Evaluation of stress induced by high-fidelity simulation among anesthesiology and emergency residents: impact of oral debriefing versus video assisted

Evaluation du stress induit par la simulation haute-fidélité chez les résidents d'anesthésie et de médecine d'urgence: impact du débriefing oral versus vidéo assisté

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Abstract

Aim: To describe the level of stress in emergency medicine and anesthesia residents during high fidelity simulation sessions and to evaluate the effect of video-assisted debriefing versus no-video assisted debriefing on stress level.

Methods: Prospective randomized study. Inclusion: emergency medicine and anesthesia residents consenting. Stress was assessed, before and after the training session, by: Blood Pressure (BP), Heart Rate (HR), Simple Numerical Scale (SNS), Scale trait anxiety inventory-YA (STAI-YA). Heart Rate and SNS were measured after debriefing. Residents were randomized into two groups according to the debriefing modality. The design of the simulation session was evaluated by the Simulation design scale (SDS).

Results: Thirty-six residents were included. We observed significant increase in the mean HR and mean Systolic BP before briefing and after the scenario respectively from 83.8±9.97 cpm to 101.3±17.84 cpm (p <0.001) and from 112.2±8.3 mmHg to 149.6±16.8 (p <0.001). Mean SNS and mean STAY-YA increased before the briefing and after the scenario respectively from 5±2.11 to 6±1.52 (p=0.004) and from 40±6.6 to 57.8±12.3 (p=0.01). HR and SNS decreased significantly after debriefing regardless of modality. The mean SDS was 84.53±5.8. After scenario, we found significant negative correlation between HR and time needed to initiate symptomatic treatment (r = - 0.449, p = 0.019).

Conclusion: Learning by simulation of critical situations is associated with significant stress which decreased after debriefing.

Key-words: Simulation, Stress, Pedagogy, Evaluation study, Emergencies

Résumé

Objectif: Décrire le niveau de stress chez des résidents en médecine d'urgence et en anesthésie réanimation lors de situations critiques en simulation haute-fidélité et d'évaluer l'effet de la modalité du débriefing vidéo assisté versus débriefing non vidéo assisté sur l'intensité du stress.

Méthodes : Etude prospective randomisée. Inclusion : Résidents d'anesthésie réanimation et de médecine d'urgence consentants. Le stress a été évalué avant et après le scénario par : (Pression Artérielle (PA), Fréquence Cardiaque (FC), Echelle Numérique Simple (ENS), Scale trait anxiety inventory-YA (STAI-YA)) et par la FC et l'ENS après le débriefing. Notre population a été randomisée en deux groupes selon la modalité du débriefing. La conception de la séance de simulation a été évaluée par le Simulation Design Scale (SDS).

Résultats : Inclusion de 36 résidents. Une augmentation de la moyenne de la FC et de la PAS avant et après le scénario a été notée passant de 83,8±9,97 cpm à 101,3± 17,84 cpm (p<0,001) pour la FC et de 112,2± 8,3 mm Hg à 149,6±16,8 (p<0,001) pour la PAS. Une augmentation de la moyenne de l'ENS et de la moyenne du STAY-YA avant le briefing et après le scénario a été notée allant respectivement de 5±2,11 à 6±1,52 (p=0,004) et de 40±6,6 à 57,8±12,3 (p=0,01). La FC et l'ENS ont diminué de façon significative après le débriefing indépendamment de sa modalité. Corrélation négative significative entre SDS et le délai nécessaire pour instaurer un traitement symptomatique (r= -0,449, p=0,019) après le scénario

Conclusion : L'apprentissage par simulation est associé à un stress important. Ce stress a diminué après le débriefing indépendamment de sa modalité.

Mots-clés : Simulation, Stress, Pédagogie, Étude d'évaluation, Urgences

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INTRODUCTION

Learning by Simulation is now mandatory pedagogic tool for health professionals. Emergency medicine and anesthesia are two disciplines with often patient's safety concerns. These two disciplines benefited from the contribution of both procedural and high-fidelity simulation (HFS) techniques. Training by urgent simulated situations allows learners to mobilize their knowledge and to assess their technical and non-technical skills.

The use of HFS makes possible to reproduce situations that are difficult to manage psychologically by the participants in the scenario. The fear of failure and of negative evaluation by the instructor or by the group can generate stress [1].

Stress calls upon the sympathetic nervous system and causes physiological and psychological modifications that in turn affect cognitive function [2,3]. Because of their limited experience, this stress is important for young physicians (resident) and can affect their technical and non-technical skills.

The aim of this study was to describe the level of stress in residents (emergency medicine and anesthesia) during HFS and to evaluate the effect of video-assisted debriefing (VAD) versus non-video assisted debriefing (NVAD) on the intensity of their stress.

METHODS

We conducted a prospective randomized study at the Emergency Care Teaching Center during one year (January – December 2017). The protocol of the present study was reviewed and approved by the local ethics committee of hospital.

Study population

We included anesthesiology and emergency medicine resident who participated at HFS sessions, and who enrolled during simulation days organized as part of training in the Emergency Care teaching Center. Recruitment was carried out on a voluntary basis. Informed written consent was obtained from all participants to simulation sessions.

Non-inclusion criteria: participants volunteer for the simulation sessions but who not consenting to participate in our study

Excluded criteria: Concomitant use of medications affecting heart rate (HR) or blood pressure (BP) and any psychoaffective drugs.

Taking any stimulants just before simulation session (smoking, coffee)

Residents who did not complete their self-assessment sheets were excluded

Materials and training sessions

We used the Adult Full Body ALS Trainer mannequin with a simulator during the HFS sessions.

The theme of the scenario was the management of acute coronary syndrome with ST-segment elevation, which is complicated by a cardiac arrest (ventricular tachycardia without pulse) in the emergency department. Residents managed simulated situation scenario in teams of four, each playing his/her role as a doctor or a nurse. The instructor played the role of a senior physician who could intervene directly or by phone. Training sessions were recorded. Residents who did not directly participate were allowed to observe but were seated away from the acting residents and could not interact with them. The mean duration of the scenarios was 10 minutes. After each training session, all participants gathered in another room for an approximately 30-minutes debriefing.

Study protocol

HR and BP were recorded to evaluate the sympathetic response to stress. HR was measured at three time-point: before the training session, after the training session and after the debriefing. BP was measured before and after the training session.

Self-evaluation of the stress was assessed using simple numerical scale (SNS) at three time-point: before the training session, after the training session and after the debriefing.

Anxiety was assessed using the State-Trait Anxiety Inventory (STAI-YA). Scores range from 20 (lowest degree of anxiety) to 80 (highest degree of anxiety). Learners completed the STAI-YA [4] before and after the training sessions.

Learners were randomized into two groups using a six-element permutation table to benefit from video assisted debriefing (VAD) or non-video assisted debriefing (NVAD).

At the end of the session, the simulation was evaluated by the learners using the Simulation Design Scale (SDS) [5].

Technical and non-technical skills were scored by two instructors by analyzing the video recordings. For technical skills we collected the time to recognize cardiac arrest, to determine etiology as well as the delay to initiate symptomatic and etiological treatment. Non-technical skills were assessed by considering four criteria (situation management, teamwork, decision-making and situational awareness) using the Anesthesist's non-technical skills (ANTS)

Statistical analyses

The data was analyzed using SPSS software version 22.0 (IBM SPSS Inc, Chicago, Illinois, USA) for data analysis.

Quantitative variables were expressed as means±standard deviation (SD) and qualitative variables as numbers and percentages. The Shapiro-Wilk test was used to verify the normality of distributions. Multiple pairwise comparisons were performed using the student t or Wilcoxon tests for paired samples as appropriate. Correlation between 2 quantitative variables was studied by Spearman's correlation coefficient (Spearman's Rho). For all statistical tests, $p<0.05$ was considered as statistically significant.

RESULTS

A total of nine simulation sessions were organized at the Emergency Care Teaching Center. All participants reported not using medications affecting HR or BP and any psychoaffective drugs. All questionnaires were correctly completed (fig 1).

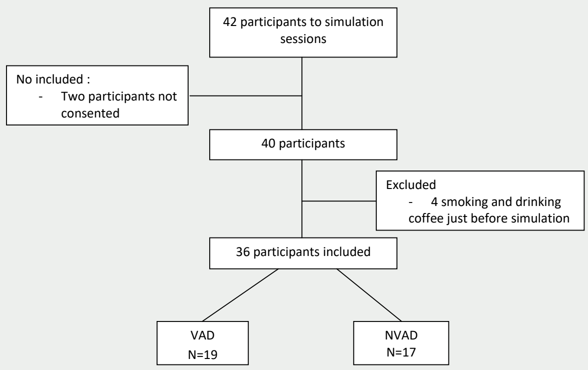

Figure1. Participants selection diagram

Characteristics of the participants

Thirty-six residents were included (29 women, 7 men). Their mean age was 29.7±2.4 years. According to the year of study, residents were distributed as follows: six in the 2nd year, thirteen in 3rd year, thirteen in 4th year and four in the 5th year. The table 1 shows general characteristics of the residents.The conceptual evaluation of simulation using SDS showed minimum and maximum values of 72 and 95, respectively. Thirty-three learners (91.6%) had an SDS greater than 80.

Table 1. General characteristics

variables	
Mean age (years±SD)	29.7±2.4
Gender-ratio (M/F)	0.24
Emergency medicine residents n(%)	24(67)
Anesthesia residents n(%)	12(33)
Residents who have previously participated at simulation session n(%)	14(39)
Residents having the role of doctor during simulation sessions n(%)	27(75)

SD: standard deviation

Physiological assessment of stress before and after scenario

Before and after the scenario, mean Heart Rate (HR) and Systolic Blood Pressure (SBP) increased significantly (table 2). After the scenario, mean HR (104.45±16.3 cpm) was higher for learners who did not participate at previous simulations compared with mean HR (81.09±10.88 cpm) for those how participated at previous simulation (p=0.03) Also, mean SBP (145.41±13.68 mmHg) was higher for learners who did not participate at previous simulations compared with mean SBP (133.29±19.08 mmHg) for those how participated at previous simulation (p<0.001). Mean HR after the scenario was higher among learners who were a function of team leaders (91.8±8.4 cpm) compared to those who had the role of doctor (83±9.8 cpm) with a p equal to 0.012

Table 2. sympathetic system response to stress in the study population

variables	Before scenario mean±SD	After scenario mean±SD	p
HR (cpm)	83.9±10	101±17.8	<0.001
SBP (mmHg)	112.2±8.3	149.6±16.8	<0.001

HR : heart rate , SBP : systolic blood pressure, SD : standard deviation

Self-assessment of stress before and after scenario

After scenario, 15 residents (42%) had an SNS superior than six Mean SNS was higher after the scenario (6±1.5) compared to SNS before scenario (4.6±2.1) with a statistically significant difference (p = 0.004). An increase in the mean of STAY-YA before and after the scenario was noted ranging from 40±6.6 to 57.8±12.3 (p=0.01) (Fig 2)

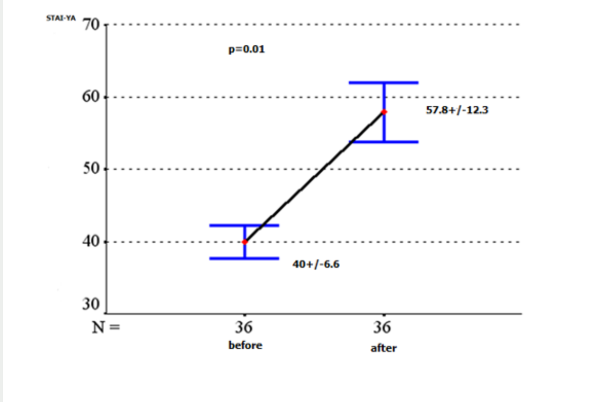

Figure 2. Variation of STAI-YA before and after the scenario

STAI-YA: Scale trait anxiety inventory

Impact of debriefing on stress markers

We noted a decrease in the HR after debriefing (85.2±12 cpm) compared to the mean after the scenario (101±17.8 cpm) with a statistically significant difference (p <0.001). A significant decrease in the mean of the SNS after debriefing (3.6±0.6) was also noted (p <0.001). There was no difference of psychophysiological parameters of stress according to the debriefing modality (table 3).

Table 3. Psychophysiological parameters of stress according to the debriefing modality

	VAD mean±SD (n=19)	NVAD mean±SD (n=17)	p
HR2	85±12.7	85.5±12	NS
SNS2	3.6±0.7	3.6±0.7	NS

HR2: heart rate; SNS2: simple numerical scale after debriefing; NS: not significant
VAD: video assisted debriefing; NVAD: Non-video assisted debriefing

Correlation between physiological and psychological parameters of stress

We did not find any correlation between the physiological parameters of stress and the SNS. We found a positive correlation between HR and STAI-YA after the scenario (Spearman's Rho = 0.510 and p = 0.01) (Fig 3).

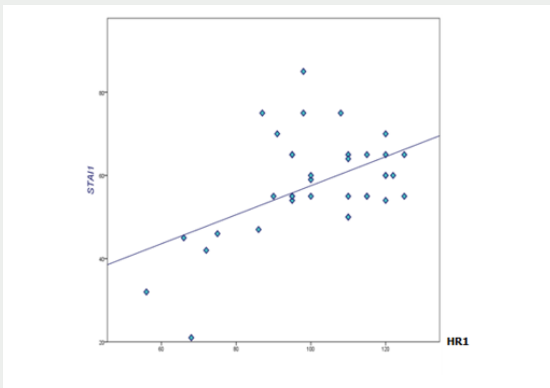

Figure 3. Correlation between HR and STAI-YA after scenario

HR1: Heart rate after scenario, STAI 1: STAI-YA after scenario

Correlation between skills and stress

We noted a negative significant correlation between HR after the scenario and the time needed to initiate symptomatic treatment with Spearman coefficient. Spearman's Rho= -0.449 and p = 0.019. No significant correlation was found between stress parameters and non-technical skills.

Correlation between SDS and stress

We found a negative significant correlation between SDS and STAI-YA after the scenario with Spearman's Rho = -0.487 and p = 0.012.

DISCUSSION

In this study, emergency medicine and anaesthesia residents presented significant stress during HFS sessions as demonstrated by the significant increase of HR and SBP after the scenario (from 83.9±10 to 101±17.8 cpm for HR and from 112.2±8.3 to 149±16.8 mmHg for SBP). We also showed an increase of psychological parameters of stress after the scenario. Stress markers significantly decreased after the debriefing independently of its modality. Finally, we demonstrated that the level of stress had a negative correlation with technical skills and was correlated to the simulation design.

First strength point of our study was the evaluation of stress by measuring objective parameters such as heart rate and blood pressure known as stress markers. Second strength point was originality by evaluation of the effect of debriefing through two different modalities (randomization). Limitations of our study was the low number of participants included and population heterogeneity (two specialties and four levels of study).

SHF is an active student-centered pedagogical process, an evaluation of the design of this method is necessary. The Kirk Patrick classification is the method recommended for this evaluation by experts in clinical simulation. During this study, we were interested in the evaluation of the first level (the degree of satisfaction of the participants) using the SDS, validated in 2014 by Franklin et al [5] and we found that all participants appreciated simulation sessions. Bakhshialiabad et al. [6], indicated that student satisfaction was an important indicator of the quality of the learning experience and was linked to the results and perception of the activity and the framework of education to modify and optimize the teaching strategies. Student's satisfaction with their learning activities and environment influences their motivation to learn [7].

In this study, all measures of stress markers showed that simulation generates significant stress. This result was also reported by Vincent et al. [8] who concluded that all professionals were stressed independently of their prior experience. The experience of the simulation session can be stressful because the critical situations that it generates, induces an emotional charge that is difficult to manage [9]. Thus, stress generates changes in the activity of the autonomic nervous system (ANS) and influences the sympathetic/parasympathetic balance, which results in cardiovascular repercussions, particularly at the level of HR. This physiological parameter variation is a good indicator of ANS changes and has been used by PEIA-PATRU [10].

As our study, a similar result was reported by Sandroni [11] who assessed stress in 82 "Team Leaders" during "Advanced Life Support" training sessions. During this study, the author used HR, DBP and PAS as objective markers of stress. The analysis of the results showed a statistically significant increase of all the parameters during the scenario.

Ghazali et al. [12] showed that the salivary cortisol level increases during a high-fidelity simulation and decreases after debriefing without returning to the reference level. Similarly Geeraerts et al. [13] used salivary amylase as a physiological parameter of stress during the simulation. In our study, we could not do biological analysis to assess the level of stress.

Individual reaction to stress is a complex phenomenon involving several types of response, notably physiological and emotional.

The prevalence of anxiety in medical students is higher than in students from other disciplines [14,15]. The appearance of HFS in the already evaluation-rich curriculum represents another challenge for them. In a Canadian study, 81% of anaesthesia residents stated that the anxiety induced by HFS sessions was greater than the one of a day in the operating room [8].

In a Tunisian study [16], 30 students participating in a high-fidelity simulation training course Stress was evaluated by self-assessment using a numerical scale before and after the session. The authors concluded that simulation-induced stress, which was increased significantly after the session and was influenced by the role to be played during the scenario.

In this study, self-assessment of stress was done by the simple numerical scale and by Spielberg's anxiety-state scale (STAI), which are the most commonly used self-perceived anxiety scales in research and clinical practice [4] STAI-YA was used by Christian Bauer et al [17], they found high STAI-YA after the simulation scenario despite low initial state anxiety (STAI-YB) in participants before simulation.

Relationship between the intensity of stress and the quality of memorization follows an inverted-Ushape curve (Yerkes–Dodson law) that defines an ideal zone for performance and zones where performance declines due to either boredom, when stress is too weak, or distress when stress is too high [2,18,19]. Moreover, in this study we found a correlation with inverse relationship between stress intensity after simulation and performance during the scenario for a time to start symptomatic corrective measures.

This allowed us to hypothesize that our learners were in the optimal performance zone because this level of stress had a positive impact on the delay to correct a serious symptom such as the rhythm disorder in our scenario. The intensity of the stress felt by the participants and the importance of the variations of the psychophysiological parameters related to the stress (especially among the residents having a team leader role) are essential to take into account in the debriefing which immediately follows the scenario.

Debriefing, whatever its modality, allows learners to take a step back from the simulated situation, to make a self-assessment and the trainer to summarize the simulation process and analyze performance jointly with the students. Previous studies have analyzed the effect of debriefing modality on performance [20,21] and concluded that it improves performance regardless of its modality.

Video recording of sessions can be a relevant educational tool for trainers during the debriefing. Indeed, several reactions; shouting, aggression, or complete inhibition may emanate from participants in stressful situations without them noticing. Filming these attitudes and watching them during the debriefing allows participants to better perceive the repercussions of stress on group interactions, decision-making and their psychomotor skills. This makes it easier for the trainer to self-manage in order to control stress and therefore be more efficient [22].

Evaluation of the effect of the repetition of HFS sessions on the stress level of the learners seems interesting to us. This is to help learners to better manage their stress initially during scenarios and subsequently during real emergencies.

CONCLUSION

We shought to determine what levels of stress was induced by HFS to emergency medecine and anaesthesia residents who participated at simulation learning method. We found that our participants presented significant stress during training sessions. This stress may decrease delays to initiate symptomatic treatment. Any modality of the debriefing and an appropriate design conception of the session can reduce this stress.

During the simulation session, the trainer should not be limited to the transfer of knowledge. It must also take into account the stress felt by the learners, especially during the debriefing.

It seems interesting to perform a delayed analysis of stress after simulation session to assess the psychological consequences at a distance.

Abbreviations list :
HFS : High Fidelity Simulation
VAD : Video Assisted Debriefing
NVAD : Non Video Assisted Debriefing
HR : Heart Rate
BP : Blood Pressure
SBP : Systolic Blood Pressure
SDS : Student Design Scale
STAI-YA : Scale Trait Anxiety Inventory-YA
SNA : Simple Numerical Scale
ANTS : Anesthesist's Non Technical Skills

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