Perioperative mortality

DAVID E. CHINCHILLA, M.D., E. ANTONIO CHOCCA, M.D., PH.D.

Department of Neurosurgery, Ohio State University Medical Center, Columbus, Ohio

Naturally, the risk of death related to surgery is one of the foremost concerns of patients and their families prior to undergoing surgery. It is the most devastating complication a patient could suffer after undergoing a potentially diagnostic, palliative, or curative procedure. Not only is perioperative survival an oft-cited success of surgery, surgical mortality in craniotomy is an Inpatient Quality Indicator according to the US Agency for Healthcare Research and Quality. Without a doubt, the pressure for improved data collection and reporting will affect the measure of quality for institutions and individual practitioners alike. The evolution of surgical techniques, preoperative evaluation, neuroanesthesia, and postoperative care are a few of the variables that have been believed to benefit patient survival. However, there are few long-term, population-based data that document this success.

In this issue of the Journal of Neurosurgery, Solheim et al. provide an eloquent exposition of 30-day mortality after primary brain tumor surgery using a Norwegian national databank covering a 53-year period and including 15,918 relevant patients. Norway has a socialized health care system, which has utilized the Cancer Registry of Norway since 1952. There are 4 institutions that offer cranial neurosurgical procedures for the entire Norwegian population, approximately 4.7 million persons. Using this registry, the authors provide invaluable data regarding surgery for primary brain tumors. They found a significant improvement in 30-day mortality over time, with a 7.6% risk prior to 1980 and a 2.1% risk after 2000. Additionally, patients 70 years or older were found to have a 5.7% risk of perioperative mortality, whereas younger patients demonstrated a 2.9% overall risk. Surgical mortality was significantly higher in patients with high-grade lesions and in those undergoing biopsy as opposed to craniotomy and resection. The authors found significantly lower mortality in patients treated at the center with the highest operative volume; however, when adjusted for identified independent risk factors of increased mortality, regional differences were no longer significant.

This population-based review is similar to a recent publication, which also explored perioperative mortality rate and associated risk factors of a subpopulation of Norway during a 5-year period, 2003–2008. Solheim et al. found almost identical rates of perioperative mortality and similar risk factors (that is, increased age and biopsy as the primary procedure). This current review is more informative to practitioners in two regards. First, this study demonstrates a significant improvement in 30-day survival for patients undergoing a primary cranial procedure for a neoplastic process. This is demonstrated at a national level with over 50 years of data, in which all such procedures in Norway are believed to be captured. Although no single factor (that is, improved surgical technique, patient selection, neuroanesthesia, or perioperative management) can account for this change, this documented success is a powerful statement that practitioners in neurosurgery have allowed and encouraged improvements to the practice to enhance patient care. Second, the study demonstrates no survival benefit between institutions of varied operative volumes, after adjustment for known risk factors. One institution in Norway serves an estimated 54% of the population, with the rest of the population receiving regional care from 3 centers. Although Solheim et al. published similar evidence for outcomes in children undergoing primary cranial procedures for tumor, this finding is in stark contrast to results in a series of publications by Barker et al., which have consistently demonstrated a linear relationship between the mean number of cases of an institution and patient outcome (in-house mortality and discharge to home). The inability to show a case volume to patient outcome relationship may suggest improved standardization of patient care across all institution types in the Norwegian practice of neurosurgery.

This study is not without limitations. Details regarding causes of perioperative death are not clearly defined in many cases. The authors address this limitation as an inherent issue of the data reporting. Death certificates, the document used to determine the cause of death, have limited information and cannot account for multifactorial causes. In addition, reporting of surgical complications by the treating physicians may not always be recorded accurately. Unfortunately, this limitation does not allow further analysis of the data to identify significant preventable causes of death. The second glaring limitation of the study is its inability to generalize to neurosurgical practice in other regions of the world. Norway has the significant benefit of training neurosurgeons for primary cranial tumor surgery at just 4 centers. Many other countries or regions lack similar training facilities and experienced surgeons.
regions around the world have many more training institutions and even more centers that perform cranial surgery for tumors. Residency training, patient selection, surgical technique, perioperative management, and institution resources are just a few variables that make these results difficult to translate to all practices and centers.

The authors should be commended for their contribution to our field. As it should be, perioperative mortality provides a definitive benchmark by which physicians and centers can gauge their overall success or failure. With improved reporting and large-population data such as these, not only will new standards in practice be made, but patients will also be more accurately informed about the cranial procedures they will be undergoing. (http://thejns.org/doi/abs/10.3171/2011.10.JNS111719)

Disclosure

The authors report no conflict of interest.

References


Response

OLE SOLHEIM, M.D., PH.D.,1,2 ASGEE STORE JAKOLA, M.D.,1,2 SASA GULATI, M.D.,1 AND TOM BORGE JOHANNESEN, M.D., PH.D.3

1Department of Neurosurgery, St. Olavs University Hospital; 2Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim; and 3Norwegian Cancer Registry, Oslo, Norway

Thank you very much for the thorough and important editorial comments on our article. We appreciate that this issue is being addressed.

We nevertheless question the belief that “perioperative mortality provides a definitive benchmark by which physicians and centers can gauge their overall success or failure.” Comparisons based on unadjusted surgical mortality rates postcraniotomy have a high risk of misleading and seem equivalent to rating different interventions based on observational studies with completely different inclusion and exclusion criteria. We certainly agree that dying is the worst possible surgical result and find it reassuring that perioperative mortality rates seem to have improved over the last few decades. In our study, however, even on a national level, improvement was not statistically significant over the last 20 years despite major advances in perioperative care, imaging, neuronavigation, and surveillance in the same time frame. This underscores the insensitivity of this measure in reflecting quality of care and also shows the low statistical power in comparative analyses with such an infrequent measure, even with pooled data from several centers over long time periods. Our findings also indicate that surgical mortality rates after brain tumor operations reflect who is treated more than how. This is a major threat to the validity of this outcome measure, since there is no universal agreement on the optimal management for many brain tumor entities. In the modern era of neuroimaging, incidental and asymptomatic brain lesions are frequently diagnosed, but the clinical management may vary. For lower-grade lesions and many benign lesions there are still controversies between a conservative wait-and-scan policy and direct resection. Moreover, biopsy alone is offered in 10%–50% of high-grade glioma cases, and a variable percentage are not even histopathologically diagnosed.
Both referral and local treatment traditions will therefore profoundly affect surgical mortality rates postcraniotomy if they are not adjusted for. Even though some neurosurgical studies attempt to adjust for differences in referral, the differences in surgical strategies or treatment indications are never accounted for. In Norway, smaller neurosurgical centers were more willing to offer surgery to patients with poor prognoses. If this is true elsewhere as well, it may have implications for the interpretation of the perceived volume-outcome relationship for craniotomies. The editorial suggests that neurosurgery in Norway may be special. Organization in Norway is presumably quite similar to that in other developed countries with a socialized health care system. Still, we agree that findings can be difficult to generalize. In fact, a recent extensive systematic review revealed such large variations in findings that the authors concluded that the “heterogeneity of results from individual studies calls into question the validity of case volume as a proxy for care quality.” However, since there are now excellent cancer registries in many countries, our findings should be validated elsewhere.

There are now 10 publications that specifically address the effect of provider volumes in various neurosurgical tumor operations. Eight articles are based on US administrative claims data and utilize in-house mortality as the main outcome. As we pointed out earlier, there is no disease-related risk adjustment in these publications, presumably because of the limitations in the data. National Surgical Quality Improvement Program (NSQIP) studies have also “underscored the major limitations of claims data and administrative databases in the provision of adequate risk-adjustment models that are crucial for volume-outcome studies.” Authors of a recent study based on Medicare data concluded that “for a small number of surgical procedures associated with particularly strong direct volume-outcome relationships, such as pancreatectomy and esophagectomy, referral to high-volume centers should continue to be encouraged. For most high-risk procedures, however, strategies such as operating room checklists, outcomes measurement and feedback programs, and collaborative quality improvement initiatives are likely to be more effective than volume-based referral.” Thus, for many procedures, the local systems for quality of care seem to have greater importance than case loads, even though a statistical association between unadjusted surgical mortality rates and treatment volumes may be found.

How could we more accurately measure quality of care? Adjustment for disease-related risk factors seems a necessity for valid comparisons of surgical mortality after craniotomies. The severity of the intracranial disease could still be difficult to control for since there are no accepted staging criteria for CNS tumors equivalent to the TNM system (tumor size, lymph nodes affected, metastases) for primary cancers outside the CNS. However, classification systems that allow for a better adjustment of disease-related factors could be developed for intracranial tumors. But even if short-term survival is easy to measure, overall or longer term survival is probably a much better gauge for quality of care as it also reflects the quality in today’s multimodal treatment and follow-up regime. Superior surgical technique or excellent neuroanesthesia may not even help if indications are questionable, follow-up is poor, adjuvant treatment protocols are not followed, and cooperation with other treating health professionals is dysfunctional. The focus on mortality could also be extended to patient-related outcomes, as reflected by their functional status and quality of life. New deficits after surgery are associated with inferior survival. Systematic and standardized measurements of adverse events should further be encouraged and could be included in patient registries. In the future, automatic segmentation software might also allow for automatic measurements of lesion volumes and resection grades and quantify surgically induced circulatory changes or infarctions based on routine pre- and postoperative MR images.

In conclusion, surgical deaths used to be common after brain tumor operations and an important gauge of quality of care, much like the cracked-pot sound that was once an important clinical sign for diagnosing hydrocephalus. Today, these measures are simply too insensitive, nonspecific, and infrequent to be of much use, at least for comparative studies.

References


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