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Exploring Intraoperative Cognitive Biases in Cardiac Surgery Teams

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ABSTRACT

This study focuses on understanding the influence of cognitive biases in the intraoperative decision-making process within cardiac surgery teams, recognizing the complexity and high-stakes nature of such environments. We aimed to investigate the perceived prevalence and impact of cognitive biases among cardiac surgery teams, and how these biases may affect intraoperative decisions and patient safety and outcomes. A mixed-methods approach was utilized, combining quantitative ratings across 32 different cognitive biases (0 to 100 visual analogue scale), regarding their "likelihood of occurring" and "potential for patient harm" during the intraoperative phase of cardiac surgery. Based on these ratings, we collected qualitative insights on the most-rated cognitive biases from semi-structured interviews with surgeons, anaesthesiologists, and perfusionists who work in a cardiac operating room. A total of 16 participants, including cardiac surgery researchers and clinicians, took part in the study. We found a significant presence of cognitive biases, particularly confirmation bias and overconfidence, which influenced decision-making processes and had the potential for patient harm. Of 32 cognitive biases, 6 were rated above the 75th percentile for both criteria (potential for patient harm, likelihood of occurring). Our preliminary findings provide a first step toward a deeper understanding of the complex cognitive mechanisms that underlie clinical reasoning and decision-making in the operating room. Future studies should further explore this topic, especially the relationship between the occurrence of intraoperative cognitive biases and postoperative surgical outcomes. Additionally, the impact of metacognition strategies (e.g. debiasing training) on reducing the impact of cognitive bias and improving intraoperative performance should also be investigated.

Keywords: Cognitive bias, Human factors, Cardiac surgery, Decision making, Operating room

INTRODUCTION

The cardiac operating room (OR) is a high-risk high-stakes environment in which specialized professionals interact with each other using various equipment, technological devices, and interfaces (Dias et al., 2018). Despite considerable improvement in patient safety and outcomes in the past decade,

the incidence of errors and preventable adverse events continues to be high in cardiac surgery compared to other surgical specialties (Gawande et al., 1999). Among the many factors contributing to clinical errors, the cognitive mechanisms underlying human errors play a crucial role in clinicians' performance (Patel et al., 2015; Zenati et al., 2019). Heuristics refers to cognitive strategies or mental shortcuts that are automatically employed during the human decision-making process (Elstein, 1999). Although heuristics can facilitate expeditious decision-making, they can also fail and lead to errors, known as cognitive biases (Saposnik et al., 2016). To date, over 34 cognitive biases have been described in medicine in general, and although less tangible than procedural and technical errors, cognitive biases are inherent to clinical reasoning and decision-making (Croskerry, 2003).

The incidence and impact of cognitive bias on clinicians' performance have been extensively documented in several clinical specialties (Saposnik et al., 2016). Nonetheless, cognitive bias in surgery has been relatively understudied. In a recent systematic review of the literature, (Armstrong et al., 2023) reported that from 39 studies investigating cognitive biases in surgery, only 12 studies have addressed cognitive biases during the intraoperative phase in the OR, and none of those included cardiac surgery procedures. Studies have shown that biases such as overconfidence (Vogel and Vogel, 2019) and confirmation bias (Thiels et al., 2015) are prevalent in surgical settings, leading to variations in clinical judgment and potentially adverse events and complications (Armstrong et al., 2023).

Cardiac surgery, characterized by its complex nature and high-risk procedures, demands a heightened awareness and understanding of these cognitive biases and their potential impact on the quality of surgical care and patient safety (Zenati et al., 2020). This gap highlights the importance of this study, which seeks to explore and quantify the impact of cognitive biases in cardiac surgery teams, contributing to a deeper understanding and potential strategies for mitigation. In the present study, we aimed to investigate the perceived prevalence and impact of cognitive biases among cardiac surgery teams, and how these biases may affect intraoperative decisions and patient safety and outcomes.

METHODS

HSI Study Design and Setting

This cross-sectional study used a mixed-method approach including online surveys and semi-structured interviews. The study was carried out in a tertiary teaching hospital in the United States and a research protocol was approved by the local IRB. All participants completed an informed consent.

Participants

Seven cardiac surgery researchers, part of our multidisciplinary team, including 1 cardiac surgeon, 1 perfusionist, 1 cardiac anaesthesiologist, 1 OR nurse, 1 organizational psychologist, 1 emergency physician/ human factors scientist, and 1 computer scientist, completed the online survey. Nine subject-matter experts (3 cardiac surgeons, 3 anaesthesiologists, and 3 perfusionists), who have performed at least 400 cardiac surgeries each, participated in the semi-structured interviews facilitated by a human factors scientist.

Procedures

Online Survey: The multidisciplinary research group completed a web-based survey designed to evaluate each of the 32 different cognitive biases that are widely described in the medical literature (Croskerry, 2003). Participants were provided with definitions of each cognitive bias and asked to rate each one on a 0 to 100 visual analogue scale, regarding their "likelihood of occurring" during the intraoperative phase of cardiac surgery, and their "potential for patient harm".

Semi-structured Interviews: Based on survey responses, the cognitive biases rated above the 75th percentile were further elucidated by a human factors researcher during semi-structured interviews with the subject-matter experts to identify clinical examples of each bias.

RESULTS

Of 32 cognitive biases, 6 were rated above the 75th percentile (Figure 1) for both criteria (likelihood of occurring and potential for patient harm). The definitions of selected cognitive biases alongside illustrative examples gathered from the semi-structured interviews are shown in Table 1.

Table 1. Cognitive biases with 'highest likelihood of occurring' and 'potential for patient harm' during the intraoperative phase of cardiac surgery.

Cognitive Biases	Examples
Assessment Momentum - the tendency for a particular assessment (e.g. the diagnosis of a specific situation) to become established without adequate evidence. Once labels are attached to patients, they tend to become stickier and stickier. Through intermediaries (patients, nurses, physicians), what might have started as a possibility gathers increasing momentum until it becomes definite, and all other possibilities are excluded.	*"Patient is known as having coagulopathy (e.g. Factor V Leiden or recent exposure to P2Y12 inhibitors) at the beginning of surgery and we do not search for other causes of bleeding when it occurs."* *"Sometimes we 'buy' a diagnosis without proper evaluation and initiate a lot of unnecessary measures"*
Confirmation Bias - the tendency to look for confirming evidence to support a course of action rather than look for disconfirming evidence to refute it, despite the latter often being more persuasive and definitive. In difficult cases, confirming evidence feels good, whereas disconfirming evidence undermines the hypothesis and means that the thinking process may need to be re-started.	*"During echocardiography, we tend to look for images that confirm our primary hypothesis (e.g. real extent of valve regurgitation as opposed to the degree that we prefer")* *"When the ACT isn't coming up, we continually seek evidence that confirm heparin resistance"*
Availability - the disposition to judge things as being more likely or frequent if they readily come to mind. Thus, recent experience with a situation may inflate the likelihood of it coming to mind. Conversely, if a situation has not been seen for a long time (is less available), it may be underdiagnosed. Novices tend to be driven by availability, as they are more likely to bring common prototypes to mind, whereas experienced clinicians are more able to raise the possibility of the atypical variant.	*"If a patient presents complications related to a specific technique (e.g. off- pump coronary bypass converted to on-pump), we may avoid this technique in future cases because of recent negative experiences."* *"If the patient is bleeding, the first reason that comes to mind is excessive heparin dose"*

(Continued)

Table 1. Continued

Cognitive Biases	Examples
Omission Bias - the tendency toward inaction. In hindsight, events that have occurred through the natural progression of a case are more acceptable than those that may be attributed directly to the action of the clinician. The bias may be sustained by the reinforcement often associated with not doing anything, but it may prove disastrous.	*"If the blood pressure curve is flat, we think that this is because of arterial line artifact. However, sometimes it means that the patient is in cardiac arrest or shock."* *"Sometimes the echocardiography suggests a leak after valve replacement, but we decide to not consider these findings"*
Overconfidence Bias - a universal tendency to believe we know more than we do. Overconfidence reflects a tendency to act on incomplete information, intuitions, or hunches. Too much faith is placed in opinion instead of carefully gathered evidence. When overconfident people believe that their involvement might have a significant impact on outcomes (whether it actually does or not), they tend to believe strongly that the outcome will be positive.	*"Sometimes we believe that the graft is perfect, and it is not the cause of bleeding."* *"In certain situations, I think I can just do something (e.g. get the sternum opened) and the problem will be fixed easily"*
Search satisfying - reflects the universal tendency to call off a search once something is found. Comorbidities, sites of bleeding, and other complications may all be missed. Also, if the search yields nothing, people satisfy themselves that they have been looking in the right place.	*"If the patient is bleeding and we detect a low platelet count, we feel relieved that this is the cause of bleeding and can be solved with transfusion."*

DISCUSSION

In the present multidisciplinary study, we identified 6 unique cognitive biases (assessment momentum, availability, confirmation bias, omission bias, overconfidence bias and search satisfying) that present both a high chance of occurring and a high potential for patient harm during the intraoperative phase of cardiac surgery. Since cognitive biases are thought processes, and therefore cannot be explored by observation alone, our approach of using semi-structured interviews may provide researchers with a helpful tool to elucidate the myriad of mechanisms and factors involved in intraoperative cognitive errors.

This study's findings resonate with existing literature, highlighting significant cognitive biases in surgical settings (Armstrong et al., 2023). Specifically, biases like anchoring and overconfidence, as identified in our research, have been noted to influence surgical decision-making, potentially leading to suboptimal patient outcomes (Vogel and Vogel, 2019). The critical nature of cardiac surgery, where decisions have immediate and significant consequences for patients, necessitates a focused approach to recognize and address these biases. The development of tailored interventions, such as cognitive training programs (Karnick et al., 2021) and decision-support systems (Tarola et al., 2018), is imperative for mitigating these biases. Future research should prioritize evaluating the effectiveness of these interventions in cardiac surgery settings, aiming to enhance decision-making quality, reduce errors, and improve patient safety and outcomes.

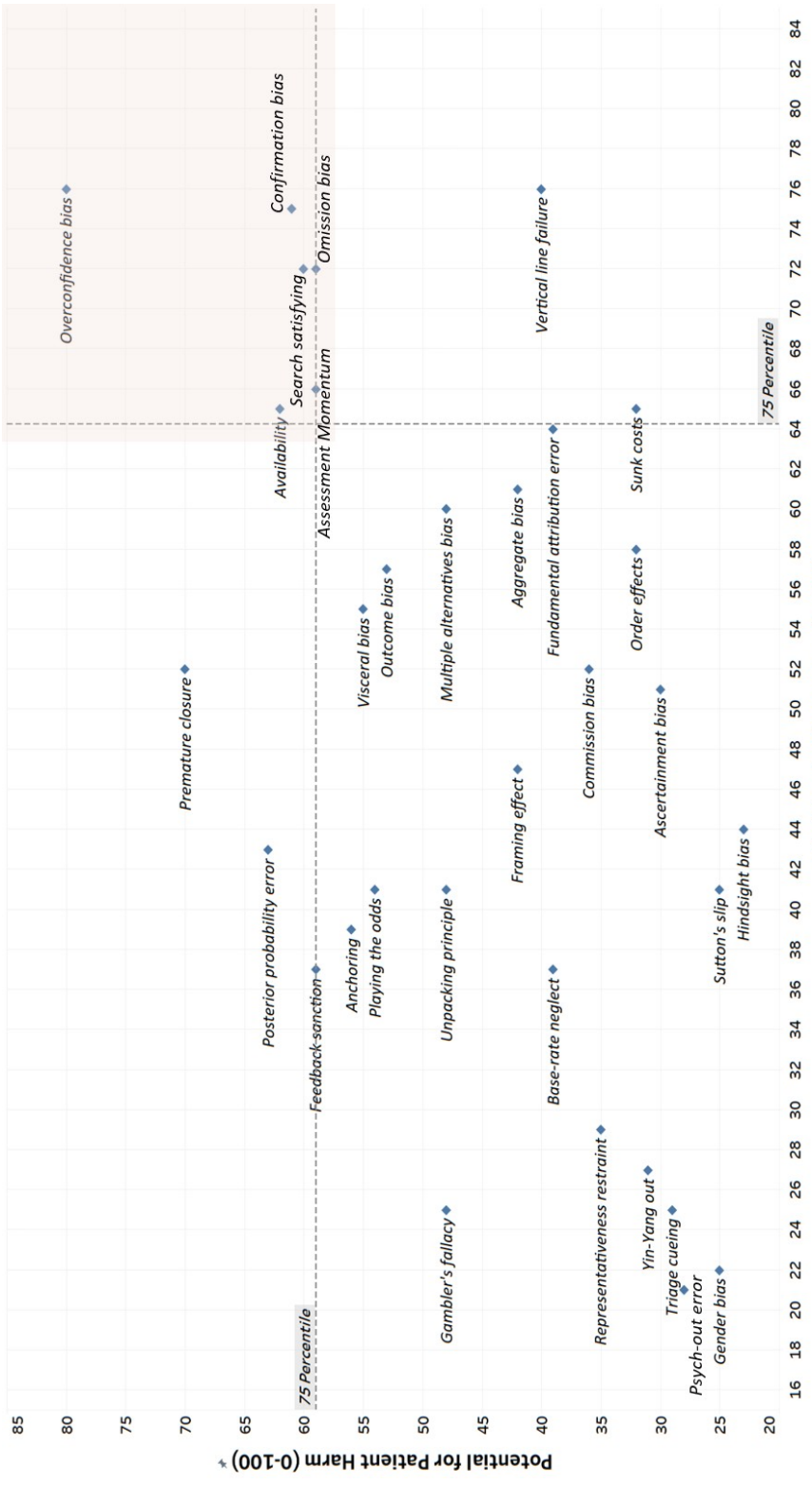

Figure 1. Rating of 32 cognitive biases regarding the "likelihood of occurring" and "potential for patient harm" during the intraoperative phase of cardiac surgery.

The concept of cognitive bias is relatively new to surgical literature. Our preliminary findings provide a first step toward a deeper understanding of the complex cognitive mechanisms that underlie clinical reasoning and decision-making in cardiac OR. Future studies should further explore this topic, especially the relationship between the occurrence of intraoperative cognitive biases and surgical outcomes. In addition, the impact of metacognitive strategies (e.g. debiasing) on reducing the impact of cognitive bias and improving intraoperative performance should also be investigated.

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