The Science of Medical Decision Making: Neurosurgery, Errors, and Personal Cognitive Strategies for Improving Quality of Care

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During the last 2 decades, there has been a shift in the U.S. health care system towards improving the quality of health care provided by enhancing patient safety and reducing medical errors. Unfortunately, surgical complications, patient harm events, and malpractice claims remain common in the field of neurosurgery. Many of these events are potentially avoidable. There are an increasing number of publications in the medical literature in which authors address cognitive errors in diagnosis and treatment and strategies for reducing such errors, but these are for the most part absent in the neurosurgical literature. The purpose of this article is to highlight the complexities of medical decision making to a neurosurgical audience, with the hope of providing insight into the biases that lead us towards error and strategies to overcome our innate cognitive deficiencies. To accomplish this goal, we review the current literature on medical errors and just culture, explain the dual process theory of cognition, identify common cognitive errors affecting neurosurgeons in practice, review cognitive debiasing strategies, and finally provide simple methods that can be easily assimilated into neurosurgical practice to improve clinical decision making.

INTRODUCTION

The recent paradigm shift within the U.S. health care system towards enhancing patient safety and reducing medical errors is largely attributed to the seminal report by the Institute of Medicine (IOM) entitled "To Err is Human: Building a Safer Health System" (31, 52). Published in 1999, this IOM report indicated that between 44,000 and 98,000 patients die each year within the United States as a result of medical errors. One study estimated that approximately 18% of patients are injured during the course of their care in hospitals; 9% of these injuries are life-threatening (32). It was estimated in 1999 that the total annual costs of preventable adverse events is between $17 billion and $29 billion per year (31).

Complications and patient harm events are common among neurosurgical patients. In a recent review of the American College of Surgeons National Surgical Quality Improvement Program database by Rolston et al. (47), complications occurred in 14.3% of the 38,000 neurosurgical procedures performed during the 5-year study period. Studies of the Nationwide Inpatient Sample database in which researchers evaluated the incidence of the Agency for Healthcare Research and Quality patient safety indicators and Centers for Medicare and Medicaid Services hospital-acquired conditions have also suggested that such events are commonplace among neurosurgical patients. In these studies, 15%–20% of brain tumor and stroke patients, 10%–15% of patients with unruptured aneurysms undergoing treatment, and 48% of patients undergoing treatment for ruptured aneurysms had at least one patient safety indicator or hospital-acquired condition occur during their hospitalizations (10, 11, 44, 45). Although it is unclear how many of these events are preventable, it is likely that at least a proportion of these occurrences are attributable to neurosurgeon error.

During any given year, 19% of neurosurgeons face malpractice claims (27). Although many of these claims are thrown out, many cases represent true patient harm events from medical errors or physician negligence. Furthermore, wrong site or wrong patient procedures remain persistent, regardless of countermeasures developed to reduce these "never" events (50). In a survey of practicing neurosurgeons, 50% indicated that they had performed wrong-level lumbar surgery at least once, and almost 20% were subject of malpractice claims secondary to these errors (22).

Key words
- Cognitive debiasing
- Malpractice
- Medical decision making
- Medical error
- Neurosurgery

Abbreviations and Acronyms
ACGME: Accreditation Council for Graduate Medical Education
CDR: Cognitive dispositions to respond
CT: Computed tomography
DPT: Dual process theory
ED: Emergency department
IOM: Institute of Medicine
MRI: Magnetic resonance imaging

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There are an increasing number of publications in the medical literature addressing cognitive errors in diagnosis and treatment; these are for the most part, however, absent in the neurosurgical literature. Books such as Daniel Kahneman's *Thinking, Fast and Slow* (28) and Jerome Groopman's *How Doctors Think* (23) have summarized the inherent weaknesses of human decision making and provided the public at large considerable insight into how vulnerable physicians are to making cognitive errors. The purpose of this article is to highlight the complexities of medical decision making to a neurosurgical audience, with the hope of providing insight into the biases that lead us towards error and strategies to overcome our innate cognitive deficiencies.

TYPES OF ERRORS

The 1999 IOM report defined *medical error* as "the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim" (22). Errors were then subdivided into 4 different categories: 1) diagnostic errors, including wrong diagnosis or delay in diagnosis, failure to use indicated tests, and failure to act on results of monitoring or testing; 2) treatment errors, including errors in the performance of an operation or test, error in administering the treatment, dose errors, and avoidable delays in treatment or in responding to an abnormal test; 3) prevention errors, including the failure to provide prophylactic treatment or monitoring follow-up of treatment; and 4) other errors, including failure of communication or system failures. For neurosurgeons, diagnostic and treatment failures represent the majority of preventable errors.

RESIDENT TRAINING AND MEDICAL ERRORS

Resident physicians are considered to be at high risk for making medical errors because of their relative inexperience, long duty hours, and large potential work burden. Medical school often times does not prepare resident physicians adequately for managing this complex interplay of patient, workplace, and individual variables. The Accreditation Council for Graduate Medical Education (ACGME) has recognized this vulnerability and mandated that first-year residents be supervised at all times in the 2011 physician duty hour regulations.

The detrimental effects of fatigue on resident cognitive ability, mood, and well-being are well documented in the medical literature (17, 24, 35, 40, 48, 57). Numerous simulator, retrospective reviews or fatigue studies have argued for a deleterious effect of sleep deprivation or fatigue on operative outcomes or performance testing (1, 7, 15, 16, 18, 21, 25, 29, 33, 43, 54). In a national survey before the 2011 ACGME duty hour restrictions, 6% of neurosurgical residents admitted to making a medical error that resulted in patient harm at the end of an extended shift (9). Surveys of residents as well as driving simulator studies of residents post-call have suggested an increased risk of motor vehicle collisions after extended shifts (2, 36, 51, 56). To make matters worse, residents are often unable to appreciate their own cognitive deterioration when they are fatigued (1, 43). Therefore, although there remains considerable argument over how the ACGME duty hour limitations have affected patient safety or resident competency, there is little argument that fatigue and sleep deprivation create an environment that puts residents at risk for making errors (35).

The ACGME has recognized the importance of teaching residents about sleep deprivation by mandating that all residents undergo annual sleep deprivation and fatigue training. However, most residents receive no training regarding the cognitive processes that underlie medical decision making, and most receive no education in recognizing the biases that distort their decisions. Studies do suggest that resident physicians have excellent insight into their previous medical errors and have the capability to reflect on the complex biases that lead them astray (41). Therefore, it stands to reason that graduate medical education could benefit immensely from the implementation of curricula that teach residents to identify cognitive biases, recognize the processes that underlie decision making, and reflect upon previous errors. Training such as this would appear to be especially important during the earliest, formative resident years, when new physicians are not only more inexperienced and more likely to make mistakes but are also establishing and solidifying the practices that will form the foundation for their future careers.

MITIGATING MEDICAL ERRORS AND MALPRACTICE CLAIMS

There are essentially 4 basic avenues for mitigating the risk of medical errors or litigation. The first strategy is to eliminate the opportunity for complications for a given procedure by no longer providing that service. In surveys, 40% of neurosurgeons (39) and physicians in high-risk specialties (53) have indicated that they had restricted their practice in the last 3 years by eliminating complication-prone procedures from their practice (53). Although protecting the physician from potential litigation secondary to negligence or errors associated with high-risk procedures, this strategy does nothing to augment the fundamental cognitive mistakes that may lead to the errors in the first place.

A second strategy for reducing the risk of errors and malpractice claims involves the practice of heightened defensive medicine. In a survey of neurosurgeons (39), approximately two-thirds of respondents reported ordering extra imaging examinations, laboratory studies, and consultations for defensive purposes. Other surveys encompassing physicians in high-risk specialties have suggested that this number is closer to 90%–95% of respondents (53). It is therefore not surprising that the annual incurred health care expenditures as the result of such defensive practices lies in the tens of billions of dollars (38). Besides increasing unnecessary cost, such practices also subject patients to potentially unnecessary blood draws, imaging tests, or even invasive diagnostic procedures.

A third strategy for reducing the risk of errors is to use select events to alter select behaviors. Reviewing patient misadventures in morbidity and mortality or peer review conferences would fall into this category. This approach, although potentially successful for reducing an index error, by definition requires that the physician make (or witness, in some manner) that index error first. This means that a patient had to be harmed first before the lesson can be learned. Often times these lessons are potent and long-lasting, and they certainly do play an important role in physician decision making. However, given that there are countless means by which patients can be harmed, and the significant variability among individual patients, procedural goals and approaches to care, this method is by no means an acceptable strategy for ubiquitously enhancing patient safety. Furthermore, studies suggest that many errors or patient safety events