Computed tomography-guided stereotactic aspiration and biopsy of a cystic metastatic adenocarcinoma of the pons

TH Aung, CK Kwok, YF Mak, EG Mak

We herein report a case of adenocarcinoma of the right main bronchus disseminated to the pons, left cerebral peduncle, and liver. Computed tomography-guided Cosman-Robert-Wells stereotactic aspiration of the cystic pontine lesion was performed through a transoccipital, transtentorial route and a catheter inserted in the cyst cavity that was connected to a subgaleal Ommaya reservoir for further aspiration and decompression. The choice of this approach to the lesion is briefly discussed.

HKMJ 1997;3: 232-5

Key words: Brainstem; Brain neoplasms; Aspiration, mechanical

Introduction

Computed tomography-guided stereotactic surgery of brainstem lesions using the Brown-Roberts-Wells (BRW), Cosman-Roberts-Wells (CRW), Kelly-Goerss and Leksell stereotactic systems[1-6] has been described in the literature with a 98% positive biopsy rate. While lesions such as gliomas, demyelinating processes, inflammatory granulomas, cavernous angiomas, and pyogenic abscesses have been recognised, there are few reports of metastatic adenocarcinoma occurring in the brainstem. Although magnetic resonance imaging (MRI) can elegantly demonstrate brainstem pathology in many cases,[7] without the artifacts seen on computed tomography (CT),[8] CT should still be considered an alternative for depicting such lesions. While usually a pre-coronal burr hole with a transfrontal approach for lesions in the rostral midbrain[4,5,9] and suboccipital burr hole with a transcerebellar approach for lesions in the lower pons[2,5,9] are used, we approached the lesion in this patient through a transoccipital-transtentorial route without any procedural-related complications. We would like to share the experience after reviewing the literature.

Case report

A 34-year-old Chinese man was admitted in August 1995 with a one-week history of slurring of speech, unsteady gait, and diplopia. On examination he was afebrile, appeared dull, and walked with a wide base gait. He also had impaired gag reflex with multiple lower cranial nerve palsies and right-sided cerebellar signs. Reflexes were brisk in the lower limbs with an extensor plantar response on the right side. The haematological examination was normal and his erythrocyte sedimentation rate was 5 mm/hr Westergren. Renal function and liver function tests were also normal and the chest X-ray and skull X-rays were also unremarkable. The CT scan with contrast revealed a cystic lesion in the pons with a rim enhancement. A T1-weighted MRI with gadolinium diethylenetriaminepentaacetic acid suggested a cystic tumour in the pons (Fig 1).

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Fig 1. Pre-operative T1-weighted magnetic resonance imaging of the brainstem after administration of Gadolinium-diethylenetriaminepentaacetic acid. Transverse (left) and sagittal (right) sections demonstrating a rim-enhanced cystic lesion (arrow) in the pons.

Operative technique

Stereotactic surgery is an operative procedure where the probe is advanced to a predetermined target using a stereotactic frame with three-dimensional arrangement. Under local anaesthesia, the CRW head ring was fixed to the patient's head and with the CRW localizer, a CT scan with contrast was taken (Fig 2). The patient was then given general anaesthesia and placed in the supine position with the neck in flexion. The XY co-ordinates obtained from the CT scanner console were entered into the portable computer and the target was calculated from the pre-installed program. After confirmation on a phantom base, the CRW arc system was returned onto the base ring. A semicircular scalp flap, about 3 cm in diameter, was made in the occipital region, 3 cm above the torcular and 3 cm lateral to the midline, guided by the probe in the CRW-3 arc system.

A 1/8th inch twist drill hole was made through the skull and the dura was punctured. A biopsy probe was then introduced along the twist drilled hole, through the dura and occipital lobe until it came to a stop on the upper surface of the tentorium. At this point, the biopsy probe was removed and a sterile probe with a pointed tip was passed along the tract. With a rotatory movement of the probe tip, a hole was created in the tentorium. The probe was removed and a ventricular catheter with a stylet was introduced along the newly-created tract. The wall of the cyst was punctured and about 20 mL of straw-coloured fluid with some necrotic tissue was aspirated. The (Hermatic) ventricular catheter (Baxter Healthcare Corp., Deerfield, Ill, US) was cut, leaving about 8 cm length in situ and connected to an Ommaya reservoir.[10] The scalp flap was closed over the reservoir and the whole CRW-3 system removed.

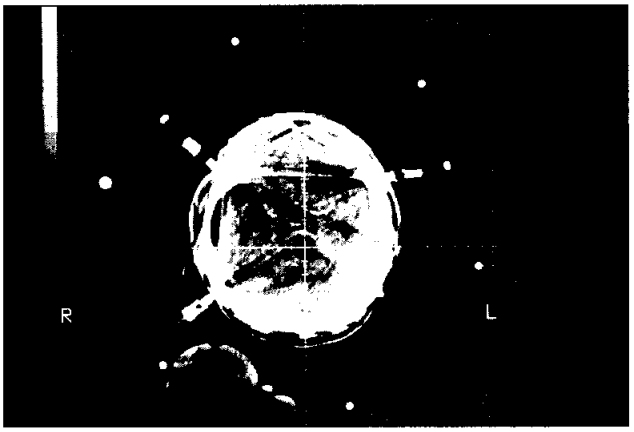

Fig 2. Computed tomographic scan of the patient with CRW head ring and BRW localizer affixed to the skull. Transverse section with nine fiducial markers and target over the centre of the cystic lesion.

The post-operative period was uneventful and the patient became more conscious and communicative. Cytological studies of the fluid showed atypical cells and the tissues aspirated were later confirmed histologically to be metastatic adenocarcinoma. The patient remained stable for approximately one week and a post-operative CT scan depicted collapse of the

cyst with the cyst catheter in situ (Fig 3). He became dull again one week later and required repeated aspiration of the cystic fluid through the reservoir. Three weeks after the stereotactic surgery he became comatose and had jaundice and ascites. His serum albumin was 25 g/L (normal range, 40-60 g/L) and serum alanine aminotransferase was raised to 102 U/L (normal range, 0-35 U/L). After ventilation for another two weeks, he died.

Autopsy revealed a fleshy greyish tumour in the pons that was expanding into the left cerebral peduncle (Fig 4). The ventricular cyst catheter was also seen passing through the right occipital lobe, tentorium, and the vermis of the cerebellum with no compromise to the major vessels and no evidence of a haematoma on the tract. Histological section revealed a moderately differentiated adenocarcinoma involving the lung and the right main bronchus with similar histological features in the lesions of the cerebral peduncle, pons, and both lobes of the liver (Fig 5).

Discussion

Image-guided stereotactic biopsy and aspiration of brainstem cystic lesion can result in significant amelioration of symptoms and reversal of neurological deficits although it may not change the patient's ultimate outcome.[4,8,11] Minimally invasive CT-guided stereotactic biopsy and aspiration seems to be the ideal initial procedure before embarking on a major surgical procedure. While it is true that stereotactic biopsy carries an extremely low mortality, it is not without risk. Choice of approach to such lesions should be individualised and after careful study of possible structures that may be encountered in the approach.

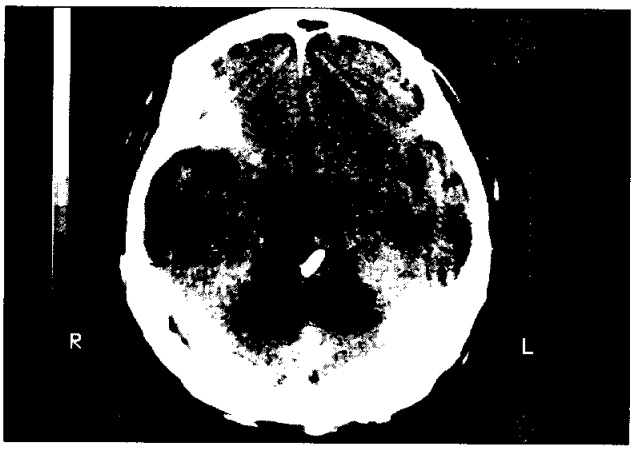

Fig 3. Post-operative computed tomographic scan of the patient with ventricular catheter in the cyst demonstrating the collapse of the cyst wall.

The risk of subdural or subarachnoid haemorrhage when the stereotactic puncture probe pierces the tentorium should also be kept in mind. Open craniotomy may result in significant morbidity, especially if the lesion in this region turns out to be an abscess.[12] Lesions in the brainstem can be approached through the frontal, occipital transtentorial, or suboccipital transcerebellar routes, depending on the location of the lesion. Usually, lesions in the rostral midbrain and upper pons are approached through the frontal route and lesions in the lower pons and upper medulla can be approached either by the occipital transtentorial or suboccipital transcerebellar routes. The frontal approach requires passage through the ventricle and thalamus but less vascular structures are encountered. The midbrain is about 8 cm from the frontal burr hole. The occipital approach requires passage through the tentorium and the cerebellar vermis. There is a risk of subdural or subarachnoid haemorrhage and injury to the vein of Galen and draining veins, if the stereotactic puncture is not made at a distance from the tentorial margin. Hence, careful planning and study of anatomical structures should be made before embarking on these procedures.

Fig 4. Post-mortem examination: transverse section at the level of the cerebral peduncle showing the tumour in the pons and left cerebral peduncle.

Potential brachytherapy of brainstem gliomas using stereotactically-implanted isotopes (iodine-131 or iridium -192 or intracavitatary irradiation with beta-emitting radioisotopes phosphorous-32(32P) chromic phosphate,[5] yttrium-90, and rhenium-186) has been reported to be effective in prolonging survival of patients, but there is no record of its application or efficacy with metastatic brainstem lesions. Recently, gamma knife radiosurgery has been shown to be effective for solitary metastatic lesions in the cerebrum,

but its role in treating brainstem metastatic lesions has not been studied because of the rarity of this lesion. Although a cystic lesion may be aspirated repeatedly with brachytherapy as an acceptable option after histological confirmation, this patient's rapidly worsening clinical state precluded him for receiving radiotherapy. In retrospect, we could have not ventilated the patient and let him die peacefully when he became comatose with jaundice and ascites.

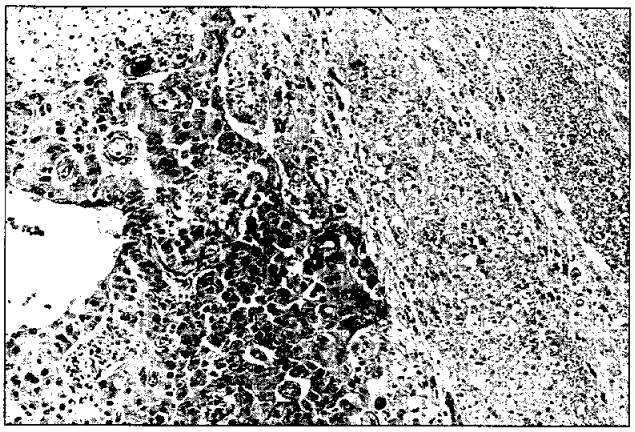

Fig 5. High power photomicrographs of the tumour in the cerebral peduncle, showing a moderately differentiated adenocarcinoma with surrounding oedema and reactive gliosis (H&E, x 100).

While most authors use the transfrontal or the suboccipital transcerebellar routes we found that for this particular patient the transoccipital transtentorial route[4] provided better access with no added complications related to the procedure. This route also avoids traversing important structures such as the thalamus or ventricles although it may trangress several pial planes. The major complication of bleeding from the vein of Galen or draining veins can be avoided by this approach, as the probe passes below and lateral to these structures.

Implantation of the reservoir over the occipital region for subsequent aspiration provides immediate amelioration of the neurological symptoms and causes no compression of the reservoir when the patient is lying down. The infratentorial approach requires the base frame to be placed extremely low and would pose a problem in patients with a short neck.[2] This corridor, under the transverse sinus would pass through the middle cerebellar peduncle. The transfrontal route involves traversing a vast amount of brain as well as the lateral ventricle, and the interpeduncular cistern must be meticulously avoided.[8] It is not suitable for lesions in the rostral midbrain and lower pons. We would therefore like to recommend the transoccipital transtentorial approach when such lesions are located in the brainstem.

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