Article

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STEREOTACTIC BIOPSY FOR INTRACRANIAL LESIONS

Clinical-pathological compatibility in 60 patients

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Abstract – **Objective:** Image guided stereotactic biopsy (SB) provides cerebral tissue samples for histological analysis from minimal lesions or those that are located in deep regions, being crucial in the elaboration of therapeutic strategies, as well as the prevention of unnecessary neurosurgical interventions. **Method:** Sixty patients with central nervous lesions underwent SB from November 1999 to March 2008. They were followed up to 65 months. Preoperative diagnosis was based on clinical presentation and neuro-radiological features, pathologic diagnosis, clinical outcome. The compatibility of these findings with the pathologic diagnosis was analyzed. **Results:** Considering diagnosis confirmation when inflammatory hypothesis were made, our accuracy was of 76%, with 94% of those cases having clinic-pathological correspondence after an average of 65.2 months of follow up. Considering diagnosis confirmation with the preoperative hypothesis of neoplasm, our accuracy was of 69% with 90% of these cases having clinic-pathological correspondence after an average of 47.3 months of follow-up. Morbidity rate was of 5% and mortality was zero. The diagnosis rate was 95%. **Conclusion:** Stereotactic biopsy represents a safe and precise method for diagnosis. Anatomic and histopathological analyses have high compatibility with long-term clinical outcome.

KEY WORDS: stereotactic biopsy, morbidity, accuracy, pathology.

Biopsia estereotáctica para lesões intracranianas: compatibilidade clínico patológica em 60 casos

Resumo – **Objetivo:** A biopsia estereotáctica (BE) guiada por imagem propicia amostras de tecido cerebral para análises histológicas, sendo decisiva na estratégia terapêutica e prevenção de intervenções neurocirúrgicas desnecessárias. **Método:** 60 pacientes com lesões do sistema nervoso central foram submetidos à biópsia estereotáctica no período de novembro de 1999 a março de 2008. Foram analisados a acurácia do método, a capacidade de confirmar o diagnóstico clínico pré-operatório e o comportamento evolutivo com sua compatibilidade com o diagnóstico patológico. **Resultados:** As três lesões mais freqüentes foram: neoplasias neuroepiteliais, processos inflamatórios e infecções. Considerando a confirmação diagnóstica quando pensava-se em lesão inflamatória, nossa acurácia foi 76%, com 94% destes casos tendo compatibilidade clínico patológica após média de 65,2 meses de acompanhamento. Considerando a confirmação diagnóstica com a hipótese pré-operatória de lesão neoplásica, nossa acurácia foi 69%, com 90% destes casos tendo compatibilidade clínico-patológica após média de 47,3 meses de acompanhamento. O índice de morbidade foi 5%. A mortalidade foi nula e o índice de diagnóstico foi 95%. **Conclusão:** A biopsia estereotáctica é um método seguro e preciso para o diagnóstico. O exame anátomo-patológico possui alta compatibilidade com a evolução clínica dos doentes a longo prazo.

PALAVRAS-CHAVE: biopsia estereotáctica, morbidade, acurácia, anatomopatológico.

Pre-surgical diagnosis of intracranial lesions based on clinical presentation and neuroimaging can be inaccurate in one third of the cases[1-3]. Histopathological analysis of cerebral tissue acquired through stereotactic techniques is decisive and can avoid unnecessary neurosurgical intervention. Image guided stereotactic biopsy (SB) pro-

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vides brain tissue samples for further anatomical and histopathological analysis of minimal lesions, as well as lesions located in deep or eloquent brain sites, having low complication risks given its minimal invasive characteristics[4]. The clinical indication is precise for those cases of unclear diagnosis where the precise nature is not clear.

Despite high anatomical accuracy given by computed tomography (CT) and magnetic resonance imaging (MRI), pathological analysis does not always provide the correct diagnosis to the physician, leading to possible underestimation for the lesion heterogeneity and diffuse vascularization[5-14].

The word stereotactic derives from the Greek *stereo*, three dimensions and from the Latin word *tangere,* to play. Its concept was established by Clarke[15,16] and his colleague Horsley, who was initially skeptical about the clinical use of the technique. It was only after 1947 that Spiegel initiated stereotactic surgery dealing with psychosurgery[17], followed by Leksell (Stockholm) and Talairach (Paris)[18].

With the advent of computed tomography (CT) in the 70s, there was a revolution in appreciation, evaluation and outcome of central nervous system diseases[19,20], with perfect view of lesion limits and easier access to implement strategies.

Image guided SB is considered an effective and safe medical procedure. A recent meta-analysis including 7471 patients showed positivity for histopathological diagnosis of SB material in 91% of the cases, with morbidity rates of 3.5% and mortality rates of 0.7%[5], while transitory neurological deficits were reported in 9% of the patients[6-14]. We present a critic analysis of clinical outcome and lesion's behavior associated with pathologic findings and correspondence in the long term outcome.

METHOD

From November 1999 to March 2008, 60 patients underwent SB with needle in Santa Casa Medical School (São Paulo – Brazil).

As to establish effective clinical or surgical therapeutic strategy, the procedure was indicated for those patients without precise diagnosis, with unclear lesions independently of anatomical aspects (deep, small, multiple or lesions located in eloquent areas).

Demographic characteristics, clinical presentations, neuroradiological features, preoperative diagnosis, surgical details, histopathological diagnosis, clinical outcome and its compatibility to pathological diagnosis were verified retrospectively.

Stereotactic planning was made though fixation of TM MICROMAR® 03B arch under local anesthesia effect following target location with cranial CT with venous contrast or with fusion between tomography and MRI. This method was used for lesions of imprecise location in tomography, as well as those lesions with higher morbidity due to their location in either posterior fosse, or next to basal ganglia or even in inflammatory lesions.

Local anesthesia was used in all cases given the necessity of neurological functional preservation and lower morbidity.

Through linear incision of approximately 2.0 cm and drill or trefine trepanation, tissue samples of 1 mm width × 8 mm length were obtained with 1.7 mm Nashold biopsy needle and sent to histopathological analysis. In each case there were taken 10 to 12 fragments for target, there were chosen three distinct lesion points according to its heterogeneity. For those cases in which frozen section and smear did not established satisfactory diagnosis, additional samples from suspect sites were collected.

Pathology

Tissue analysis during the surgery was performed by the use of frozen section and smear, using *H & E* and toluidine blue stain. The remaining tissue samples were sent to routine microscopically examination. For specific cases, it was necessary to use further techniques to verify the etiological agent and to analyze the sample by immunohistochemistry.

Data analysis

Patients were divided into two groups according to clinical hypothesis before procedure: patients with neoplasm, or with inflammatory diseases. In the present study, the authors verified the method's accuracy using the following parameters: ability to determine conclusive anatomical-pathological diagnosis; preoperative diagnosis' confirmation, i.e., the finding of pathological diagnosis similar to that previously elaborated with clinical and radiological features; and the clinical-pathological compatibility, i.e., the compatibility between anatomopathological diagnosis and the clinical outcome during follow-up.

RESULTS

The average age of this group of patients was of 42.64 years (±19.6 years ranging from 4 and 81 years), 31 patients were female (52%) and 29 were male (48%). The average follow up time was 55.6 months (±3.06 months).

Lesions were more frequent in frontal region (36%), followed by parietal lesions (20%), thalamic, and basal ganglia lesions (Table 1).

According to the lesion nature, the most common were neuroepithelial neoplasm (43%), infection (15%), demyelinating disorders and lymphoma (5%).

Anatomic-pathological diagnosis was obtained for 53 patients (93%) (Table 2). In two cases, only normal brain tissue was observed at pathological analysis. In another case, there was only intraparenchymal hemorrhage, which underwent complete and spontaneous remission during a long follow up period.

Patients with preoperative clinical or radiological hypothesis of inflammatory processes had diagnosis confirmation in 76% of the cases, with method's positivity in 82% of the patients (78% with etiological elucidation) and correspondence between anatomical-pathological diag-

Table 1. Distribution of patients according to lesions' site.

Site	N	%
Frontal	21	36
Parietal	12	20
Thalamic	11	17
Basal ganglia	6	10
Cerebellum	3	5
Insula	3	5
Occipital	2	3
Brain stem	1	2
Temporal	1	2
Total	60	100

Table 2. Patients distribution according to pathological diagnosis.

Histological type	N	%
High-grade glioma	14	23.3
Low-grade glioma	12	20
Infectious process	9	15
Brain abscess	5	8.3
Neurotoxoplasmosis	1	1.7
CMV encephalitis	1	1.7
Tuberculosis	2	3.3
Reactive astrogliosis	9	15
Inconclusive	4	6.7
Lymphomas	3	5
Demyelinating disorders	3	5
Multiple sclerosis	2	3.3
ADEM	1	1.7
Vasculitis	2	3.3
Normal brain tissue	2	3.3
Metastasis	1	1.7
Hemorrhage	1	1.7
Total	60	100

nosis and clinical outcome in 94% of these cases. Considering the preoperative hypothesis of neoplasm, confirmed diagnosis was observed in 69% of the cases (87% for high grade malignancy lesions and 63% for low grade lesions), with positivity of this method for 83% of the patients, and compatibility between anatomic-pathological diagnosis and clinical outcome in 90% of the cases (Table 3).

Morbidity rate in our study was of 5%. There was one case of intraparenchymal hemorrhage with spontaneous resolution (2%), one case of temporary partial motor deficit and one case of acute subdural hematoma surgically treated, without related mortality.

DISCUSSION

Computed tomography associated to stereotactic system reveals precisely 3D graphic images of central nervous system lesions. Recently, the literature shows advanced studies regarding the concomitant use of CT, angiography, MRI and computer software allowing the surgeon to create interactive images which will guide him precisely during biopsy, with great preservation of important anatomical and neurovascular structures. This complex system provides accurate diagnosis with low morbidity and mortality rates together with high positivity for both the frame system and the frameless needle guided biopsies[21,22].

Considering the isolated anatomic-pathological criteria aiming for final diagnosis, the rate of accuracy in our study was of 82% for inflammatory lesions, with etiological elucidation in 78%. Regarding neoplasic lesions, the rate was 83%, while 83% were obtained considering all tissue samples. Our results are in accordance to those verified in literature, with positivity rates varying from 64 to 95%, with lower rates for inflammatory lesions or low malignancy grade lesions[5,23-26].

With the implementation of new imaging techniques in neuroradiology, many centers worldwide claim for a substitution of invasive diagnostic procedures for innocuous procedures. Following this line, there has been an increase in publications considering the reliability of neuroradiological methods. We analyzed the reliability of clinical and radiological correlation in all cases which underwent deep cerebral biopsy and observed higher discrepancy than previously verified in literature. Possible inflammatory lesions were confirmed in 76% of cases and neoplasm lesions only in 69%, determining a general confirmation in 71% of patients. The latter results varied from 87% in high grade neoplasm lesions to 63% in low grade ones. This variation is considered to be similar to those of other studies, when all patients underwent spectroscopy, diffusion, and perfusion evaluations.

Table 3. Preoperative diagnostic confirmation, method's accuracy and clinical–pathological compatibility were summarized.

	Preoperative diagnostic confirmation	Method accuracy	Clinical-pathological compatibility
Inflammatory process	76%	82%	94%
Neoplasm	69%	83%	90%
Total	71%	83%	92%

Initially, biopsies from inflammatory lesions presented unspecific results (4% in the present study), however, during an average follow-up of 65,2 months, it was observed that 94% of them showed remission or remained without progression, a behavior suggestive of gliotic tissue. Considering neoplasm lesions, during an average follow-up of 47.3 months, it was observed that stability of neoplastic behavior pattern for 90% of the cases, with a clinical outcome compatible to the one expected for each tumor.

Primary central nervous system lesions can grow very slowly, remaining unnoticed for many years. Therefore, the authors considered that reactive astrogliosis and inconclusive biopsies could reflect mild increase of glial cells and lesion indolence, even when the immunohistochemical analysis was negative. Therefore, it is crucial to associate methods, especially with neuroimaging techniques that can analyze cellular metabolism, such as MRI with diffusion, perfusion and spectroscopy.

Even with pathological results from three different lesion sites and the use of neuroimaging, we consider it to be essential to maintain a long outpatient follow up.

Diagnostic failure can be correlated to some factors. The choice of biopsy site must be discussed with a neuroradiologist, targeting the lesion should include areas with distinct aspects in neuroimaging; low caption of contrast in CT or targets at posterior fossa demand fusion with MRI. Inexperience of surgical staff can lead to bad positioning of stereotactic frame, technical difficulty to obtain tissue samples or incorrect transportation. The use of smear techniques or other pathological analysis strategies during surgical procedure increase the success rate, reducing the rate of non-relevant samples for diagnosis[25,26].

Our patients underwent control CT scans in the post-surgical follow up. Kulkarni et al.[27] concluded that such procedure is only indicated if it could be a determinant for reducing hospitalization time. In their retrospective study of 102 patients with stereotactic biopsy, it was reported that patients with normal neurological exam and CT without evidences of hemorrhage, did not present neurological deficits or hemorrhage at follow up. This fact drew our attention to the possibility of biopsy and hospital discharge at the same day.

Our morbidity (5.1%) and mortality (0%) rates are in accordance with those verified in international literature[6,23]. The most frequent complications are: hemorrhage and new neurological deficit. Lesions next to polar sites, ependymal surface, brain sulci and cisterns present higher risk of hemorrhagic complications.

In conclusion, stereotactic biopsy is a safe and precise method for diagnosis and management of brain lesions in deep sites or eloquent areas. Anatomic-pathological examination has high compatibility with long-term clinical outcome.

REFERENCES

1. Friedman WA, Sceats DJ Jr, Nestok BR, Ballinger WE Jr. The incidence of unexpected pathological findings in an image-guided biopsy series: a review of 100 consecutive cases. Neurosurgery 1989;25:180-185.
2. Lobato RD, Rivas JJ, Cabello A, Roger R. Stereotactic biopsy of brain lesions visualized with computed tomography. Appl Neurophysiol 1982; 45:426-430.
3. Wild AM, Xuereb JH, Marks PV, Gleave JR. Computerized tomographic stereotaxy in the management of 200 consecutive intracranial mass lesions. Analysis of indications, benefits and outcome. Br J Neurosurg 1990;4:407-415.
4. McGirt MJ, Woodwoth GF, Coon AL, Frazier JM. Independent predictors of morbidity after image-guided stereotactic brain biopsy: a risk assessment of 270 cases. J Neurosurg 2005;102:897-901.
5. Hall WA. The safety and efficacy of stereotactic biopsy for intracranial lesions. Cancer 1998;82:1749-1755.
6. Greene GM, Hitchon PW, Schelper RL, Yuh W, Dyste GN. Diagnostic yield in CT-guided stereotactic biopsy of gliomas. J Neurosurg. 1989;71: 494-497.
7. Apuzzo ML, Chandrasoma PT, Cohen D, Zee CS, Zelman V. Computed imaging stereotaxy: experience and perspective related to 500 procedures applied to brain masses. Neurosurgery 1987;20:930-937.
8. Bernays RL, Kollias SS, Khan N, Brandner S, Meier S, Yonekawa Y. Histological yield, complications, and technological considerations in 114 consecutive frameless stereotactic biopsy procedures aided by open intraoperative magnetic resonance imaging. J Neurosurg 2002;97:354-362.
9. Blaauw G, Braakman R. Pitfalls in diagnostic stereotactic brain surgery. Acta Neurochir 1988;42(Suppl):S161-S165.
10. Bouvier G, Couillard P, Leger SL, Lesage J, Rotent F, Beigne RA. Stereotactic biopsy of cerebral space-occupying lesions. Appl Neurophysiol 1983;46:227-230.
11. Dorward NL, Paleologos TS, Alberti O, Thomas DG. The advantages of frameless stereotactic biopsy over frame-based biopsy. Br J Neurosurg 2002;16:110-118.
12. Field M, Witham TF, Flickinger JC, Kondziolka D, Lunsford LD. Comprehensive assessment of hemorrhage risks and outcomes after stereotactic brain biopsy. J Neurosurg 2001;94:545-551.
13. Gralla J, Nimsky C, Buchfelder M, Fahlbusch R, Ganslandt O. Frameless stereotactic brain biopsy procedures using the Stealth Station: indications, accuracy, and results. Zentralbl Neurochir 2003;64:166-170.
14. Yu X, Liu Z, Tian Z, et al. Stereotactic biopsy for intracranial space-occupying lesions: clinical analysis of 550 cases. Stereotact Funct Neurosurg 2000;75:103-108.
15. Clarke RH. Investigations of the central nervous system: methods and instruments. Jonhs Hopkins Hospital Report, Special Volume,1920:1-162.
16. Horsley V, Clark RH. The structure and function of cerebellum examined by new method. Brain 1906;31:45-124.
17. Spiegel EA, Wycis HJ, Marks M, Lee A. Stereotactic apparatus for operations. Science 1947;106:439-450.
18. Kelly PJ. Tumor stereotaxis, Philadelphia: WB Saunders, 1991:1-220.
19. Apuzzo MLJ, Sabshin JK. Computed tomographic guidance stereotaxis in management of intracranial mass lesions. Neurosurgery 1983;12:277-285.
20. Schlitt MJ, Morawetz, Bonnin JM, Zeiger HE, Whitlety RJ. Brain biopsy for encephalitis. Clin Neurosurg 1986;33:591-602.
21. Woodworth GF, McGirt MJ,Samdani A. Frameless image-guided stereotactic brain biopsy procedure: diagnostic yield, surgical morbidity, and comparison with the frame-based technique. J Neurosurg 2006;104: 233-237.
22. McGirt MJ, Woodworth GF, Coon AL. Independent predictors of morbidity after image-guided stereotactic brain biopsy: a risk assessment of 270 cases. J Neurosurg 2005;102:897-901.
23. Ostertag CB, Mennel HD, Kiessling M. Stereotactic biopsy of brain tumors. Surg Neurol 1980;14:275-283.
24. Hisatugo MK, Stávale JN, Bidó JO, Ferraz FP. Image guided stereotactic approach of central nervous system lesions: accuracy, morbidity and mortality. Arq Neuropsiquiatr 1999;57:615-620.
25. Berkeley BB, Adams JH, Doyle D, Graham DI, Harper CG. The smear technique in the diagnosis of neurosurgical biopsies. N Z Med J 1978;87: 12-15.
26. Ciricillo SF, Rosenblum ML. Use of CT and MR imaging to distinguish intracranial lesions and to define the need for biopsy in AIDS patients. J Neurosurg 1990;73:720-724.
27. Kulkarni AV, Guha A, Lozano A, Berstein M. Incidence of silent hemorrhage and delayed deterioration after stereotactic brain biopsy. J Neurosurg 1998;89:31-35.