as possible critical [19]. Many methods have been developed to secure spine movement during mobilization, the most well-established of which are the log-roll and the lift

Table 1. *Log-roll technique competency assessment sheet.*

Log-rolling technique competency assessment						
Team leader's responsibilities						
A. Communication						
1. Takes the time to explain the procedure to team members. 2. Identify the patient and explain the procedure and instruct him/her not to move, nod, or resist movement. 3. Informs team members with their assigned role and directs team members to their respective positions. 4. Gives clear instructions on when to move the patient (on the count of three, turn the patient towards you to a 90-degree angle: one, two, three). 5. Obtains feedback from the patient (pain, comfort, and alignment).						
Score:		1	2	3	4	5
B. Head and spine immobilization						
1. Ensures that the patient has a rigid cervical collar on and placed properly. 2. Ensures the bed is flat. 3. Positions the patient's arms crossing over the lower abdomen or pelvis. 4. Insures proper spinal alignment (chin is in alignment with the sternal notch and umbilicus, no neck flexion, extension, or rotation) 5. Firmly holds the patient's shoulders at midclavicular area with forearms held tightly on the patient's head and neck, with elbow flexed 90 degrees on the bed.						
Score:		1	2	3	4	5
C. Safety and documentation						
1. Asks for extra assistance when needed, based on the patient's size and extent of trauma. 2. Secures tubes and drains (if any) to ensure no unnecessary traction or compression occurs during turning. 3. Does a pre- and post-procedure neurological motor/sensory assessment and documents the results. 4. Makes sure the patient is in neutral position throughout the procedure. 5. Ensures documentation of the full procedure done in appropriate records.						
Score:		1	2	3	4	5
Turn team responsibilities						
Follows commands and synchronizes will with the team.						
A. Turn team member 1: 1. Positions them self on the side of the bed to which the patient is to be turned, levelling with the patient's shoulders and upper chest and reaches both arms across the patient. 2. Puts one hand at the level of the scapula, and the other on the hip.						
B. Turn team member 2: 1. Positions them self on the side of the bed to which the patient is to be turned, levelling with the patient's hip and reaches both arms across the patient. 2. Puts one hand at the level of the iliac crest while crossing the hand of turn team member 1, and the other underneath distal thigh; with forearm resting on the other thigh of the patient.						
Score:		1	2	3	4	5
Third assistant's responsibilities						
1. Follows commands and synchronizes well with the team. 2. Slides out the spinal board as per leader's instructions. 3. Palpates the spine for tenderness (if the patient is awake), gaps, steps, and crepitus. 4. Check for bleeding, bruises, gunshot wounds along the entire spine area and back of the chest and flanks. 5. Does a digital rectal examination for perianal sensation, tone, bleeding, and high riding prostate.						
Score:		1	2	3	4	5
Overall assessment of the procedure						
1. Patient safety was insured. 2. Patient alignment in the neutral position is maintained throughout the procedure. 3. Team members only applied careful minimal spinal movement. 4. Team members were synchronized. 5. Every team member knows their corresponding role.						
Score:			1	2	3	4	5
Total score	<15	16-20	21-25		26-30	
Competency	Unsafe	Marginal	Competent		Highly competent	

and slide techniques [11,13,20]. The log-roll technique is well studied and used daily in trauma settings. With its relatively simple principle, it has managed to survive and was included in the ATLS protocol [8]. However, its careful execution is required to guarantee desirable minimal spinal movement.

Table 2. *The modified GRS.*

The modified GRS								
A. Patient assessment								
Refers to the individual's overall ability to select and perform a physical exam and investigation of signs and/or symptoms that is organized and appropriate given the clinical situation and level of urgency. This includes: Ability to select and perform appropriate physical examination and investigations. Ability to prioritize clinical investigations needed based on the scenario. Interpreting and evaluating findings while discriminating between relevant and irrelevant findings. Ability to continue appropriate reassessment/detailed assessment as needed. Consideration for differential diagnosis while working toward a working diagnosis.								
5	4	3	2	1	Score:			
B. Decision making								
Refers to the individual's overall ability to select an appropriate, safe, and effective management plan and/or strategy. This includes: Decision made is safe and effective. Decision based on consideration of risks, benefits, and differential diagnosis. Having adequate information for decisions made (i.e., avoiding premature closure) and Ensuring decisions are appropriate prioritized and timed. Selecting an appropriate management device, method, or technique based on evidence (i.e., situation awareness, patient condition, resources, etc.) and context.								
5	4	3	2	1	Score:			
C. Resources utilization								
Refers to the individual's overall ability to identify and use resources effectively to accomplish goals and maximize care. This includes: Delegation of tasks, the coordination of efforts. Selecting appropriate members (e.g., allied agencies, patients, etc.) for given task. Ensuring effectiveness. Requesting additional resources as necessary. Ability to function as a team with appropriate leadership.								
5	4	3	2	1	Score:			
D. Communication								
Refers to the individual's overall ability to clearly and accurately exchange information with the team, patient, and/or bystander for optimal patient care and team effectiveness. This includes: Use of concise and appropriate language. Ensuring statement is directed at appropriate individuals and that message are heard /received (i.e., closes the loop). Demonstrating effective listening skills, demonstrating empathy. Responding appropriate to statements by the team, patient, or bystander. Actions are appropriately communicated with team, patient, or bystander, verbal and nonverbal ques are appropriate and congruent.								
5	4	3	2	1	Score:			
E. Procedural skill								
Refers to the individual's overall ability to complete psychomotor or procedural skills or tasks effectively, appropriately and to standard. This involves: Familiarity with equipment used. Ensuring appropriate and safe while completing tasks to standard. Avoiding commission or omission errors. Adaptability to failures/problems (as necessary) and ensuring team, patient, and bystander safety while performing these procedures. Appropriate execution, properly sequenced and evaluating/revaluating effectiveness.								
5	4	3	2	1	Score:			
F. Overall clinical performance								
5	4	3	2	1	Score:			
26-30					21-25	16-20	<15	Total score
Highly competent					Competent	Marginal	Unsafe	Competency

Lebel et al. [17] described five phases of the log-roll technique: In phase 1 (initial phase), the lead rescuer immobilizes the patient's head. In phase 2 (roll phase), the lead rescuer gives a signal and the patient is rolled on the side with the help of one or more assistant. In phase 3 (maintain phase), the lead rescuer maintains a relative orientation of the head to the trunk that is as constant as possible while the assistant pushes the board closer to the patient. In phase 4 (push phase), the lead rescuer gives the signal to initiate the slow push of the patient toward the floor and onto the board. In phase 5: (slide phase), the patient is repositioned into the middle of the board while the lead rescuer maintains patient stability.

Although the technique is well-designed, moving the patient in a single arc of motion onto their side and back again to the supine position could be difficult considering the different proportions of the head, torso, and head as suggested by Suter et al. [7]. Considering these challenges, adequate assessments are required for the training of healthcare professionals providing trauma care. A typical log-roll training session involves a simulator and an experienced judge to provide feedback to trainees as they perform the technique [17]. However, a valid and objective method for evaluating log-rolling training adequacy is lacking.

The log-roll technique competency assessment sheet presented in this study is a new tool that was designed and validated to enhance the quality of trauma care training and allow for the objective evaluation of trainees.

Because concordance is key to a successful log-roll, the assessment sheet evaluates team performance using one score. Each team member was evaluated using different

statements, but each individual's performance affects the team's overall score.

The responsibilities of the team leader were further divided into three subcategories: communication, head and spine immobility, and safety and documentation. This emphasizes the importance of giving clear orders while holding the patient's head and ensuring documentation accuracy before and after the log-roll. All other team members follow the leader's commands and synchronize with them to achieve the best outcome.

The GRS was developed to assess providers' technical skills in paramedic and trauma care training using generalized statements. The log-roll technique competency assessment sheet scores were compared to the GRS scores in the evaluation of concurrent validity.

However, one of the limitations of the current study was the sample size, where 25 subjects were needed to detect large difference. Whereas, the assessment sheet was shown to be reliable when statistical difference between groups was observed.

Conclusion

This study showed that the log-roll technique competency assessment sheet developed was both valid and reliable for the evaluation of healthcare professionals executing the technique. However, other tools might be needed to enable the evaluation of this technique in the clinical setting. Follow-up studies for further validation are underway where motion detection sensors would be used to further objectively evaluate the technique and compare that to the log roll assessment sheet and measure head and trunk motion during the maneuver.

List of Abbreviations

GRS Global Rating Scale
ATLS Advanced trauma life support

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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None.

Consent to participate

Informed consent was obtained from all the participants.

Ethical approval

Ethical approval was obtained from the research ethics committee of the Umm Al-Qura University (No. HAPO-02-k-012-2019-01-264 on: 16/1/2019).

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