Original Article

Role of computed tomography in the evaluation of schwannoma in the posterior cranial fossa

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Abstract

Schwannoma is one of the most common posterior cranial fossa tumours. Normal skull radiograph may not give any clue to diagnosis and further investigation with computed tomography or magnetic resonance imaging is necessary. This cross sectional study was carried out in the department of neurosurgery and the department of radiology and Imaging, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh during the period from July 2009 to June 2011 to evaluate the role of computed tomography in the diagnosis of schwannoma in the posterior cranial fossa. Total eighty nine patients with clinical features of posterior cranial fossa tumour were enrolled in this study. Mean age of the patients was 29.15±19.64 years. Computed tomography scan revealed that 38.2% had schwannoma, 24.7% had meningioma, 21.3% had astrocytoma, 15.7% medulloblastoma, 10.1% had brain stem glioma, 5.6% had ependymoma and for the rest 4.4%, 1.1% of each had epidermoid, metastatic, hemangioblastoma and others. After histopathological diagnosis 36.0% patients had schwannoma, 19.1% had astrocytoma, 15.7% had medulloblastoma, 11.2% had meningioma, 7.9% had brain stem glioma, 5.6% had ependymoma and rest 4.4% had epidermoid, metastatic, hemangioblastoma and others. Sensitivity of computed tomography to diagnose schwannoma was 100.0%, specificity 96.5%, positive predictive value 94.1%, negative predictive value 100.0% and accuracy 97.8%. It can therefore be concluded that computed tomography is a useful modality in the evaluation of schwannoma in the posterior cranial fossa.

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Introduction

The most common posterior cranial fossa tumours of brain in case of adult are schwannoma, meningioma and epidermoid.[1] A brain tumour, when occurring in the posterior cranial fossa and involving the brain stem, is one of the most devastating forms of human illness.[2] The plain radiograph was the only means for the evaluation of intracranial neoplasms in recent past. However, normal skull radiograph can not rule out intracranial pathology and therefore further investigation with computed tomography or magnetic resonance imaging is mandatory.[3] Schwannoma is a benign tumour and composed entirely of schwann cells. Neurofibroma is a well-differentiated nerve sheath tumour composed predominantly of schwann cells and, to a lesser extent, fibroblasts and perineural cells. Neurofibromas of cranial nerves are extremely rare.[4] Schwannomas are the second most common extra axial intracranial tumours preceded only by meningiomas. They constitute 5.0–10.0% of all intracranial neoplasms.[5] The peak incidence is between the third and sixth decade. Macroscopically, schwannomas are typically well circumscribed and more often globular than fusiform in configuration. In small lesions, the parent nerve can be detected within the tumour, but in larger tumours the relationship between the nerve and the tumour becomes obscured.[6] Schwannoma is surrounded by a thick, completely collagenous capsule.[7] Microscopically, according to the morphology of the tumour cells and their spatial arrangements, two patterns can be distinguished - the Antoni A and Antoni B types as described in 1920 by Antoni. In the Antoni A type, tumour texture is compact and composed of interwoven bundles of long bipolar spindle cells. The type B Antoni architecture is often intermingled with type A and has a loose texture and polymorphism. Mucinous and cystic changes occur and when confluent, large cysts develop.[8] Like their intraspinal counterparts, the intracranial schwannomas show a predilection for the sensory nerves, and most often involve the vestibular division of the eighth nerve. The fifth cranial nerve is the second most common site of origin. Schwannomas of the jugular foramen usually originate from the ninth nerve. The facial nerve schwannoma can be located in the internal auditory canal or in the facial canal. On non-enhanced CT scans, most schwannomas are iso-attenuating relative to brain parenchyma. Calcification

or areas of haemorrhage are rare. On contrast-enhanced computed tomography scans, the enhancement pattern is typically homogeneous.[5] Bone-window images can demonstrate remodeling of the adjacent skull base, such as expansion of the internal auditory canal by vestibular schwannomas and expansion of the facial canal by facial schwannomas. Expansion of the jugular foramen by cranial nerve IX, X, or XI schwannomas can also be seen.[9] Thin-collimation computed tomography imaging of the skull base can be helpful in evaluating bone destruction. This finding is useful in differentiating jugular foramen schwannomas from paragangliomas.[10] With computed tomography scanning, large lesions can be diagnosed with a high degree of confidence. However, distinguishing a schwannoma from a meningioma may not be possible by using computed tomography scanning. A small lesion that affects a cranial nerve cannot be confidently excluded. Computed tomography findings can be false-negative in small lesions. Occasionally, a false-positive diagnosis occurs because a streak artifact in the cerebellopontine angle cistern mimics a lesion.[11] The current study aimed at providing information regarding appropriate diagnosis of schwannoma by computed tomography scan and helping in further decision making for appropriate management as well as introducing computed tomography scan in all levels of hospitals.

Methods

It was a cross sectional type of study. The study was carried out in the department of Radiology & Imaging, Bangabandhu Sheikh Mujib Medical University, Dhaka in collaboration with department of neurosurgery of the same hospital. Clinically suspected cases of posterior fossa tumours attended in the neurosurgery department of Bangabandhu Sheikh Mujib Medical University were enrolled in this study. This study was carried out from July 2009 to June 2011. Consecutively selected 98 patients with a suspicion of posterior cranial fossa neoplasm were referred for CT of brain. At first all the patients were evaluated by detail history and clinical examination with special emphasis on nervous system. CT of brain was performed in all cases. After surgery histopathological diagnosis was done. The histopathological reports were collected and correlated with CT findings. Among all, 7 patients refused to undergo surgery and no histopathological reports were available from another 2 patients. Finally, histopathology reports from 89 patients were available and they were considered as study sample. All these information were collected in a pre-designed structured data collection sheets. Sample size was determined by power analysis for a single proportion. We hypothesized that accuracy of CT in the diagnosis of posterior cranial tumour will be 90% or greater.

The sample size was calculated for a power level of greater than 80%, an ? error of 0.05, and expected diagnostic accuracy of CT scan of 83.0% based on previous reports.[6] We considered 10% drop out rate. So, at the initial stage of study we planned to enroll 98 patients. [Increased sample size by a factor of (1? [1-0.10]), or 1.11]. Samples were selected randomly among the patients having posterior cranial fossa tumours who attended in the department of neurosurgery and department of radiology & imaging of BSMMU. Inclusion criteria were patient having clinical suspicion of posterior cranial fossa tumour who had CT scan of brain, patients of all age group irrespective of their sex and patients having single intracranial masses labeled as brain tumour on the basis of their CT features. Exclusion criteria were patients who were not willing to undergo surgery and hence no histopathological reports were available, multiple lesions and patient who were not fit for surgery.

Prior to the commencement of this study, the research protocol was approved by the Ethical review committee of Bangabandhu Sheikh Mujib Medical University, Dhaka. The aims and objectives of the study along with its procedure, risks and benefits of this study were explained to the patients in easily understandable local language. Informed consent was taken from each patient. It was assured that all information and records would be kept confidential and the procedure would be helpful for both the neurosurgeons and the patients in making rational approach of the case management.

Statistical analyses of the results were obtained by using window based computer software devised with statistical packages for social sciences (SPSS-13). The results were presented in tables and figures. For the validity of study outcome, sensitivity, specificity, accuracy, positive predictive value and negative predictive value of CT scan in the diagnosis of schwannoma in the posterior cranial fossa were calculated.

Results

Maximum 30.3% patients belonged to the 'up to 10 years' age group followed by 22.4% to 41-50 years age group, 19.1% to more than 50 years, 12.4% to 11-20 years, 11.2% to 21-30 years and rest 4.5% to 31-40 years age group. Mean age of the patients was 29.15±19.64 years (Figure-1).

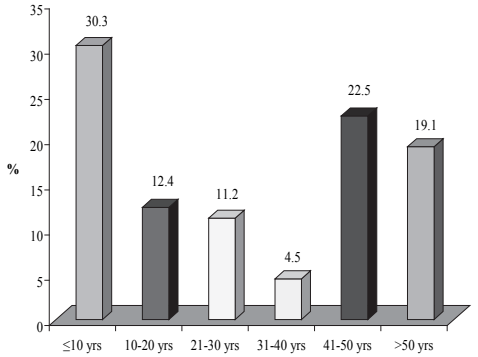

Figure-1: *Bar diagram of the patients by age group*

Out of all patients 38.2% had schwannoma, 24.7% had meningioma, 21.3% had astrocytoma, 15.7% medulloblastoma, 10.1% had brain stem glioma, 5.6% had ependymoma and rests 4.4% had epidermoid, metastatic, hemangioblastoma and others (1.1% each). (Figure-2)

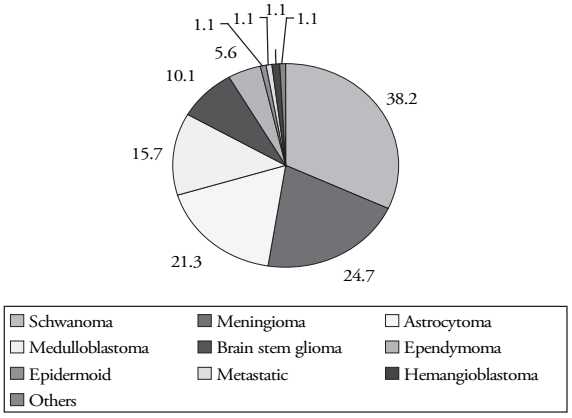

Figure-2: *The computed tomography distribution of the posterior fossa tumour*

Histopathological diagnosis of the different types of posterior fossa tumour showed that 36.0% had schwannoma, 19.1% had astrocytoma, 15.7% had medulloblastoma, 11.2% had meningioma, 7.9% had brain stem glioma, 5.6% had ependymoma and rest 4.4% had epidermoid, metastatic, hemangioblastoma and others. (Figure-3)

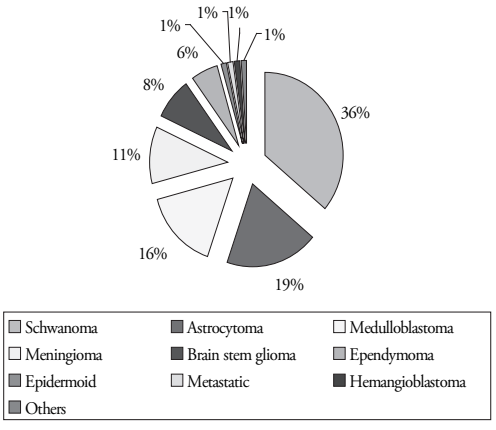

Figure-3: *Histopathological diagnosis of the posterior fossa tumour*

Out of all patients, 32 cases were diagnosed as schwannoma by computed tomography and confirmed by histopathological evaluation. They were true positive. Two cases were diagnosed as schwannoma by computed tomography but not confirmed by histopathological findings. They were false positive. Out of 55 cases not having schwannoma on computed tomography, all 55 were confirmed by histopathology. So, false positive cases and true negative cases were 0 and 55 respectively. Sensitivity of computed tomography to diagnose schwannoma was 100.0%, specificity 96.5%, positive predictive value 94.1%, negative predictive value 100.0% and accuracy 97.8%. (Table-I)

Table-I: Sensitivity, specificity, accuracy, positive and negative predictive values of the computed tomography in the diagnosis of schwannoma

Validity tests for Schw an noma	Values of the CT (%)
Sensitivity	100.0
Specificity	96.5
PPV	94.1
NPV	100.0
Accuracy	97.8

PPV = Positive Predictive Value; NPV = Negative Predictive Value

Discussion

This study included 89 patients who were confirmed as posterior cranial brain tumours. The age ranged from 4 months to 57 years and the mean age (±SD) was 29.15 ± 19.64 years. In Khalid et al series a total of 100 patients were included who underwent computed tomography scan for suspected brain tumours.[12] The patient's age ranged from 13-85 years and mean age 43 years. Age distribution of their series is not comparable with our findings because age range of their patients was 13 to 85.

In the present series computed tomography scan revealed that 34 (38.2%) patients had schwannoma and 36.0% had histopathologically diagnosed schwannoma. Our study finding was not comparable with Khalid et al findings. The computed tomography findings of Khalid et al study revealed that out of hundred cases, gliomas were 48, meningiomas 25, pituitary adenomas 12, craniopharyangiomas 6, pineal region tumours 4, acoustic neuromas 3 and choroid plexus papilloma in 2 cases.[12]

Out of all patients, 32 cases were diagnosed as schwannoma by computed tomography scan and confirmed by histopathological evaluation. Two cases were diagnosed as schwannoma by computed tomography scan but not confirmed by histopathological findings.

Sensitivity of computed tomography scan to diagnose schwanoma was 100.0%, specificity 96.5%, positive predictive value 94.1%, negative predictive value 100.0% and accuracy 97.8%. Chung et al retrospectively reviewed the computed tomography scan (9 cases), Magnetic resonance imaging (3 cases) and medical records of 10 facial schwannoma patients. After classifying these into intra temporal schwanoma and extra temporal schwanoma, radiologic and clinical findings were analyzed. The most common clinical manifestations were facial nerve dysfunction (6/6 cases, 100%) and hearing impairment (5/6 cases, 83.3%) in intra temporal schwanoma and parotid mass (4/4 cases, 100%) in extra temporal schwanoma. Geniculate ganglion was the most commonly involved segment of intra temporal schwanoma (5/6 cases, 83.5%). On computed tomography scan, intra temporal schwanoma arising in geniculate ganglion(4 cases) showed erosion of the petrous bone (4 cases), cochlea (3 cases), lateral semicircular canal (1 case) and ossicles (3 cases). Intra temporal schwanoma arising in the mastoid segment (1 case) showed the destruction of the jugular plate and external auditory canal wall. All three intra temporal schwanoma in which MRI was performed showed iso- to hypointensity on T1WI, hyperintensity on T2WI and well-enhanced on post-enhanced T1WI. Extra temporal schwanoma showed various findings, but all four extra temporal schwanoma were located in the posterolateral portion of the retromandibular vein and extended toward the stylomastoid foramen. In conclusion, intra temporal schwanoma shows the schwannoma on MRI. Extra temporal schwanoma shows various findings. However, if the tumour is located along the extratemporal facial nerve course, then facial schwannoma may be suspected.[5] Comparable to our findings, Khan et al showed sensitivity of computed tomography scan in diagnosis of brain tumours in children was 93.33%.[13] In Khalid series the diagnostic accuracy of computed tomography scan was found to be 83% on average.[12] High sensitivity, specificity and accuracy of computed tomography scan in the diagnosis of schwannoma in posterior fossa confirm that computed tomography scan is a useful preoperative diagnostic modality for schwannoma in posterior cranial fossa.

Computed tomography scan findings of the present study correlated well in most of the cases with the histopathological results. It can therefore be concluded that computed tomography scan is a useful modality in the evaluation of schwannoma in posterior cranial fossa. MRI could be added as an additional imaging modality in solvent patients and comparing its diagnostic accuracy with computed tomography scan.

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