



Your Patient's Brain

Physical Exercise Prehabilitation and Postoperative Brain Health

Miles Berger, MD, PhD

Daniel J. Cole, MD, FASA

“It is exercise alone that supports the spirits, and keeps the mind in vigor.” The great Roman statesman and orator Cicero (106 BC-43 BC) uttered these timeless words over two millennia ago, words that remain relevant today for anesthesiologists concerned about our older patients' brain health following anesthesia and surgery. Today, modern biology can explain the molecular and cellular mechanisms by which physical exercise benefits the brain – increases in trophic factors that support neuronal health, the birth of new neurons (i.e., neurogenesis), altered connectivity within specific brain networks, etc. Further, we now know that physical exercise provides highly specific mental benefits such as reduction in anxiety, depression, and stress and prevention of age-related memory loss. Partly for these reasons, in addition to the well-known benefits of physical exercise on cardiovascular health, current guidelines call for older adults to get 30 minutes of moderate intensity aerobic exercise at least five times per week or at least 60-75 minutes per week of vigorous intensity aerobic exercise (*Circulation* 2007;116:1094-105; *JAMA* 2018;320:2020-8).

All of this is well-accepted scientific consensus. In perioperative medicine, it is also quite clear that patients in better physical health generally tend to have better postoperative physical outcomes. Yet it is less clear whether higher preoperative physical fitness is associated with better postoperative brain health, especially in older patients who are at highest risk of perioperative neurocognitive disorders such as delirium. Frail, older surgical patients are at higher risk of postoperative delirium than age matched non-frail surgical patients (*Anesthesiology* 2020;133:1184-91), though it is unclear whether improving physical fitness (and/or reducing frailty) via “prehabilitation” will reduce postoperative delirium.

There are intuitive reasons to think that “prehabilitation” should reduce postoperative delirium and other perioperative neurocognitive disorders. Prehabilitation exercise reduces neuroinflammation, a mechanism theorized to play a role in causing perioperative



neurocognitive disorders in mouse models (*J Neuroinflammation* 2013;10:114). However, before we can conclude that “prescribing” physical exercise prehabilitation to older adults would improve their brain health following surgery, we must consider a major difference between mice and humans. Aside from differences in size and other obvious attributes, there is a fundamental behavioral difference between humans and mice. Mice will voluntarily exercise for hours per day when given the opportunity to do so (i.e., when given running wheels), yet simply providing exercise opportunities has been largely unsuccessful in inducing the majority of humans to exercise for multiple hours per day. Indeed, in the perioperative setting, several studies have found that many patients did not complete their “prescribed” prehabilitation physical exercise.

Thus, in thinking about and studying the potential benefits of physical exercise prehabilitation for improving brain health and reducing perioperative neurocognitive disorders in older adults, it is important to keep in mind the difference between efficacy versus effectiveness. Efficacy is the effect of an intervention under ideal circumstances, such as the effect of exercise prehabilitation on perioperative neurocognitive disorders in a group of highly motivated patients who fully complete their “prescribed” exercise. In contrast, effectiveness is the effect of an intervention under real-world conditions, such as the effect of a prehabilitation exercise intervention on delirium among patients who may not complete the “prescribed” prehabilitation exercise.

This discussion may make some anesthesiologists uncomfortable because it

covers an intervention (prehabilitation exercise) whose real-world effectiveness for reducing the risk of perioperative neurocognitive disorders will likely depend on patient adherence. Adherence is a concept often taught in medical school, and describes the extent to which patients correctly follow medical advice. Yet adherence is a concept foreign to many anesthesiologists. In operating room anesthesiology practice, at least, we do not depend on patients to take the medications we prescribe. Rather, we typically administer anesthetic drugs intravenously or in the very air we give our patients to breathe. Many of us likely went into anesthesiology partly because we enjoy watching the real-time physiologic and neurologic effects of medications that we administer to patients ourselves; although operating room anesthesiology has its stresses and challenges at times, patient adherence is not one of them.

Further, counselling patients about behavior change is not something in which we anesthesiologists are typically well-versed, and it is not a topic we typically teach or spend much time on with our residents and fellows. Rather, health behavioral change is typically the domain of primary care doctors, health psychologists, and perhaps cardiologists (when advocating for physical exercise for cardiovascular fitness). Thus, even though as the “physiologists” of medicine, we as anesthesiologists are in prime position to appreciate the physiologic effects that we see in the OR among physically fit patients, we are perhaps not ideally positioned to facilitate behavioral change (i.e., promoting adherence to physical exercise prehabilitation) among our patients before surgery. Rather, we believe that anesthesiologists should work together with other members of the perioperative care team in encouraging our patients to follow age-related physical activity guidelines and to do “prehabilitation” exercise before surgery. Indeed, this focus on working together with multidisciplinary teams to optimize perioperative brain health for our older patients is a major theme of the ASA Brain Health Initiative.

While we do not have clear evidence from clinical trials that prehabilitation exercise reduces perioperative neuro-



Miles Berger, MD, PhD

Associate Professor, Duke Anesthesiology Department, Neuroanesthesiology Division, Senior Fellow, Center for the Study of Aging & Human Development, Duke University Medical Center, Durham, North Carolina.



Daniel J. Cole, MD, FASA

Professor of Clinical Anesthesiology, Department of Anesthesiology and Perioperative Medicine, David Geffen School of Medicine, University of California, Los Angeles.

cognitive disorders in older patients, we know from a substantial body of scientific evidence that physical exercise “supports the spirits, and keeps the mind in vigor,” as Cicero wrote. From this perspective, even without knowing whether increased physical exercise prehabilitation will reduce postoperative delirium, we already have more than enough evidence to recommend it more generally for both the minds and bodies of our older patients.

Finally, encouraging interventions such as physical exercise prehabilitation in our preoperative screening clinics is just one way that we as anesthesiologists can help improve health care value and promote perioperative brain health. Additionally, promoting proper nutrition, smoking cessation, and proper management of diabetes and hypertension in our preoperative screening clinics are further ways that we can help improve perioperative brain health for our older patients. If we are able to help patients begin to make meaningful change in these domains of their own behavioral health and chronic illness management, a few additional minutes spent discussing these items in preoperative screening visits may well provide much longer lasting brain health benefits. In this sense, our ability as anesthesiologists to “support the spirits and keep the mind in vigor” for our older surgical patients may come to depend as much if not more on these prehabilitation interventions than on the exact drugs and doses we administer to patients in the OR. ■