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Review Article

A stab in The Dark

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ABSTRACT

In most of classic surgical training programs, we have taught how to perform surgery, but we have not taught how to live as a surgeon. Surgeons share many personality characteristics with high achievers, and these characters lend themselves toward negative emotions and burnout. However, surgeons are also in a unique position to take advantages of on many aspects of happiness that they touch upon every day in their pursuit of helping people to feel better. As a group, surgeons need to be aware of and minimize the possible negative aspects of surgery-related inherent nature threatens. They must also be aware of happiness as a reality and explore all aspects of happiness in their professional and personal lives. Here, we tried to explore the potential stressors and their effects among the field of surgery. Finally, the coping strategies are addressed to make a clear view for application in the daily surgical practice. The value of this review to shed light in a dark-area in our surgical community. We hope that, it will present the topic in the heart of surgical teachers.

Conclusion: Surgery related stressors are diverse and have significant risks. However, although we are aware by harmful effects of stressors, the coping strategies not gain the same value and actually did not taught explicitly during residential surgery training. This article presents a light in the dark about the harmful effects of stress on both physicians and their patients aiming to improve the coping strategies. It is also a voice to consider and include coping strategies in surgical curricula.

Keywords: Stress; Surgery; Sleep Deprivation; Distraction; Burnout; Fatigue.

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INTRODUCTION

Over half of all adverse medical events include patients submitted to surgery. The majority of these events occurred intraoperatively, and fortunately many of these events could be prevented [1]. There are many invisible factors can affect the surgeon performance, the net result is increase of surgical mistakes and complications. Medico-legal importance is crucial for all surgeons, as it can terminate their career completely and no one will be empathic with them as they not see the stab which impeded in his heart with no apparent features of complaints. At the end the surgeon obligated to seems stable, smart, polite and professional although all hidden stabs which come from different areas in his environment. In this review article we'll discuss the following items and its effect on surgeon performance (Stress, Surgeon's burnout, Lack of sleep, Fatigue, Operative theatre distractors, and Aging).

I-Stress

Preparation to be a surgeon and the daily practice of surgery are a stressful activity for individuals. Different causes of stress are responsible (e.g., treatment of critically ill and rapidly deteriorating patients, surgical procedures need high concentration, inevitable sleep deprivation, inadequate personal time, low social support, frequent examination for licensing, and conflict between their educational and clinical tasks. In addition, the surgical practice affected by characteristics of the surgeon and his/her team, rapid changes in technology, unpredictable intraoperative findings, and fluctuating dynamics of the surgical team. The unexpected situations in crisis had a considerable stress on the surgical team. The work-related stress could be also due to negative interpersonal communications, disruptive behaviors of the surgeons, and hostile environment [2].

The surgical teams are exposed to performance errors especially in crisis, where more concentration and optimal performance are most critical, while surgeons are under stressful conditions that can degrade their performance. The understanding of the influence of stressful factors and environment and surgeon behavioral responses is critical to reduce adverse events and improves the outcome of surgery [3].

Most researchers reported that about 25%-35% of residents had some degree of anxiety and/or depression when exposed to stressors. This documents the association between mental health and job stress. However, the research on the potential effects of stress on the clinical performance is insufficient [4].

The term "stress" was defined after the General Adaptation Syndrome (GAS). The GAS had three phases: the first is the *alarm phase,* where the subject identifies the source of stress or a threat and the body initiates an alarm response, the second is the *resistance phase,* where the body challenges to adapt and handle the stressor, and the third is the *exhaustion phase,* where the resources challenges and coping with the stressors are finally exhausted due to continued stress and the subject is unable to continue the standard function. Eventually and as a result of the exhaustion phase, there is a long-term impairment of the adrenal glands and the normal immune function, leading to different disease conditions (e.g., depression, cardiovascular, and other mental issues) [5]. Thus, the understating how the stressors affect normal clinicians' performance and abilities to process normally in daily clinical activities, remember and deal with information, decision-making and team-working is essential. Stress usually had a deleterious effect on the subject's comfort, and endangers the safety and patient care. The determination of the magnitude of the effects of stress on clinical performance will permit to adopt helpful policies effectively target the learning and technical learning environments [6].

With availability of appropriate and sufficient resources to cope with the burdens, the situation is described as a *challenge* and the subject develops an "eustress" psychological state. When the subject's resources are insufficient to cope with the demands of the stress, the *threat* situation is the rule, with development of emotional disturbances (the most is anxiety) [7].

Results of previous study are contradictory regarding the individual's response to stress. Some described an impaired performance under acute stressful conditions, but others have described improved individual's performance. A simple perception about the effects of stress on clinical performance has been developed due to insufficient research and conflicting results. Thus, the concept of learning better under stress *("you learn better under the gun")* coexist side by side to the concept of better learning and performance in environments free of stress. The full understanding of the effects of stressful condition prevents the failure of adequate preparation of surgical trainees to function adequately in daily work and especially emergency situations and impairing their continuous learning process [8].

Risk factors for stress

Many factors potentiating the stress in daily surgical practice. These include but not limited to desired outcomes, individual and team factors, factors related to the patient, the organization, the environmental and technological factors and job demands.

Desired outcomes include the absence of adverse events, with provision of high quality, efficient surgical care. Intraoperative work needs implementation of technical (psychomotor) and non-technical (e.g., cognition, communication skills, decision making, environmental awareness, team-working and leadership) skills. However, the link between technical performance and surgical outcomes did not quantified until recently [9]. The link with non-technical skills are historically neglected. But recently it has been recognized. The breakdown of non-technical performance is common and may lead to provider's errors and patient's adverse outcomes [10].

Individual and team factors: The literature is rich by description of the many surgeon's attributes which can affect individual and team performance. Some are intrinsic to the surgeon (personal traits) and other (technical and non-technical, surgical experience and attitudes) develops slowly over time. However, the surgeon's physiological and psychological conditions witness rapid changes (e.g., changes in mood, fatigue, illness and substance use). The performance also can be affected by the team factors like trust, familiarity, and experience [11].

Patient factors, such as comorbidities, immunological stated, severity of surgical pathology, and individual anatomical and physiological factors can influence the surgical outcomes directly or indirectly through their impact on the job demands. For example, obese patients or those with disability need addition efforts for their movement and securing them of the operation table. The complex surgical pathology also increases the technical difficulty and increasing demands on nursing team with additional need of intraoperative supplies [12].

Organizational factors can affect surgical performance and outcomes by their effects on job demands and resources (JDRs) and the stress of the provider. These include staffing/hiring practices, the organization culture (beliefs, values and behavior shared by the members of the organization), the employee compensation policy, practices of case scheduling, training, intraoperative safety measures and performance review and error's reporting policies [13]. The operation room (OR) often lacks the team-member's physiological safety to feel comfortable "speaking up" with concerns, with less likely to recover errors [14]. However stressful conditions and disruptive behavior could be tolerated more in the OR than other departments of the hospital due to production pressure, culture and isolation of the OR. The job demands usually increased by poor case scheduling, with limited resources of equipment's and specialized staff, and over-scheduling which exerts time pressure to finish surgical lists on time (latent safety threats) [15].

Environmental and technological factors: Construction of OP and technological reparations affect JDRs and are common sources of stress over the surgeons. Equipment issues usually lead to a higher incidence of errors and delay. About 23.5% of errors in the cardiac and general surgery were related to equipment's issues. A potential latent hazard due to poor equipment design, physical arrangement and lack of maintenance of surgical equipment's [6]. OR noise, distractions, and interruptions are also common environmental stressors. Noise specifically has shown to reduce team communication, and negatively affects technical performance [17]. Distractors and interruptions in OR include irrelevant talks, staff flow, and phone calls with possible negative effects on intraoperative cognition and cooperation [18]. ***Job demands*** can be defined as "what needs to be accomplished and how quickly,". Cognitive, physical, societal and technical demands often vary and alter the intraoperative work and outcomes. *Job resources* are the individual, team, and work environment assets that are immediately available to meet the job demands. Traits and psychophysical states of the surgeon and teams can contribute to job resources. Job resources availability can also be dynamic, changing over the course of a surgery. For example, a surgeon might have excellent psychomotor abilities and performs well at the beginning of a long surgery, but their hands tremble with the development of fatigue, dehydration and hypoglycemia after 10 hours of surgery [3].

Effects of stress

Stress and provider physiology: Stress and patient physiology are tightly coupled. The relation is usually reciprocal in nature. The stress changes physiology and physiological changes may lead to stress. The stress response recognized by the activity of adrenomedullary system and hypothalamic pituitary-adrenal axis. Catecholamine secretion is the first response to stress. Other physiological changes include increase of heart rate & blood pressure, rapid respiration and increased the tension of the muscles. During long-management surgical cases, there are temporal changes (e., fatigue, and hypoglycemia). These changes could be added to the "internal" response to stress. The surgeons' quality of performance is affected by the stress response [3]. In addition, the sleep deprivation usually leads to poor psychomotor performance in lay persons. The technical surgical performance could be affected. However, the literature is not conclusive, and effects of sleep deprivation and surgeons' fatigue on surgical outcome is inconsistent. However, the majority of researches report a negative impact. The majority of surgeons and nurses reported that, they perform effectively, even in the presence of fatigue [19].

Dehydration impacts the cognitive performance of the nurses and physicians in the outpatient clinics. The pace and nature of the surgeons often leads to poor fluid intake. However, the impact of hydration on the surgeon intraoperative performance had not been studied [20]. Hypoglycemia negatively impact surgeon's performance in the operation theatre. This is explained by the hypoglycemia-associated anger, and irritability [21].

Stress and individual technical (psychomotor) performance: *W*ork-related fatigue, anxiety and environmental factors negatively impact the perceptual and motor tasks. The surgical literature confirmed the negative impact of stressors on surgeon's intraoperative performance [22].

Stress and individual non-technical performance: Better performance of surgeons under stress had been reported. They made fewer errors and had lower morbidity and mortality rates. However, it is clear that, non-surgeons are negatively affected by excessive stress and negation emotions [23, 24]. In addition, anxiety and worry adversely affect memory [3]. On the extreme side, there is some evidence that stress can prevent distraction from irrelevant sources [25]. Distractions can reduce the surgeon's performance quality. Experience could buffer this impact [26]. Intraoperative stress (external or internal) negatively impact the surgeon's decision making. The decision making is critical during

surgery, especially when faced by unexpected findings [24].

Emotional stressor responses: Negative emotions decrease the decision quality through, as important information may be neglected or poor assessment of the outcome probabilities. Frustration in the operation room (OR) are associated with poor consideration for the team-working, coordination. Emotion also can impact appraisal [27].

Stress and emotional contagion within teams: Emotional stressors and states can be "contagious," spread among team members, and influence their performance. Negative (e.g., anger) are more contagious than positive emotions. Leaders who cope well with stress and positively support their team members, decrease the team stress and amplify their performance [28].

Strategies for maximizing surgeon performance and outcomes

1. Coping with acute stress

Coping refers to the management of stressful events by different psychological strategies and surgeons vary in their coping ability. Coping strategies correlate with personality, other intrinsic factors and factors related to the work environment. Better coping with stress is associated with improvement in the technical and non-technical performance. Coping mechanisms include, but not limited to, emotion regulation and expressive suppression [29].

2. Error compensation

Error prevention, detection and recovery are important in high risk settings such as the operation room. Team working is the better compensation for immediate treat/error. This was confirmed in the pediatric surgery, where successful error compensation by team members was associated with risk reduction of morbidities and mortality [30].

II-Lack of sleep

Sleep requirements are widely different from one to another. Adults usually need 6- 10 hours of sleep every day. The majority acquire 7 to 8 hours/day [31].

Effects

Neurocognitive Effects: Sleep deprivation, either acute or chronic, lead to mental fatigue and impact on the critical adverse effects on the surgeon's cognition. It negatively affects the surgeon's performance [32].

Attention: Attention simply is the brain's spotlight illuminating information relevant to the performance (task) at hand. Hallmarks indicators of impaired attention include prolonged response times (lapse), errors of omission or commission, and performance variability. All of these indicators observed after a long duration of wakefulness [33], chronic sleep deprivation, and mental fatigue [34].

Other Cognitive Functions: Closely associated with attention, working memory is associated with many cognitive methods. The working memory is significantly impaired in sleep-deprived and associated with altered activation of the prefrontal cortex in neuroimaging. In addition, sleep deprivation leads to decreased cognitive flexibility, over-reliance on developed strategies, a tendency toward making risky decisions [31].

Effects on surgical performance: Long work hours more than 10 hours per week is associated with chronic sleep deprivation, with disturbance of circadian rhythm with night shifts. Sleep deprivation affects both patient safety and physician's health, with frequent injuries especially during night shift [32]. Long-term sleep deprivation is associated with increased motor car accidents, increased stress, and increased risk of myocardial infarction and ischemic stroke [34].

III-Fatigue

Fatigue is defined as unusual, abnormal or excessive whole-body tiredness, disproportionate to, or unrelated to, activity or exertion. It had unfavorable impact on the performance [33].

Mitigate the effects of fatigue and lack of sleep

Working Hours: Manipulation of shift pattern is suggested to decrease stress. A major change includes 5 hours of mandatory rest for all interns in extended shift, and the maximum shift length must not exceed 16 hours [32].

Beyond Working Hours: The use of sophisticated methods to detect sleep deprivation and/or fatigue are introduced. These include polysomnography, brain imaging, and eye tracking. Consumption of caffeine and modafinil were found to counteract the effects of sleep deprivation. However, a dose of 600mg of caffeine is required [35].

IV- Burnout

Physician burnout is defined by a triad of emotional exhaustion, de-personalization, and low sense of personal achievement related to one's work. Burnout in doctors has gained significant research interest [36]. It is associated with medical errors, unprofessional performance and reduced quality of patient care [37].

Risk factors

There are intrinsic and extrinsic risk factors of burnout among surgeons. The intrinsic factors stem from the behaviors of the high achiever or surgical personality. The most obvious factor is the work-life imbalance [38]. A resilient individual has the ability to cope with stress through enhanced recovery in response to stressful

stimuli. A resilient individual use "strategic stopping" that permits for recharging rather than continuing to sustain additional stress [39]. Sex is a significant risk factor for burnout; women are more likely to experience burnout than men. **Dyrbye and colleagues** [40] surveyed 1,043 female and 6,815 male surgeons, with equal work hours. Women are more likely to have burnout and depression. In addition, women were more likely to experience work home conflicts, exhibit depressive symptoms, feel less able to rely on their spouse for childcare, and be more likely to hire a caretaker at home. A surgeon's specialty and setting of practice also play a role in burnout. Calls at nights, younger age, and work hours were associated with greater likelihood of burnout. Private surgeons were significantly more likely to experience burnout an academic setting. Trauma surgeons were more likely to have burnout and pediatric surgeons were least likely [41].

Consequences of burnout

Burnout has many potential adverse consequences including medical errors, suicide, depression, and absenteeism. Reporting an error was associated with a reduction in mental quality of life. In addition, medical errors were more common with longer work hours, more time spent in the operating room, and more nights on call per week. Suicidal ideation and suicide are other potential severe adverse consequences of burnout [38].

Prevention

Chung and Ahmed [42] evaluated the effect of a goal-oriented work load to improve the efficiency of the surgical service to help reduce stress among surgeons and residents

Surgical coping strategies

4. Early recognition of risks

Practicing surgery involves inevitable stressors and surgeons have to deal with it as part of the job. The early recognition of potential risk factors is essential for successful coping [43].

5. Control of self

"If you get stressed you don't function properly". Senior surgeons recognize the importance of effective leadership for the surgical team. In stressful conditions, they first confirm that they are in control of themselves. Key methods include physical relaxation, distancing techniques, and self-talk [44].

6. Stop and stand back

Surgeon experience unexpected complications must stop. They mentally stand-back and regain the self-control, then think again for the situation, make a decision, and prepare for the next stage. A guiding principle was to avoid over-focusing on the task and break the vicious circle of anxiety and time pressure leading to clouded judgment and decision-making problems. A good surgeon will stand back and think about causes of increased unexpected complications. The surgeon usually gets the right things to do and reduce stress in himself. Distancing from the stressor—mentally or physically—is another strategy of breaking the vicious circle. Surgeons reported leaving the operating table briefly, thereby avoiding the stressful environment [43].

7. Self-talk.

Self-talk consists of self-instructions and a positive inner conversation and can decrease the cognitive and emotional stress responses. Surgeons apply this strategy to calm down, recover their own confidence and focus, and guide themselves along the decision-making process with logical advices. "I have to keep thinking to myself: 'I need to stay calm; I can deal with this . . . Let's think logically. What is the next step that I need to do to regain control in this situation? How can I improve what I'm doing at the moment?' [44].

8. Reassessment.

To control a difficult situation, surgeons follow the stages of reassessment, decision making, intraoperative planning, preparing and leading the team, and solving the problem [43].

9. Decision making.

The surgeon considers alternative approaches to the problem, focusing on factors they can influence and addressing possible outcomes. Experienced surgeons expect potential problems, create back-up plans, and prioritize before making the final decision. After choosing a strategy the surgeon prepares the next steps. This includes ensuring that all necessary equipment is available and guiding the team [3].

10. Team communication and leadership.

The majority of the surgeons highlighted that they try not to show their own stress, to reduce tension among the surgical team: "You do depend very much on the other members of the team in an operation . . . I feel I always have to give the environment that I'm completely control . . . Because if you start to panic, rush around, shouting at everybody then everybody gets upset and nobody does anything properly and the whole thing gets quite stressed". However, it is usually the surgeon who takes the leadership role in high-stress situations. To ensure full attention, he or she must communicate clearly and be confident "I make myself more commanding, more confident, let everybody know that I'm in control and if I speak, they need to listen and they need to act . . . It becomes then a much more hierarchical structure than a team structure" [3].

11. Solving the problem.

Once a decision has been made and the preparations for the next stage are complete, the surgeon puts the plan into practice to deal with the problem. This in itself can have a reassuringly

stress-reducing effect and lead to a positive feedback circle: "I think if you take the decisions and they are apparently the right ones the stress becomes less because you think 'that's good' you know, 'I've got control. We want the next step" [44].

Conclusion: Surgery related stressors are diverse and have significant risks. However, although we are aware by harmful effects of stressors, the coping strategies not gain the same value and actually did not taught explicitly during residential surgery training. This article presents a light in the dark about the harmful effects of stress on both physicians and their patients aiming to improve the coping strategies. It is also a voice to consider and include coping strategies in surgical curricula.

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