Kobe J. Med. Sci., Vol. 56, No. 4, pp. E148-E153, 2010

Morbidity of Stereotactic Biopsy for Intracranial Lesions

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Received 23 June 2010/ Accepted 15 July 2010

Key Words: stereotactic biopsy, brain tumor, glioma, cancer, complication

The safety of stereotactic biopsy (STB) was studied in this article. CT-guided STB (Brown-Roberts-Wells; BRW) was performed 58 times for 56 patients (male: 29, female: 27) at Hyogo Cancer Center between 1988 and 2007. The age distribution ranged from 15 to 83 (mean: 55) years old. Histological diagnoses were established for 58 samples, with 35 cases of glioma, eight of metastatic brain tumor, nine of malignant lymphoma and leukemia, two of germ cell tumor, two of abscess, one necrosis, and one case with normal tissue. There were 3 cases (5.2%) in which an intratumoral hemorrhage with neurological deficits was occurred. They were needed surgically removal and those histological pathology revealed glioma. Concerning location of biopsy, STB for basal ganglia (putamen or globus pallidus) and thalamus were caused complication of the intratumoral hematoma after biopsy. The review of the 575 cases indicates that glioma was the relative risk factor for morbidity associated with CT-guided STB (odds ratio 5.36). The overall morbidity rate was 6.4% (37/575). We considered that tumors of the basal ganglia (putamen or globus pallidus), thalamus and glioma were risk factors of morbidity for CT-guided STB.

Stereotactic biopsy (STB) is used for the diagnosis of lesions occupying the intracranial space. Many reports have shown that CT-guided STB is less invasive, especially for surgically inaccessible lesions and for patients whose general condition is not suitable for craniotomy in order to remove the lesion.[1, 3, 4, 6, 12, 14] However we occasionally experienced postoperative hematoma after biopsy which caused neurological deficits. In this article, we studied the safety of STB with review of literatures.

MATERIALS AND METHODS

CT-guided STB (Brown-Roberts-Wells; BRW) was performed 58 times for 56 patients at Hyogo Cancer Center between 1988 and 2007. The diagnosis was not clear in two cases by the first STB, the additional biopsy was performed. Twenty-nine patients were male and 27 female with the age ranged from 15 to 83 (mean: 55) years old. The selection criteria for STB comprised the patients whose lesions were located in an eloquent area or deep-seated area (brain stem, basal ganglia, pineal body and thalamus). We excluded the cases with severe neurological deformities whose radiological findings showed increased intra-cranial pressure. The patients with bleeding tendency that could not be controlled were also excluded. Locations of tumors are shown in Table I. All the procedures were performed under local anesthesia. STB was planned with the aid of enhanced CT scanning. Abnormal

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density areas, especially enhanced regions, on the CT scan were used as a target for biopsy. We selected two targets on the CT scan and obtained specimens from four to eight pieces by using forceps. Intraoperative frozen-section examinations, permanent paraffin-embedded analysis and immunohistochemical examinations were performed as well as flow cytometry when deemed necessary. Pathologists at our institute decided on the final diagnosis. The pathological diagnoses as well as the surgical complications of each case were studied.

RESULTS

Histological Diagnosis

Histological diagnoses were established for 58 cases, showing 35 cases with glioma, eight with metastatic brain tumor, nine of malignant lymphoma and leukemia, two of germ cell tumor, two of abscess, one necrosis, and one case with normal tissue (Table II). The diagnosis was not clear in two cases (3.4%) by the first STB, one with necrosis and the other with the normal brain tissue. The additional biopsy was performed and both were diagnosed as glioblastoma. In one case, there was no complication associated with the first biopsy of normal tissue, but after additional biopsy, intratumoral hemorrhage occurred and surgical removal was required. Discrepancies between the histological and clinical diagnoses were noted in six (10.3%) cases, all of which were diagnosed as astrocytoma (WHO grade II). None of these cases produced findings suggesting the presence of a malignant glioma, such as necrosis, pleomorphysm, mitotic change or endothelial proliferation. However, malignant glioma was suspected. The clinical course of all these 6 cases deteriorated progressively within 2 months.

Complications

The only complication associated with STB was post-operative intratumoral hematoma. In three cases (5.2%), intratumoral hemorrhage occurred and had to be surgically removed, and two cases (3.4%) suffered permanent hemiparesis (Table III). The morbidity rate was 3.4%. Those three were glioma cases, which showed no other factors related to hemorrhage such as bleeding tendency or having received medication containing anticoagulant or antiplatelet agents. There was no morbidity among patients with other diseases than glioma, nor were there operative mortalities during STB. An examination of the relation between location of biopsy target and complication of hematoma (Table IV) disclosed that hemorrhage after STB had occurred in two cases of basal ganglia (putamen or globus pallidus) and one case of thalamus.

DISCUSSION

Apuzzo et al. reported the BRW unit achieved point-accurate intracranial access with an accuracy of less than 1 mm and the procedural objectives were achieved satisfactorily without mortality and an overall complication rate of only 4%.[1] Many authors have reported that in most cases STB can provide a definitive diagnosis with low risk even for deep brain lesions such as basal ganglia and brain stem.[1, 3, 4, 6, 12, 14] For our cases, the complication rate was 5.2%. The main reasons for the inaccurate diagnosis of the biopsy were heterogeneity of glioma and minor errors of target selection and targeting.[11] Jackson et al. reported the diagnoses based on biopsy or resection for the same patient with glioma differed in 30 (38%) of 80 cases.[5] They recommended surgical resection whenever possible as the initial treatment for patients with suspected glioma.[5] Other authors have reported that positron emission tomography combined with fluorodeoxyglucose guided biopsy was useful.[7,8] They suggested that special efforts were needed for planning accurate biopsy. As for lymphoma, it was

reported that intraoperative frozen-section examinations in conjunction with flow cytometry and measurement of IL-2 receptor were effective for an accurate diagnosis.[9] Permanent paraffin-embedded analysis and immunohistochemical examinations were found to be useful to obtain an accurate diagnosis of tumors such as metastatic brain tumor and germ cell tumors. These procedures were credited with contributing to the accuracy of the diagnoses. In the case of glioma, however, it was sometimes difficult to obtain accurate diagnosis from a small specimen because of the heterogeneity of glioma, so that other examinations were required.

Glioma was the candidate for complication of hematoma in our cases. Postoperative intra-axial hemorrhage requiring surgical removal occurred in three cases. Some authors have studied complications associated with STB.[3, 6, 10, 12, 13] Sawin et al. reported the increased risk of morbidity was associated with the preoperative use of antiplatelet agents, chronic administration of corticosteroids, the presence of deep-seated lesions and malignant gliomas, and an increase in the number of biopsy attempts.[10] If the sample is obtained from a richly vascular lesion, postoperative hemorrhage after biopsy may often happen, and if the samples of malignant glioma contain abnormal vessels, they will cause intra-axial hemorrhage. In our one case of suspected malignant glioma, the erroneous biopsy of normal tissue showed no complication after biopsy. When additional biopsy was performed, an accurate diagnosis of glioblastoma was able to be obtained, but the procedure caused intratumoral hemorrhage. As for biopsy target regions of the tumors in our series, the basal ganglia (putamen or globus pallidus) constituted the target in two cases and the thalamus in one case. They are richly vascular regions with several perforating vessels. It is thought that basal ganglia (putamen or globus pallidus) and thalamus glioma is a high-risk region for STB. Warnick et al. analyzed seven cases of postoperative hematoma after STB and identified four cases of glioblastoma, and one each of anaplastic astrocytoma, lymphoma and low-grade astrocytoma.[13] Five patients with glioblastoma died due to intracranial hypertension after biopsy, one from subarachnoid hemorrhage, one from intracerebral hemorrhage, and three from increased edema without hemorrhage.[2]

According to Kim et al., intracranial hypertension following STB was an important factor causing complications[6]. Many authors have reported complications associated with biopsy.[10, 12, 13] We conducted a search for reported cases among MEDLINE entries from 1998 to 2006 of studies with detailed descriptions of pathological diagnoses and complications of STB. The result of histological diagnoses and morbidity cases are shown in Table V. The overall morbidity rate was 6.4% (37/575). The review of the 575 cases shown in Table V indicates that glioma was the relative risk factor for morbidity associated with STB (odds ratio 5.36). This finding supports our result that STB for glioma is an important factor of morbidity. In addition, special care should be taken to prevent hemorrhage after biopsy for cases with suspected basal ganglia (putamen or globus pallidus) and thalamus glioma. If there is a strong suspicion of glioma, surgical resection and biopsy with craniotomy as well as confirmation of hemostasis should also be considered. CT-guided STB therefore did not always prove to be a less invasive examination for tumors located in putamen or globus pallidus. It is hoped that other, less invasive examinations for glioma located in the basal ganglia will become available in the near future.

CONCLUSION

We considered that glioma of the basal ganglia (putamen or globus pallidus) and thalamus was risk factor of morbidity for CT-guided STB.

Table I. Location of tumor

Total	58 cases (%)
Frontal	10 (17.2)
Parietal	6 (10.3)
Temporal	3 (5.2)
Occipital	2 (3.4)
Pineal	1 (1.7)
Insula	1 (1.7)
Over 2 lobes	
ipsilateral	4 (6.9)
bilateral infiltration	8 (13.8)
Thalamus	8 (13.8)
Basal ganglia (putamen or globus pallidus)	4 (6.9)
Brainstem	1 (1.7)
Multiple	10 (17.2)

Table II. Histological diagnosis

Total	58 cases	%
glioma	35	60.3
astrocytoma	(17)	(29.3)
anaplastic astrocytoma	(6)	(10.3)
glioblastoma	(12)	(20.7)
metastatic brain tumor	8	13.8
malignant lymphoma	8	13.8
leukemia	1	1.7
germ cell tumors	2	3.4
germinoma	(1)	(1.7)
choriocarcinoma	(1)	(1.7)
Abscess	2	3.4
necrosis	1	1.7
normal brain tissue	1	1.7

Table III. Histology and complication (morbidity)

Age	Diagnosis Morbidity	MRI findings	Complication
62	Astrocytoma	rt F, BG, Gd(-)	ICH, lt hemiplegia*
69	GBM	rt BG, Gd(+)	ICH, lt hemiparesis*
40	AA	rt TH, Gd(+)	ICH, lt hemiparesis**

Abbreviations: GBM; glioblastoma multiforme, BG; basal ganglia (putamen or globus pallidus), TH; thalamus, F; frontal, Bil; bilateral, rt; right, lt; left, ICH; intracerebral hematoma, AA; anaplastic astrocytoma, Gd; gadolinium *persistent, **transient

Table IV. Biopsy target and complication (hematoma)

Biopsy target	Case	Hematoma (case)
Lobe (cerebrum)	43	0
Pineal body	2	0
TH	8	1
BG (putamen or globus pallidus)	4	2
Brainstem	1	0

Abbreviations: BG; basal ganglia, TH; thalamus

Table V. Histological diagnosis and morbidity (Summary of reviewed cases containing our cases)

	Cases	Histology	morbidity	odds ratio
575	295 (51.3%)	glioma	31(10.5%)	5.36
	82 (14.3%)	lymphoma	3 (3.7%)	0.51
	61 (10.6%)	metastasis	0 (0%)	
	10 (1.7%)	germ cell tumor	1 (10%)	1.63
	16 (2.8%)	inflammation	1 (6.3%)	0.97
	18 (3.1%)	abscess	1 (5.6%)	0.85
	93 (16.2%)	others	0 (0%)	

Results of analysis were shown.

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