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EDITORIAL

Is It Time for New Target Volumes in Radiation Oncology?

David Palma, MD, PhD

Division of Radiation Oncology, London Health Sciences Centre, London, Ontario, Canada

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Practice makes perfect. Whether in sports, music, or medicine, deliberate practice is required to achieve mastery in a given field. Author Malcolm Gladwell popularized this phenomenon, calling it the *10,000 hour rule*, with the implication that roughly 20 hours per week of practice over 10 years is needed to reach an elite level of performance (1). Others have debated the exact number of hours required and the relative contributions of practice versus innate skills, but the overarching premise is well-established: repeated practice, with appropriate motivation, effort, and feedback, leads to improvements in performance (2).

This rule of "practice makes perfect" is recognized in many branches of medicine, perhaps most in the surgical literature. For many types of surgeries, patient outcomes are strongly related to surgical volumes (defined as the number of times per year that a given surgeon undertakes a specific operation) and hospital volumes (the number of times that the procedure is done at a specific hospital) (3). For example, for patients undergoing esophagectomy, a seminal US publication in 2003 reported a mortality rate of 8% for high-volume surgeons at high-volume hospitals, increasing to 22% for low-volume surgeons at low-volume hospitals (4). Similar compelling data exist for other types of operations (3) and have led some jurisdictions to centralize high-risk surgeries at high-volume centers.

Do the same volume–outcome relationships hold in radiation oncology? Emerging evidence suggests that they do. Prostate brachytherapy is perhaps the radiation oncology procedure most analogous to surgery. In a Surveillance, Epidemiology, and End Results Program–Medicare analysis examining outcomes for more than 5000 men undergoing prostate brachytherapy, for every 100 additional brachytherapy cases that the treating radiation oncologist had performed over a 10-year period, the risk of recurrence fell by 11%, and the risk of prostate cancer death fell by 20% (5). In head and neck cancer, a similarly sized study using Medicare claims found that in patients undergoing intensity modulated radiation therapy (IMRT), the risk of death fell by 21% for every 5 additional patients treated by their provider per year, a relationship not seen in patients treated with 2- or 3-dimensional radiation techniques (6). This finding suggests that the complex nature of IMRT, with its greater dependence on target delineation and quality assurance, plays a role.

Moving beyond the level of the individual radiation oncologist's experience, researchers have also examined the relationship between institutional patient volumes and outcomes. One approach has been to use large databases, such as the National Cancer Database, to obtain actual institutional case volumes and relate them to outcomes. For example, for high-risk prostate cancer (7) and stage I and III non-small cell lung cancer (NSCLC) (8, 9), National Cancer Database data suggest that patients have inferior outcomes at low-volume centers. A second approach has been to undertake secondary analyses of previously collected clinical trial data to examine outcomes based on institutional accrual volumes. In one example, in a secondary analysis of Radiation Therapy Oncology Group trial 0129, patients with head and neck cancer treated at historically low-volume centers were more likely to have radiation therapy protocol deviations (18% vs. 6% at

Reprint requests to: David Palma, MD, PhD, Division of Radiation Oncology, London Health Sciences Centre, 790 Commissioners Rd E, London, ON N6A 4L6, Canada. Tel: (519) 685-8500, ext. 53347; E-mail: David.palma@lhsc.on.ca

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historically high-volume centers), had higher rates of locoregional failure at 5 years (36% vs 21%, respectively) and inferior 5-year overall survival (51% vs 69%, respectively) (10). The authors estimated that protocol noncompliance only explained approximately 21% of the observed relationship between volumes and overall survival, suggesting that other factors at high-volume centers play a role, besides merely adhering to treatment protocols. A secondary analysis of Radiation Therapy Oncology Group trial 0617 reported similar findings in the setting of stage III NSCLC (11).

Adding to this emerging body of data, the article in this issue by Rieber et al (12) assesses the influence of institutional experience and technological advances on outcomes for patients undergoing stereotactic body radiation therapy (SBRT) for oligometastatic lung lesions. The authors analyzed a database of 700 patients treated at 20 centers in Germany, and should be commended for assembling such a valuable research tool, a process that can be time-consuming and susceptible to multiple administrative roadblocks. Stereotactic body radiation therapy is known to be an effective modality for establishing local control for lung lesions, but the large ablative doses carry a risk of harm, particularly when treating targets near critical organs. Deficiencies in SBRT contouring or planning have been associated with serious toxicities (13, 14).

Rieber et al evaluated several metrics of center experience and found that many of these were strongly associated with local control. The best-associated metric was the number of SBRT cases completed in the last 2 years. Receiver operating characteristic curve analysis identified a cut-off of 4 cases within the past 2 years to best distinguish between high-volume and low-volume centers. When dichotomizing outcomes based on that cut-off, 3-year local control rates differed by approximately 30%, favoring the high-volume centers. The authors did not detect a significant relationship between SBRT experience and overall survival, a relationship that had been demonstrated in a previous study in the setting of early-stage lung cancer (8). These disparate findings may be attributable to the fact that for oligometastases, whether SBRT influences overall survival at all is still a matter of open debate (15).

These data alone do not prove a relationship between institutional volumes and outcomes in the setting of SBRT, but they add to the evidence base suggesting that provider and hospital volumes are important in radiation oncology. Certainly a causal relationship is plausible. Generating randomized evidence to prove these relationships would be difficult, and such trials were not required to implement centralization for many types of cancer surgeries.

The volume–outcome relationships in surgery, radiation oncology, and other areas of medicine likely go beyond the simple factor of sheer patient numbers alone. Patient volume may be a surrogate for other factors, including proficiencies that develop in preventing and addressing complications, and perhaps better infrastructure and resources that may be present at larger centers, including access to additional subspecialty care if complications arise. However, high patient numbers do not guarantee high levels of proficiency—repeating an incorrect practice again and again will not lead to improvements. The term "deliberate practice," the underpinning of the *10,000 hour rule*, includes feedback, time for problem-solving and evaluation, and the opportunity to refine behavior (2). These can be provided by collecting local data on treatment and outcomes, undertaking peer review of treatment plans, pursuing continuing medical education, and implementing new learnings in clinical practice.

As a specialty, we must consider a new type of target volume: minimum recommended provider and hospital volumes to help ensure proficiency, as exist for some surgical procedures. In surgery, many of the strongest volume–outcome relationships are seen in high-risk surgeries that are infrequently performed, such as esophagectomy. It follows that in our specialty, complex treatments (eg, head and neck IMRT) might be more susceptible to the influence of patient volumes than simpler treatments (eg, breast tangents). The process of developing new patient target volumes should include research to determine the scenarios in which these patient volumes are most important.

In the interim, radiation oncology departments and individual radiation oncologists should be cognizant of a potential risk associated with low-volume treatments. As individual doctors, when faced with a situation in which we ourselves are the low-volume provider, we should seek out appropriate mentorship and consider referral to a high-volume provider as the situation warrants.

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