

## Seeing Is Believing

*The good surgeon believes what he sees; the bad one sees what he believes.* Like so many adages, this one captures our common-sense notion of how surgery and surgeons work. Like many adages, it is not so much distilled truth as a placeholder for a whole set of complexities. How belief might be derived from seeing seems, at least at first glance, straightforward enough. But how is it that seeing can sometimes be constructed from belief? And how do these processes lead to surgical misadventures? How do we “see”?

In their article in this issue of *Annals of Surgery*, Way et al. present a careful analysis of a particularly troubling and persistent class of surgical misadventure: common bile duct injury during cholecystectomy. In doing so, they become embroiled in these questions. Their method of inquiry involves the detailed analysis of a corpus of cases containing a variety of information, including video recordings of some of the procedures. For their analysis, the authors have turned to research on human expert decision-making and cognition. They conclude that the evidence shows that such injuries arise because of specific features of human cognition, notably the way that recognition flows from the presence of subtle patterns and the way that decisions flow from heuristics.

Their central conclusion, that common duct injuries occur because of a visual illusion created during the process of dissection, depends critically on the review of video recordings from the surgical procedures. The videotape evidence allows Way et al. to dissect each moment and to share, vicariously, the experience of the operating surgeons. The videotapes of operations literally show the operators deliberately, intentionally cutting the common bile duct, believing that they were cutting the cystic duct. The surgeons believe what they see. But the appearance of the image on the television screen is deceiving. Only later, sometimes much later, does it become apparent that it was the common and not the cystic duct that was being cut. Then it becomes clear that the surgeon was seeing what he or she believed. The clarity at the moment of injury was a delusion.

A decade ago it became apparent that common duct injuries were related to inexperience with the then-new laparoscopic technique. The documentation of the relationship did not, however, produce a deeper understanding of *why* experience matters. Although it is clear that difficult cases are also at risk for injury, how this hard-to-characterize difficulty generates failure remains unclear. Operator experience and technical “difficulty” are correlated with but are not causes of injury. What Way et al. are proposing goes beyond searching for correlation towards a deeper understanding of the injury mechanism: in this case they conclude that there is a cognitive mechanism of injury.

The modern search for cognitive mechanisms of injury can be traced back to the 1960s and 1970s, when it became clear that recognition and decision-making processes are susceptible to induced failure, at least in laboratory settings. Cognition seemed to rely on fallible rules of thumb called *heuristics*, and this reliance implied that human cognition was inherently unreliable and intrinsically flawed. Closer examination of real-world disasters demonstrated that the relationship between expertise and accidents was more complex than simple reliance on rules of thumb. The nuclear reactor meltdown at Three Mile Island was a watershed experience that led to the golden decade—roughly between 1980 and 1990—of research on cognition and error. Several productive themes arose from this research. One is that human work calls on a variety of cognitive abilities and that these are closely matched to the demands of the real world. Examination of the sorts of complex, real-world settings in which cognition is actually applied (i.e., study of “cognition in the wild”<sup>1</sup>) produced a field now known as *naturalistic decision-making*. Klein’s book<sup>2</sup> is a good starting place for surgeons interested in this area. Another theme is that safety is a dynamic rather than static characteristic of complex systems. Accidents are normal occurrences<sup>3</sup> in such systems and serve to point to the fragility and hazard that exist in the world rather than to the frailty of human cognition *per se*. Across healthcare, researchers are coming to grips with the implications of this collected work as they seek to devise methods to improve patient safety. Early experiences have been revealing. Efforts to improve safety by a direct assault on error have been unsuccessful. Instead, it is becoming clear that progress requires substantial, long-term effort directed at supporting human performance rather than trying to prevent its failure.<sup>4</sup>

A particular difficulty with accident analysis is hindsight bias, which contributes to both our sense that these injuries

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Correspondence: Richard I. Cook, MD, 5841 S. Maryland Ave., MC4028, Chicago, IL 60637.

E-mail: [ri-cook@uchicago.edu](mailto:ri-cook@uchicago.edu)

were preventable and our view of what how prevention might be achieved. The cognition of researchers is every bit as dependent on heuristics and recognition as that of the practitioners they study. Hindsight bias<sup>5</sup> changes our present view of what others should have seen in the past. Outcome knowledge poisons our postaccident judgments.<sup>6</sup> The appearance of a past seemingly amenable to other outcomes is at least as much an artifact of our own cognition as it is of the characteristics of the past. Way et al.'s data suggest that there may be subtle clues (e.g. the presence of more lymphatics around the common duct) that might lead to detection of incipient failure. On this basis they encourage the surgical community to pursue safety through more liberal use of cholangiography and increased vigilance. Are these suggestions likely to bear fruit? Perhaps, although it appears that the strength of the illusion they identify was not overcome by intraoperative cholangiography, and the procedure has its own complications. We should also be alert to the ways in which hindsight bias plays into emphasis on vigilance. Efforts to establish a lower threshold for instituting various countermeasures often underestimate the uncertainty that permeates healthcare work. Experience in other domains suggests that the attraction of such countermeasures is itself a kind of illusion: there is a real danger here of seeing what we believe.

How, then, can we produce progress? The work of Carthey, de Leval, and Reason<sup>7-9</sup> provides one model. Prompted by a series of arterial switch operation accidents in Britain, Carthey and Reason, psychology researchers, and de Leval, a cardiac surgeon, conducted what must be the largest, deep observational study of any surgical procedure. They identified not only the elements of failure but also the factors critical to success. The results of that study invite those interested in patient safety to undertake a determined search for a research-based understanding of the sources of success.<sup>4</sup> Way et al.'s work encourages the search for similar sources of insight in laparoscopic cholecystectomy. We want to know about the sources of power<sup>2</sup> that routinely lead to this complication being prevented. There are several hints about what we may find.<sup>10</sup> In an important study of laparoscopic cholecystectomy, Dominguez<sup>11,12</sup> characterized a "field of safe travel" as part of surgical cognition. There is work on laparoscopy beginning at several academic centers in the United States and elsewhere.<sup>13</sup> Significantly, all of the productive past and present work comes from long, intimate collaborations between human performance experts and practitioners.

Way et al. have assembled a complex collection of evidence, and their analysis plays off the strengths and weaknesses of its parts. Their approach is sensitive to the subtleties of surgery and disease in ways that are difficult or impossible to achieve using large incident databases. The complexity of the processes of surgery is not represented in such systems; they can provide little of the kinds of insights needed to make progress on safety.<sup>14</sup> It is likely that na-

tional, mandatory incident reporting systems will come online in the next few years. Making sense of the output of these systems depends critically on having already in place a deep understanding of the nature of failure and success. Generating that deep understanding will require new tools and, more importantly, sustained collaborations between surgeons and human performance researchers.

We may anticipate lively debates over whether Way et al. have studied good surgeons who believed what they saw or bad ones who saw what they believed, but such debates are ultimately unproductive and diversionary. Progress does not arise from debates about prowess but from research that demonstrates how seeing works, how belief is constructed and sustained, and how recognition works in laparoscopy and elsewhere. Those projects are the future of patient safety in surgery. For now, it is enough that these authors have shown that seeing is believing.

Richard I. Cook, MD  
*Cognitive technologies Laboratory*  
*University of Chicago*  
*Chicago, Illinois*

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