

Stereotactic Brain Biopsy or Bronchoscopic/Transthoracic Needle Biopsy for Diagnosis of Metastatic Cancer Presenting Simultaneously in Lung and Brain: A Comparison of Safety and Efficacy

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Abstract

Background: When patients present with simultaneous lung and brain lesions consistent with metastases, it is often presumed that it is safer and less invasive to biopsy the lung lesion. **Objective:** To determine whether lung biopsy or stereotactic brain biopsy has a higher diagnostic yield and lower morbidity for tissue diagnosis in patients with simultaneous brain and lung lesions. **Methods:** Retrospective review of the author's stereotactic biopsy series and of the literature on brain and lung biopsies for suspected malignancy. **Results:** The overall diagnostic yield for bronchoscopic lung biopsy ranged from 44% to 88% and the pneumothorax rate from 1.2% to 8%. No deaths were reported. The overall diagnostic yield for transthoracic lung biopsy ranged from 74% to 96% and pneumothorax rate from 2.2% to 8%. No deaths were reported. The overall diagnostic yield for stereotactic brain biopsy ranged from 90.6% to 99.3% when all potential diagnoses are included. Complication rates ranged from 0.6% to 4.8% with mortality from 0% to 1.5%. Several series reported no mortality. **Conclusion:** Stereotactic brain biopsy has a higher diagnostic yield and a lower complication rate, but a higher mortality. The inclusion of diagnoses other than metastases in the reported series may account for some of the reported mortality. When lung and brain lesions are detected simultaneously, stereotactic biopsy is a better option for tissue diagnosis.

Keywords: stereotactic biopsy, metastasis to brain, lung biopsy

1. Introduction

Metastasis to brain is often the first presentation of lung and other malignancies. Once the brain lesion(s) is detected, a search for the primary usually ensues. Computed tomography (CT) of the chest, abdomen, and pelvis is often the next diagnostic test. If a lesion(s) is detected in the lung, then bronchoscopic or transthoracic biopsy is usually attempted to establish a tissue diagnosis and to plan subsequent treatment (Dasgupta & Mehta, 1999). The presumption has been that this is safer and easier than a biopsy of the brain lesion. However, the safety of stereotactic needle biopsy of brain lesions is now well established. The incision required is small and discomfort is minimal; no hair need be shaved (Sheinberg & Ross, 1999); and some studies report that this can safely be done as an outpatient (Bhardwaj & Bernstein, 2002; Kaakaji et al., 2001).

2. Method

The author reviewed his neurosurgical practice (Michigan and Oregon, USA) stereotactic biopsy series for malignant tumors of the brain and conducted a Medline literature search to compare the safety and efficacy of stereotactic biopsy with the reported safety and efficacy of bronchoscopic and transthoracic lung biopsy. The goal was to learn which is actually the safer and higher yielding procedure.

3. Results

From 1989 to 2009, the author conducted 161 (78 female/83 male; mean age 51.5 years) framed based or frameless stereotactic brain biopsies for malignant tumors of the brain. One hundred and forty-seven were for gliomas (106), central nervous system lymphomas (31), or pineal tumors and other rare primary central nervous system pathologies (10). Fourteen were for the tissue diagnosis of metastases to the brain. During this same time period, 150 resective procedures were performed for brain metastases. Three procedures (1.9%), two for suspected glioma and one for primary central nervous system lymphoma were initially nondiagnostic and had to be repeated, following which one remained nondiagnostic (0.6%). There was a single complication of a minor

intraventricular hemorrhage following biopsy of a glioblastoma in the genu of the corpus callosum which resolved without surgery or new neurologic deficit, but prolonged the hospitalization (0.6%). There were no new neurological deficits, no infections, and no deaths.

4. Discussion

4.1 Bronchoscopic Biopsy

There are variations in how diagnostic bronchoscopic biopsy is performed and reasons for selecting this technique over transthoracic needle biopsy. For a review of this topic, see Yung (2003). In one study, the diagnostic yield of transbronchial lung biopsy with fluoroscopic guidance was reported to be 43.8% with an incidence of pneumothorax of 1.2% (Rittirak & Sompradeekul, 2007). When endobronchial ultrasound, electromagnetic navigation, or both were used without fluoroscopy, diagnostic yields of 69%, 59%, or 88% have been reported (Eberhardt, Anantham, Ernst, Feller-Kopman, & Herth, 2007). The pneumothorax rate was 5-8% with these procedures (Eberhardt, et al., 2007). CT guidance with virtual bronchoscopy and an ultrathin endoscope for peripheral lung lesions yielded a diagnosis in 65.4% of patients (Shinagawa et al., 2004). Thus, diagnostic yield ranged from 44% to 88% and the pneumothorax rate from 1.2% to 8%. No deaths were reported.

4.2 Transthoracic Biopsy

For 46 patients with lesions near the chest wall, diagnostic yield of ultrasound guided transthoracic biopsy was 95.6% with one case each of hemoptysis (2.2%) and one pneumothorax (2.2%) (Seyfarth et al., 2007). In another study of 91 patients undergoing ultrasound guided biopsy, the diagnostic sensitivity was 85.5% and the risk of pneumothorax 4% (Diacon et al., 2004). CT guided biopsy in 147 cases yielded a diagnostic accuracy of 94.6% with pneumothoraces in 12.9% of which 2.7% required a chest tube (Kinoshita et al., 2006). In 506 consecutive patients, pneumothorax was detected immediately in 22.9%, treated immediately in 6.5%, and detected and treated in a delayed fashion in another 1.4% (Dennie, Matzinger, Marriner, & Maziak, 2001). In 343 biopsies performed in patients most of whom had non-diagnostic bronchoscopy, the diagnosis was made in 73.7% of malignant lesions, with pneumothorax in 7.7%, of whom 1.6% needed a chest tube, and hemorrhage in 1.3% (Schneider et al., 1999). Thus, diagnostic yield ranged from 74% to 96% and pneumothorax from 2.2% to 8%. No deaths were reported. Complications have been reported to be related to multiple punctures, longer intraparenchymal needle tract, and smaller lesion size (Nakatani et al., 2012; Smayra et al., 2012).

A recent economic analysis comparing CT guided needle biopsy to ultrasound guided transbronchial biopsy found the two modalities to be equivalent overall, but found that in specific cases one maybe more effective than the other (Steinfort, Liew, & Irving, 2012).

4.3 Stereotactic Brain Biopsy

It is difficult to discern from the published literature on stereotactic brain biopsy how many procedures were performed for malignancies, either primary or secondary. A recent review of 290 cases of CT guided biopsy reported a diagnostic biopsy in 95.5%, a 4.1% incidence of symptomatic hemorrhage (two required surgery), and a mortality of 0.8% (Ersahin et al., 2011). A recent series of 134 patients done without frozen section confirmation had a diagnostic yield of 99.3% (one targeting error) and complications in 2.2%, one of which was a conservatively treated hematoma and two of which were fatal in high grade gliomas (1.5%) (Shooman, Belli, & Grundy, 2010). In a series of 299 biopsies by 11 surgeons for all diagnoses, diagnostic yield was 90.6% with symptomatic hemorrhage in 4.4% and death in 1.3% (Chen et al., 2009). In another series of 622 diagnostic biopsies for all histologies, the diagnostic yield was 98.4%, the overall morbidity 6.9%, the symptomatic hemorrhage rate was 4.8%, new, persisting neurologic deficits occurred in 1.5% and death in 1.3% (Kongkham, Knifed, Tamber, & Bernstein, 2008). Complications were more likely in deep seated lesions and glioblastoma than other diagnoses. In 465 biopsies over a 10 year period, the diagnostic yield was 89.4% with symptomatic hemorrhage in 3.8% and mortality in 1.5% (Dammers et al., 2008). In this series, complications were more common in frontotemporal biopsies and when the diagnosis was lymphoma.

In a series of 270 patients, a symptomatic hematoma occurred in 5%, with a glucose level of greater than 200 highly associated with the likelihood of complications and thalamic or basal ganglia lesions at higher risk as well (McGirt et al., 2005). In a series of 355 biopsies, the diagnostic yield was 93.8% with a symptomatic hemorrhage rate of 3.6% and a mortality of 0.6%, with brainstem biopsy being the only factor associated with higher morbidity (Grossman, Sadetzki, Spiegelmann, & Ram, 2005). A series of 153 patients in whom a micro Doppler probe was used to look for vessels prior to biopsy yielded a diagnosis in 98%, a CT detected hemorrhage in 2.5%, permanent neurologic deficit in 0.6%, and no mortality (Hertel, Feiden, & Bettag, 2005). A series of 69 biopsies for inoperable lesions produced no morbidity and no mortality (Stranjalis, Protopapa, Sakas, & Chondros, 2003). In

two series from the same institution, 130 biopsies resulted in 3.8% symptomatic complications (4/5 transient) and one death (0.8%) and 138 biopsies resulted in 2.2% symptomatic complications (one of which was a hematoma) and no deaths (Kaakaji et al., 2001). In a series of 225 patients of which 12.9% harbored metastatic tumors, biopsy was diagnostic in 95.6%, major morbidity (hemorrhage or neurologic deficit) occurred in 3.6% and there was one death (0.4%) (Sawin, Hitchon, Follett, & Torner, 1998). Morbidity was linked to antiplatelet agents, deep seated lesion, chronic steroid use, and gliomas, but was not linked to extracranial malignancy. In a series of 122 patients by a single author (Hall, 1998), the diagnostic yield was 96% with 0.7% morbidity and one (0.7%) fatality. Hall reviewed the published literature to date in his 1998 paper, finding 7471 reported cases with an overall mortality of 0.7%, morbidity of 3.5%, and diagnostic yield of 91%. In another series of 500 biopsies, over 2000 specimens were obtained from 741 targets with a complication rate of 1% and mortality of 0.2% (Apuzzo, Chandrasoma, Cohen, Zee, & Zelman, 1987). The diagnostic yield overall ranged from 89.4% to 99.3% (95.6% overall) when all potential diagnoses were included. Non diagnostic biopsies did show necrosis in 10 cases, inflammatory response in nine cases, granuloma in one case, and gliosis in one case. On aggregate, complication rates for stereotactic brain biopsy for all pathologies ranged from 0.6% to 4.8% with mortality from 0% to 1.5%. Stereotactic brain biopsy results are summarized in Table 1.

Table 1. Summary of stereotactic brain biopsy results

Publication (First Author, Year)	Patients (n)	Diagnostic Yield (%)	Major Complication (%)	Death (% (n))
Ross DA, 2012*	161	99.4	0.6	0, (0)
Shooman D, 2010	134	99.3	2.2	1.5, (2)
Chen C-C, 2009	299	90.6	4.4	1.0, (3)
Kongkham PN, 2008	622	98.4	6.9	1.3, (8)
Dammers R, 2008	465	89.4	3.8	1.5, (7)
Grossman R, 2005	355	93.8	3.6	0.6, (2)
Hertel F, 2005	153	98	2.5	0 (0)
Sawin PD, 1998	225	95.6	3.6	0.4, (1)
Hall WA, 1998	122	96	0.7	0.8, (1)
Apuzzo ML, 1987	500	95.6	1	0.2, (1)

*data reported here

Overall, in the published literature, when compared to lung biopsy, stereotactic brain biopsy had a higher diagnostic yield and a lower morbidity, but a higher mortality. Pneumothorax and hemoptysis were the most common complications of lung biopsy; whereas, new neurologic deficit, hematoma, or death were reported in brain biopsy, but it was not possible to discern if complications were more common in diagnoses other than metastatic tumors. In the author's hands, stereotactic biopsy had a higher yield, lower morbidity, and no mortality when compared to lung biopsy. Other authors have reported similar results (Apuzzo et al., 1987; Hertel et al., 2005; Shooman et al., 2010; Stranjalis et al., 2003). It is likely that the wide range of pathologies included in the other published series of stereotactic brain biopsy may contribute to the morbidity of these procedures. Glioblastomas (Kongkham et al., 2008; Sawin et al., 1998) and lymphomas (Dammers et al., 2008) have been reported as more likely to bleed when biopsied. Targets located adjacent to the ventricles or the Sylvian fissure may be especially challenging and biopsy of vascular anomalies or infarcts may be disastrous (Neal & Apuzzo, 1989). Since many metastatic tumors to the brain are located in the gray-white junction of the hemispheres, the thalamus, or the cerebellum and present straightforward targets for stereotactic biopsy, it may be that the morbidity of these procedures is lower than the overall reported morbidity for stereotactic biopsy, but this data cannot be gleaned from the literature.

In order to be less morbid than lung biopsy, stereotactic brain biopsy should be performed with no mortality and with rare serious complications. If these criteria can be met, whenever the lung mass is thought to be technically suboptimal for biopsy or if the brain mass is in an accessible location for stereotactic biopsy, the brain lesion should be considered for biopsy in preference to the lung lesion.

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