The Diagnostic Yield of Computerized Tomography Guided Stereotactic Biopsy in Brain Mass Lesions: Histopathologic Analysis of 100 Cases

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ÖZET

Beyin kitle lezyonlarında bilgisayarlı tomografi eşliğinde yapılan stereotaktik biyopsinin tanı değeri: 100 olgunun histopatolojik değerlendirilmesi

Amaç: İntrakranial kitle lezyonlarında lezyonun doku analizi, tedavinin yönlendirilmesinde esastır. Modern görüntüleme yöntemleri ile lezyon lokalizasyonu ve komşu yapılarla ilişkisi ortaya konulabilmekle beraber, halen histopatolojiye yönelik yeterince bilgi elde edilememektedir. Stereotaktik yöntemler bu lezyonlardan güvenli ve hassas bir şekilde doku numunesi alınmasını sağlamaktadır. Bu çalışmada, kliniğimizde uygulanmış olan stereotaktik biopsi sonuçları literatür eşliğinde tartışıldı.

Yöntem: 1995 ile 2009 yılları arasında, kliniğimizde 100 hastaya 106 stereotaktik biopsi girişiminde bulunuldu. Biopsilerin tümü bilgisayarlı tomografi eşliğinde gerçekleştirildi. Hastalara ait histopatolojik tanı, morbidite ve mortalite oranları ile yöntemin tanı konulmadaki başarı oranı incelendi.

Bulgular: Toplam 100 hastaya 106 stereotaktik biopsi uygulandı. Lezyonların lokalizasyonu; frontal 21, temporal 11, parietal 14, oksipital 7, derin yerleşimli 12, serebellum 1, suprasellar 2 iken 32 olguda lezyonlar multipl idi. Girişim sonrası histopatolojik tanılar; nöroepitelyal tümörler 51, metastazlar 31, enfeksiyöz sebepler 7, demiyelinizan patoloji 1, gliozis 8 idi. Olguların 2'sinde alınan numune yetersizdi. Yöntemin tanı koydurma oranı %90 olarak saptandı. Operasyon sonrası dönemde, 3 olguda nörolojik defisitin arttığı izlendi. Bir olguda yeni nörolojik defisit saptandı. İki olguda asemtomatik hemoraji tespit edildi. Bir olguda işlem sırasında kardiak aritmi gelişti ve hasta, akciğer ödemine bağlı olarak operasyon sonrası dönemde kaybedildi.

Sonuç: Serebral lezyonların teşhisinde; morbidite ve mortalitesinin düşük olması, sensitivite ve spesifitesinin yüksek olması, genel durumu kötü hastalarda uygulanabilir olması nedeni ile stereotaksik biopsi sıklıkla başvurulan bir yöntemdir. Yetersiz materyal alınması, hedefin yanlış belirlenmesi ve lezyonun heterojen karakterde olması tanı konulmasını güçleştirebilmektedir. Kliniğimizde elde edilen sonuçlar, güvenilir ve yüksek tanı değerine ulaşan bir teknik olduğunu göstermektedir.

Anahtar kelimeler: Stereotaktik biyopsi, beyin, histopatoloji

ABSTRACT

The diagnostic yield of computerized tomography guided stereotactic biopsy in brain mass lesions: histopathologic analysis of 100 cases

Introduction: Histopathologic analysis of tissue samples is crucial for the management of patient with brain mass lesions. Lesion localization and interaction with adjacent normal tissue can be easily provided with modern imaging techniques. On the other hand, they are insufficient to reveal histopathologic nature of lesions. Stereotactic techniques can provide diagnostic tissue samples from lesions safely and sensitively. We aimed to discuss our experience and results with the help of the literature.

Method: Overall, 106 stereotactic brain biopsy procedure were performed on 100 patients in our clinic from 1995 to 2010. Lesion locations, histopathological results, diagnostic yield, morbidity and mortality were reviewed.

Results: This study included 64 males and 36 females aged 9 to 81 years (mean: 53 years). Lesion localizations were classified as: frontal 21, temporal 11, parietal 14, occipital 7, deep-seated 12, suprasellar 2, cerebellum 1 and 32 patients had multiple lesions. Histopathological diagnosis were as follows: neuroepithelial tumors 51, metastases 31, infectious 7, gliozis 8, demyelinization 1. The diagnostic yield was %90.

Conclusions: Histopathologic confirmation of brain mass lesions is the main method to decide management. Although new imaging techniques provide detailed data, evaluating tissue sampling is still the gold standart in determining the histopatologic diagnosis. Stereotactic- CT guided brain biopsy is a safe, reliable method of obtaining tissue sample with high accuracy.

Key words: Sterotactic biopsy, brain, histopathology

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INTRODUCTION

Lesion localization and its relationship with adjacent structures can easily be identified by the advances in modern imaging techniques. However, adequate information cannot be obtained about the histopathology yet. Tissue analysis and histopathological diagnosis of intracranial mass lesions will make the risk-benefit evaluation possible when surgical treatment is concerned.

Stereotactic methods were first performed by Horsley and Clarcke (1) and today are being widely and routinely performed. Combining this method with computerized tomography (CT) by Marron et al. in 1977 (2) enabled it more widespread. CT guided stereotactic biopsy make it possible to obtain tissue samples safely and sensitively. In this study, we analyzed the CT guided stereotactic brain biopsy (SBB) findings and evaluated the histopathological diagnostic efficiency and accuracy. We discussed the surgical method being used in our clinic, diagnostic variety of patients whom have undergone stereotactic biopsy, our results and compared them with the literature.

METHODS

One hundred and six stereotactic brain biopsy procedures were performed at 100 patients between 1995 and 2009 in our department. Lesion could be identified at all patients in CT. Thirty-six (36%) patients were female and 64 (64%) were male; age range was 9-81years (mean age 53 years). Fischer ZD frame (Germany) was used at all stereotactic biopsy procedures. Specimens obtained were sent to pathologist for histopathological diagnosis with the clinical and radiological records of the patient. Our stereotactic biopsy protocol was as follows: All stereotactic procedures were performed under local anaesthesia at all patients. Routine blood chemistry and bleeding diathesis tests were done at patients whom biopsy was planned. Patients with history of anticoagulant use were requested to wait until INR to get normalized and a patient with history of anti-platelet use, the medication was stopped at least 2 days prior to the procedure. Patients were taken to the tomography centre after Fisher ZD stereotactic frame was fixed and cranial CT scan with contrast was taken. Coordinates were calculated by special software taking the region absorbing contrast medium was centred. In order to prevent surgical errors, calculations were done by two different surgeons and were cross-checked. Hairy scalp skin of the patient taken into the surgery room was shaved and cleaned by Betadin. Specially designed frame arc was fixed to the frame. A 1 cm burr hole was opened at the planned entry point and a small incision was made. When trace of the stereotactic probe was selected, highest care was taken in order not to pass through sulci and big vessels to prevent bleeding. After taking the centre of the targeted point as a priority, specimens were taken from 3 different depths and 4 quadrants at 5 mm deep and 5 mm superficially. Specimens from every depth were recorded separately. Probe was removed after the specimens were taken and all layers were closed according to anatomy. After the procedure was completed, all patients were transferred to the ward and hospitalized for the following few days. CT scans were taken at 1-3 hours postoperatively. At early control CT, small amounts of air were observed at nearly all cases. Histopathological evaluations were performed by a single neuropathologist (We would like to thank to Prof. Dr. Çiçek Bayındır in Istanbul University Faculty of Medicine Department of Neuropathology for her effort and support during the evaluation period of specimens). Tissue specimens were put between two slides and transferred to the neuropathology laboratory after covering the specimen with a saline absorbed tissue. Paraffin slices were taken and stained with haemotoxylene-eosin. Immunohistochemical staining was added when needed.

RESULTS

One hundred and six biopsy procedures were implemented in a total 100 patients. Thirty-six women (36%) and 64 men (64%) were included in the study. Mean age was 53 (9-81; 51 for women, 54 for men). Localisation of the lesions was as follows: Frontal 21

Table 1: Lesion distribution according to location

Localization	n	%
Frontal	21	21
Temporal	11	11
Parietal	14	14
Occipital	7	7
Deeply located	12	12
Supracerebellar	2	2
Cerebellar	1	1
Multiple	32	32

Table 2: Lesion distribution according to histopathological diagnosis

Histopathological Diagnosis	n	%
Primary central nervous system tumour		
Diffuse Astrocytoma	8	8
Anaplastic Astrocytoma		
Glioblastoma	26	26
Oligodenroglioma	5	5
Medulloblastoma	1	1
Gliomatosis Cerebri	4	4
Neurocytoma	1	1
Lymphoma	5	5
Meningioma	1	1
Metastasis		
Lung Carcinoma	17	17
G.I.. Carcinoma	1	1
Breast Carcinoma	1	1
Primary unidentified	12	12
Infectious		
Viral Encephalitis	1	1
Prion Disease	1	1
Abscess	5	5
Demyelinating	1	1
Undiagnosed		
Gliosis	8	8
Inadeqaute tissue	2	2

(21%), parietal 14 (14%), temporal 11 (11%), occipital 7 (7%), suprasellar 2 (2%), deeply located 12 (12%), cerebellar 1 (1%), multiple 32 (32%) (Table 1). Histopathological diagnoses after the procedure: Glioblastoma multiforme 26 (26%), lung carcinoma metastasis 17 (17%), breast carcinoma metastasis 1 (1%), metastasis due to gastrointestinal system tumours 1 (1%), metastasis without a known primary lesion 12 (12%), medulloblastoma 1 (1%), oligodendroglioma 5 (5%), diffuse astrocytoma 4 (4%), low grade astrocytoma 4 (4%), atypical meningioma 1 (1%), lymphoma 5 (5%), gliomatosis cerebri 4 (4%), neurocytoma 1 (1%), abscess 5 (5%), demyelination 1 (1%), viral encephalitis 1 (1%), prion 1 (1%), gliosis 8 (8%) (Table 2). Specimens were reported to be inadequate in 2 cases. Diagnostic value of the method was calculated as 90%.

Current neurological deficit progressed in 2 cases after the surgical intervention. Hemiparesis developed in one case. Cardiac arrhythmia developed in one case and the patient died due to pulmonary oedema the following day. Asymptomatic bleeding was observed at post-op control cranial CT in 2 cases. Minimal air collection which showed access to the centre of the lesion was observed at the early cranial CT scans of all patients. Open surgical procedure was performed at 6 patients after the biopsy; histopathological diagnoses of these patients were in concordance with the biopsy. Histopathological diagnoses were lymphoma in 1 case, metastasis in 3 cases and glioblastoma in 2 cases.

DISCUSSION

Tissue analysis of intracranial lesions is mandatory to determine the therapeutic modality. Imaging techniques are progressively developing and they are not only providing lesion localization and its relationship with adjacent structures but also started to give partial information about its histopathological structure as well. However, this information has not reached to a definite level to show the risk-benefit ratio of surgical treatment. So, planning the treatment to have this ratio at minimum is correlated with a more definite histopathological diagnosis. Current method of practice is to obtain tissue sample and perform a direct examination.

Since Horsley and Clarcke (1) described stereotactic surgical technique in rat brain, stereotaxis had rapidly developed and became popular in neurosurgery practice. Maroon et al. (2) first reported that stereotactic method can be combined with CT in 1977. CT–guided direct biopsy has been performed since that time technically but point targeting became more popular.

Stereotactic brain biopsy (SBB) is based on obtaining small tissue samples after targeting a specific area by radiological imaging. Brain biopsy by stereotactic imaging technique has a wide indication spectrum. Space-occupying lesions located deeply or at a functional brain region is the most frequent area of this

technique (3-9). Other indications are defining the aetiology of multiple masses and diffuse infiltrative brain lesions. Patients having comorbid medical conditions which may increase mortality and morbidity are also among them.

Preferring stereotactic biopsy in all these indication groups is mainly due to the lower and acceptable morbidity and mortality of this method. Mortality rate was reported 0.7% (0-2.6%) and morbidity rate was reported 3.6% (0-13%) at big series (4). Most frequent reasons of morbidity and mortality were symptomatic or asymptomatic bleeding, infections, CSF fistula and convulsions. Some centres routinely use post-op CT control and others use imaging only in symptomatic cases. In these studies, asymptomatic bleeding is not included in the data. The most prevalent cause of morbidity due to intervention was bleeding. It is possible to recognize asymptomatic bleeding by routine post-interventional imaging. There are some obvious factors which affect morbidity and mortality. Main determining factor was surgical experience. At different series reported by same authors, it was reported that by time and growing experience, morbidity and mortality rates decrease (4,10). Another important factor was the selection of target point and determining the biopsy direction and entrance point (10). General tendency is to select an entrance point far from sulci and Sylvian fissure which is rich in major vascular structures. Beside these factors related with the surgeon, histological structure of the tumour/lesion is also important. Bleeding tendency and post-op. new neurological deficit rates were reported to be higher in glial tumours and lymphoma having abnormal vascular structures and neovascularisation (around 6%) (4,10). Morbidity rates in our series were complex and heterogenous and compatible with the mean rates. In the literature, it can easily be observed that biopsy attempts from high risk anatomical regions had higher morbidity. In our study, biopsy at brain stem region was not performed. Kreth et al. (11) reported post-stereotactic brain biopsy asymptomatic bleeding rates 9.6% and symptomatic bleeding rates 0.09% in their series of 326 cases. In our series, in 2 cases (2%) neurological deficit worsened, in 1 case (1%) a new neurological deficit developed and in 2 cases (2%) asymptomatic bleeding developed due to stereotactic brain biopsy. At all cases whom bleeded, diagnosis was glioblastoma. Cardiac arrhythmia developed in 1 case (1%) and this patient died due to pulmonary oedema in post-op period.

According to histopathological data, diagnostic efficiency of stereotactic brain biopsy was found 90% in our series. Diagnostic efficiency was reported 80-99% in the literature which is compatible with our results (3,4,7,12,13). We targeted the centre of homogenous lesions in our clinical practice and obtained 10 biopsies from 5 mm deep and 5 mm superficially of the centre at all 3 quadrants. In heterogenous lesions, we obtained 10 biopsies from the contrast enhancing ring at periphery of the lesion and from 3 mm. depth. It is not clear whether frozen and cytological techniques should be used or not during the operation but there is a general tendency to have them used. Kim et al (8), showed a statistically significant difference between stereotactic brain biopsy evaluation with and without frozen section in their series. However, there are studies which were not able to show any difference. In the literature, a clinic performing routine intra-operative pathological evaluation gave up after further evaluation of their series. There are two important factors in diagnostic inadequacy: First, inadequate amount of biopsy taken and second, obtaining wrong specimen due to targeting error. Some authors emphasize the number of specimens taken during the biopsy to achieve diagnostic efficiency (5,6). In our series, 2 cases (2%) were reported to have inadequate specimens after histopathological examination. In our opinion, this supports the importance of the number of specimens for diagnostic efficiency. Definite histopathological diagnosis could not be done in 10 cases. This can be due to our technical errors during the procedure and heterogenous structure of the lesion. Stereotactic brain biopsy is a gentle procedure and should be performed by an experienced team. A pre- or post-procedural small error may cause a targeting deviation. Another limitation of stereotactic brain biopsy is the diagnostic accuracy of the procedure. Diagnostic accuracy is defined as determining the type and grade of the tumour. Specimen taken in stereotactic brain biopsy is limited in amount and may not represent

the whole lesion. Limited specimen may lead to a wrong diagnosis especially due to heterogeneity of glial tumours. We try to avoid misdiagnosis due to this heterogeneity by routinely using 3 different depths and 3 different approaches. Diagnostic accuracy was reported between 80-97% in different series (3,4,9,14,15). Diagnostic accuracy in stereotactic brain biopsy was higher in homogenous lesions and lower in heterogenous and cystic lesions. Avoiding central hypodense area and taking biopsy from the better contrast enhancing area may cause lower grading of the heterogenous lesions (3,4,16). In mixed type tumours, misdiagnosis is possible due to limited number of specimens (3). In the series of Jackson et al. (15), 60% of tumours which they first defined as anaplastic astrocytoma were diagnosed as glioblastoma.

In stereotactic brain biopsy, in order to increase diagnostic accuracy it was suggested that specimens should be taken from different parts of the lesion, high resolution imaging techniques should be utilized, intaroperative frozen and cytopathological techniques should be performed and modern histoptahological methods and PET-MR spectroscopy techniques should be used in stereotactic brain biopsy (8,9,17,18).

CONCLUSION

Stereotactic brain biopsy is frequently performed in technically competent hospitals due to its lower morbidity and mortality to diagnose cerebral lesions, its high sensitivity and specifity and its utility in patients having worse general condition. Taking inadequate material, mistargeting, heterogeneous and cystic character of the lesion may make the diagnosis difficult. Our results show that stereotactic brain biopsy is a safe technique with a high diagnostic value.

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