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Safety of closed brain biopsy: population-based studies weigh in

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Perspective

Data describing the safety of stereotactic brain biopsy have been reported largely through single institution retrospective analyses that encompass the experience of one or a few surgeons. Rates of procedure-related morbidity, depending on the definition used have range from 0 to 12%, and most commonly relate to intracranial hemorrhage, edema or seizure. Reported mortality rates are typically less than 2% and are usually the consequence of severe biopsy-related hemorrhage.[4] Recognized risk factors associated with an increased rate of complications include deep-seated lesions and a pathological diagnosis of a highly vascular neoplasm such as glioblastoma multiforme (GBM) or lymphoma.[3,5] Other possible risk factors, such as patient age, functional status, number of biopsy specimens taken and lesion size have been identified in some series and not others as factors associated with postoperative morbidity and mortality.[2,6]

On the basis of these data, stereotactic brain biopsy is generally accepted as a safe diagnostic procedure that can be critical in guiding treatment decisions, especially when a lesion is not considered amenable to excision or patient medical risk factors for undergoing craniotomy are significant. Furthermore, the probability of making an accurate diagnosis via stereotactic needle biopsy is expected to be high, ranging between 80 and 99%.[4] Nevertheless, additional information that more precisely defines the morbidity and mortality of brain biopsy is critical to better inform patients of potential risks, and to better understand mechanisms to enhance the safety and effectiveness of this widely used procedure in the future.

Recently, studies conducted on data from national hospital discharge databases have provided a complementary evaluation of brain biopsy outcome. By including data from institutions performing relatively low annual volumes of biopsies, an advantage of the current study design is that biases attributable to practice patterns specific to referral centers or surgeons can be exposed, allowing a more accurate picture to be painted of expected outcomes across a wide variety of clinical settings. However, a potential pitfall is that valid interpretations of identified statistical associations are made more difficult by the inability to access contextual patient information from charts. For example, it is often not possible to determine reliably whether a death or complication resulted directly from a specified intervention of interest.

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In an analysis of 38,028 hospital admissions in which biopsy or resection of a supratentorial lesion was performed, Barker et al. found an in-hospital mortality rate of 2.5% among the 20% of admissions during which brain biopsy occurred.[1] This result was somewhat higher than results reported in single institution studies, reflecting the fact that the mortality rate at high volume hospitals (12 or more admissions per year) was significantly lower than the rate at low volume hospitals (1 or 2 admissions per year). This volume-outcome effect held true within patient subgroups divided by race, insurance type, urgency of treatment and number of medical co-morbidities. Furthermore, higher hospital caseload was independently predictive of better outcomes in multivariate analyses.

Barker et al. also found, however, that the same variables of age, race, insurance type, urgency of treatment and number of medical co-morbidities, were also predictive of better outcomes in multivariate analyses, although this finding was specific to the study population as a whole, and not necessarily to the needle biopsy subgroup. Because patients receiving treatment at high volume centers were more likely to be younger, healthier, white and have private insurance, outcomes at these centers are significantly influenced both by the volume-outcome effect and patient selection bias. Thus, population-based studies can corroborate the existence of important limitations in the generalizability of results from single institution retrospective analyses. Care must still be taken, however, in drawing any causal inferences between putative risk factors and outcomes, as data are retrospectively collected.

In this issue, Johnson et al. report on their analysis of 3523 inpatient admissions requiring closed brain biopsy, providing the largest population-based series of brain biopsy patients to date. Data were gathered from a statewide database of hospital discharges encompassing the period from 2003 to 2009. Their most notable finding is the overall in-hospital mortality rate of 3.5%, which is greater than both the average rate of 0.7% obtained from combining single institution series and the rate of 2.5% reported by Barker et al. The poorer mortality rate compared to single institution studies is perhaps unsurprising due to volume-outcome effects, patient selection and the capture of non-procedure related deaths as discussed above. However, the disparity between Johnson et al. and Barker et al. is interesting, particularly in light of the finding of Barker et al. that there was a downward trend in mortality rate over time, from 3% in 1988 to 1.5% in 2000, with increasing centralization of specialized care.

In terms of methodology, the two studies are similar except for the inclusion or exclusion of patients transferred from other hospitals or skilled nursing facilities requiring biopsy. This group represented 9% of the admissions included in Barker et al., and was excluded from Johnson et al. in an attempt to provide a more representative picture of ambulatory clinical practice. The number of patients excluded is not provided, though. Although the authors suggest that this relatively sick group of patients would increase their observed mortality rate even further, the number of excluded patients could be large enough to account for a substantial proportion of the discrepancy in rates in the two studies and is worth detailed investigation.

Among the non-transfer admissions in Barker et al., 77% were routine admissions and 23% were through an emergency department. In Johnson et al., admission source is not specified in the same way. However, 47% of admissions were scheduled with the hospital at least 24 hours in advance, while the remaining 53% were “unplanned”. It is noteworthy that planned admissions requiring needle biopsy had a mortality rate of 1.3%, compared to 5.4% for unplanned admissions. If the reasonable assumption is made that planned admissions equate to routine admissions in these two studies, urgent or emergency admissions in which a brain biopsy was performed appear to be relatively over-represented in Johnson et al., which could be a major factor contributing to the higher mortality rate.

Other differences in study population characteristics may exist that could also account for the higher rates of mortality in Johnson et al. For example, the race of more than 30% of patients in both studies could not be identified due to protections for patient privacy. As well, Medicaid funded 12.7% of hospital admissions in Johnson et al., while this was true for only 6% of admissions in Barker et al. Overall, explanations for these study population differences are unclear, but could relate to systematic differences in data handling in the hospital discharge databases, or perhaps true differences in patient demographics or healthcare provision patterns between the state of California and the United States as a whole.

Population-based studies of mortality and morbidity rates for brain biopsy complement and expand data from retrospective analyses. Population-based studies provide important insights into the complex interplay between clinical setting and health outcomes, which may be invaluable for healthcare policy decision-making and resource management. For the neurosurgeon who is faced with the daily task of counseling patients about the risks and benefits of a proposed procedure, personal experience, institution-specific data and population-based studies are all vital sources of evidence that should not be underutilized.

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