

## Accuracy of C-Arm Guided Insertion of Ommaya Reservoir Tube in Recurrent Cystic Craniopharyngiomas

MOHAMMED ADAWI, M.D.; MAHMOUD WAHDAN, M.D. and MOHAMMED MOURAD, M.D.

*The Department of Neurosurgery, Faculty of Medicine, Benha University, Egypt*

### Abstract

**Background:** Craniopharyngiomas in spite of being benign tumors they have a high rate of recurrence of which cysts constitute major component. Ommaya Reservoir System (ORS) is a simple manoeuvre for percutaneous drainage of cysts.

**Aim of Study:** To evaluate the efficacy of using C-arm as a guiding tool for placement of Ommaya reservoir tube in predominantly cystic recurrent craniopharyngiomas.

**Patients and Methods:** This study included 8 patients with clinically symptomatic and radiologically confirmed recurrent craniopharyngioma with significant cystic part. These patients were treated by C-arm guided insertion of Ommaya reservoir tube. The technique is described in details. CT brain was obtained in the first post-operative night to assess the position of the tube. Post-operative clinical and radiological evaluations were compared to the pre-operative.

**Results:** This study included 6 males and 2 females, ranging in age from 5 years to 38 years with mean age of 18.4 years. Headache was the most common presenting complaint, followed by visual impairment. All surgeries were performed with C-arm guidance and post-operative CT brain documented satisfactory position of the tube in 7 cases and only one case required second look surgery for repositioning of the tube with the same technique. Significant post-operative improvement of headache and visual symptoms were encountered in all cases due to decompression of the optic chiasm by cyst drainage.

**Conclusion:** C-arm assisted insertion of Ommaya reservoir tube is a reliable method that can minimize the errors of free hand technique and of special value in low facility centers.

**Key Words:** Craniopharyngioma – Cyst – Ommaya reservoir.

### Introduction

**RECURRENCES** of craniopharyngioma are a fact of life. The rate of recurrence may be as high as 40% in some series [1].

---

**Correspondence to:** Dr. Mohammed Adawi, The Department of Neurosurgery, Faculty of Medicine, Benha University, Egypt

One of the typical characteristics of craniopharyngiomas is the presence of a cyst within the tumor. Such cysts occur in more than 90% of tumors and often the cyst comprises the major component of the tumor [2].

The goal of surgery is decompression of the optic and ventricular pathways. For primarily cystic tumors, drainage and injection of radioactive isotopes or a chemotherapeutic agent may be an alternative to surgical resection [3].

First described in the 1960s, Ommaya reservoir placements have various applications, most notably allowing ventricular access for sampling and therapy in cancer [4].

Recurrent lesions with significant cystic component not amenable to total extirpation may be treated by repetitive aspirations through an indwelling Ommaya reservoir apparatus [5].

Ventricular catheter placement associated with an Ommaya reservoir has been accomplished by several techniques over the years. A freehand catheter technique was used initially, but over the years has been largely supplanted by various forms of image guidance as technology has improved and practitioners have recognized that freehand placement was associated with a high rate of failure [6].

### Patients and Methods

Eight cases with recurrent cystic craniopharyngioma were treated by inserting Ommaya reservoir system for cyst drainage in Benha University Hospital between March 2016 and October 2018. Information on clinical manifestation, histopathology, surgical technique, and outcome was obtained by review of the patient charts and radiological reports. Follow-up was available from 4-18 months.

*Surgical technique:*

The patient is placed supine with the head in a neutral position over a radiolucent table. By using CT brain with reformatting, relation of the cyst to the anterior and posterior clinoid processes in the antero-posterior plane, as well as its relation to the frontal crest and crista galli in the lateral plane, are studied and documented. The distance between the outer table of the frontal bone and the basal

part of the cyst is also documented to identify the ideal length of the tube. Relying on these bony landmarks, the C-arm is used to guide the insertion of the tube in the operative theater Fig. (1).

After confirming the target position of the tube, the stylet is removed and very small volume of cyst fluid is withdrawn, then final assembly of the system is performed by connecting the tube to the side of the reservoir Fig. (2).

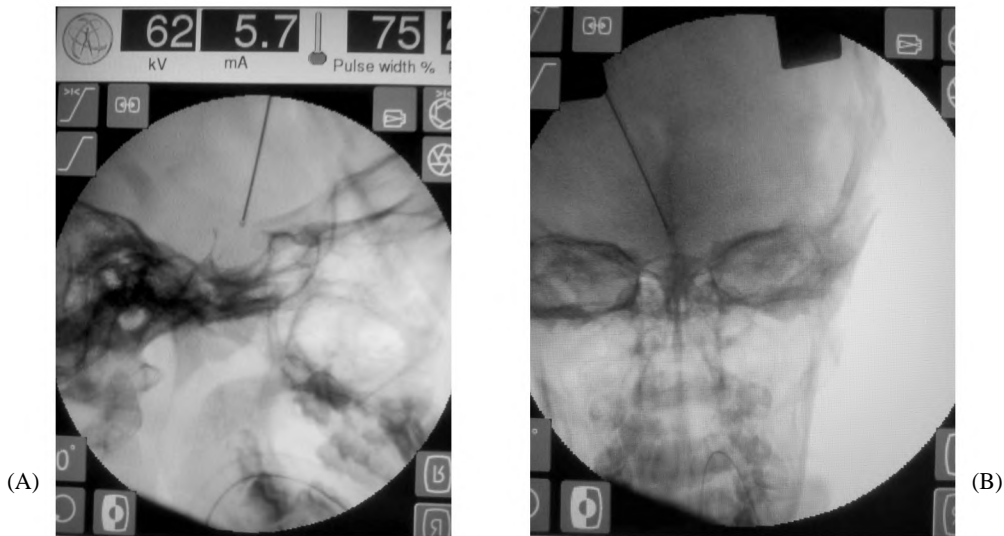


Fig. (1): Intra-operative C-arm images (A) Lateral view showing the target end of the tube tip behind and just above the anterior clinoid (to be in the center of the cyst and just above its bottom), (B) Antero-posterior view showing the distal end of the tube in the midline.

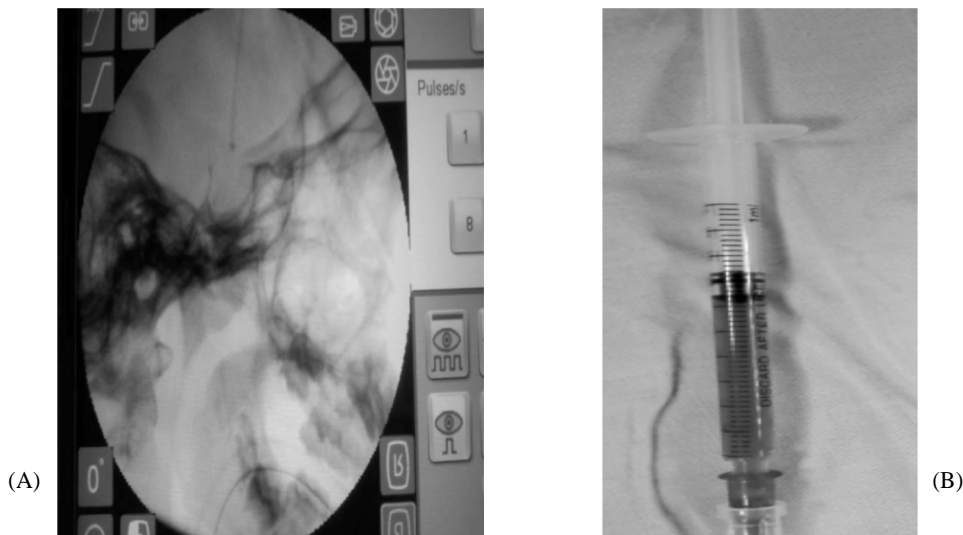


Fig. (2): (A) Lateral view by the C-arm showing the final tube position after removal of the stylet, (B) Characteristic craniopharyngioma fluid.

**Results**

Six patients were males, and 2 were females. The ages ranged from 5 years to 38 years with mean age of 18.4 years. At admission, headache was the most frequent presentation in all patients, followed by visual manifestations in 7 patients.

All included cases were treated by inserting Ommaya reservoir tube using the described technique. Post-operative CT brain documented accepted position of the tube end in all except one case that required second look surgery by the same technique Fig. (3).

Significant post-operative improvement of headache and visual symptoms were encountered in all

cases due to decompression of the optic chiasm by cyst drainage Fig. (4).

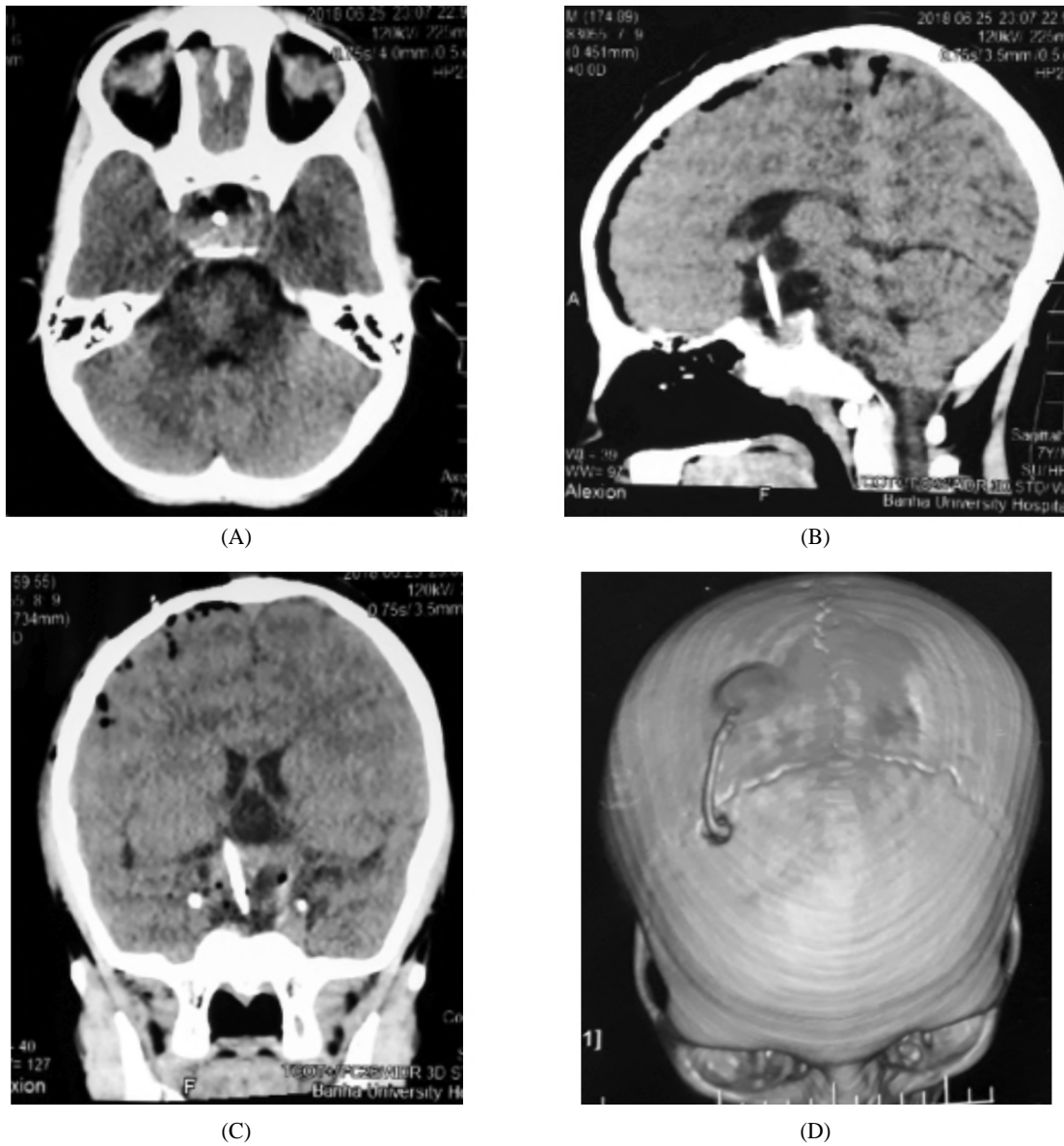


Fig. (3): First day post operative CT brain of 5 years old boy showing accepted tube position in (A) Axial plane, (B) Sagittal plane, (C) Coronal plane, and (D) 3D re-formatting showing the position of the burr hole and the connection of the tube to the reservoir.

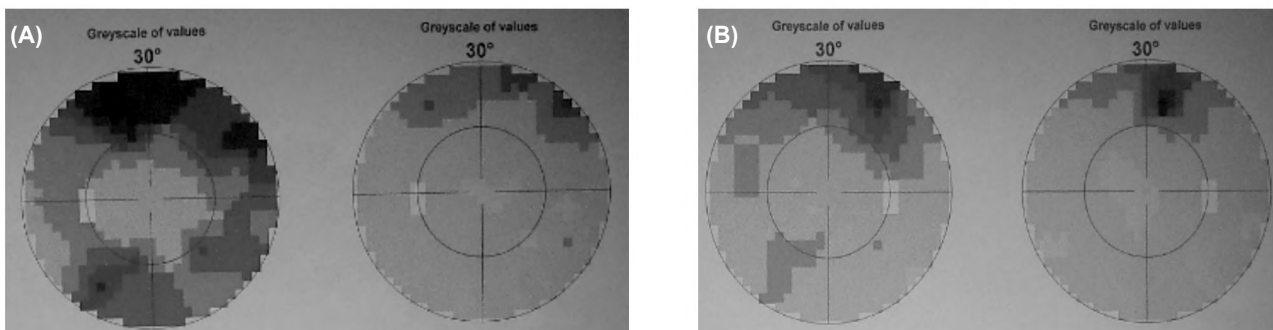


Fig. (4): Visual field examination for 35 years, female patient treated by the described maneuver. (A) Visual field of the left eye: Pre-operative field "left image" with dramatic improvement in post-operative assessment "right image". (B) Visual field of the right eye: Pre-operative field "left image" with improvement in post-operative assessment "right image".

## Discussion

Craniopharyngiomas (CPs) are benign, slow growing tumors whose ideal management remains controversial and challenging. They arise from remnants of the craniopharyngeal duct and/or Rathkes cleft. These tumors have an incidence of between 1.2% and 4.6%, with a bimodal age distribution, one peak occurring in children and the other in adults between the 4<sup>th</sup> and 6<sup>th</sup> decades. These tumors are located close to the visual apparatus, hypothalamus, pituitary stalk, 3<sup>rd</sup> ventricle, and vasculature from the circle of Willis [1].

The Ommaya reservoir is used widely in neuro-oncology, primarily for the instillation of intrathecal chemotherapy and frequent CSF tapping in patients with CNS disease [7]. We used the ommaya reservoir to continuously drain the cystic component of craniopharyngiomas.

Ommaya reservoir placement is frequently a procedure performed in very ill patients with late stage disease, in whom minimizing anesthesia and operative time is important for reducing peri-operative risk. Before the advent of neuronavigation using infrared and other tracking modalities, fluoroscopy was available to monitor catheter placement intraoperatively [8].

We consider that fluoroscopic guidance was associated with safety and simplicity on top of acceptable accuracy.

Much of the evidence regarding image guidance for ventricular catheter placement is found in the literature describing ventricular shunt procedures. It has been well established that using image guidance to place a ventricular catheter results in more accurate catheter placement than by a freehand technique [8,9]. By using the same principle we could place the catheter directly in the cystic component of craniophayngioma but depending on the bony fixed structures found near the suprasellar area. So, it's not affected by errors that may occur with navigator after egress of some cyst fluid (brain shift like).

In order to assess the accuracy of catheter placement, we relied on two parameters first is the position of the catheter inside the craniopharyngioma cyst and the steadiness of the fluid coming through the catheters.

Complications related to Ommaya reservoir placement such as infection or mal-positioning of the catheter are rare, but can have significant consequences in an already compromised patient

population [10-12]. We had a case with misplaced catheter required second look surgery for repositioning of the tube with the same technique. There was no morbidity as it didn't injure any of the important structures in the nearby area with minimal flow as the tube was touching the cystic component and drained some of the retained fluid.

Patients were referred to Gamma Knife after ensuring adequate cyst drainage.

We found that this technique is valuable as it enables the surgeon to directly visualize the termination point of the catheter to the desired location at the end of the procedure, allowing for small adjustments prior to departing from the operating room and obtaining the post-operative CT scan.

## Conclusion:

We can conclude that this technique can be used safely and effectively for placement of the catheter tip of the Ommaya reservoir in acceptable location and do not require rigid fixation of the head.

## References

- 1- RUTKA J.T.: Endonasal resection of Craniopharyngiomas. *J. Neurosurg.*, 109: 1-5, 2008.
- 2- STEINBOK P. and HUKIN J.: Intracystic treatments for craniopharyngioma. *Neurosurg. Focus.*, 28 (4): E13, 2010.
- 3- GOTTFRIED O.N., COULDWELL W.T. and WEISS M.H.: Tumors of the Sellar Region: Craniopharyngioma and Pituitary Adenoma. In: Baehring JM, Piepmeier JM (eds): *Brain Tumors Practical Guide to Diagnosis and Treatment*. New York, Informa Healthcare, 20: 353-75, 2007.
- 4- OMMAYA A.K.: Subcutaneous reservoir and pump for sterile access to ventricular cerebrospinal fluid. *Lancet*, 2 (7315): 983-4, 1963.
- 5- SPAZIANTE R., IRACE C. and De DIVITIIS E.: Brachytherapy of cystic craniopharyngiomas. *J. Neurosurg.*, 79: 966-7, 1993.
- 6- WEINER G.M., CHIVUKULA S., CHEN C.J., DING D., ENGH J.A. and AMANKULOR N.: Ommaya reservoir with ventricular catheter placement for chemotherapy with frameless and pinless electromagnetic surgical neuronavigation. *Clinical Neurology and Neurosurgery*, 130: 61-6, 2015.
- 7- McDERMOTT M.W., CIRICILLO S.F., GUTIN P.H. and EDWARDS M.S.: Stereotactic insertion of an ommaya reservoir: Technical note. *Can J. Neurol. Sci.*, 22 (3): 235-8, 1995.
- 8- WILSON T.J., STETLER W.R., AL-HOLOU W.N. and SULLIVAN S.E.: Comparison of the accuracy of ventricular catheter placement using freehand placement, ultrasonic guidance, and stereotactic neuronavigation. *Journal of Neurosurgery*, 119 (1): 66-70, 2013.

- 9- LEVITT M.R., O'NEILL B.R., ISHAK G.E., et al.: Image-guided cerebrospinal fluid shunting in children: Catheter accuracy and shunt survival. J. Neurosurg. Pediatr., 10 (2): 112-7, 2012.
- 10- SANDBERG D.I., BILSKY M.H., SOUWEIDANE M.M., BZDIL J. and GUTIN P.H.: Ommaya Reservoirs for the Treatment of Leptomeningeal Metastases. Neurosurgery, 47 (1): 49-55, 2000.
- 11- PERRIN R.G., LISHNER M., GUHA A., CURTIS J., FELD R. and MESSNER H.: Experience with Ommaya reservoir in 120 consecutive patients with meningeal malignancy. Can. J. Neurol. Sci., 17 (2): 190-2, 1990.
- 12- PEYRL A., CHOCHOLOUS M., AZIZI A.A., et al.: Safety of Ommaya reservoirs in children with brain tumors: A 20-year experience with 5472 intraventricular drug administrations in 98 patients. J. Neurooncol., 120 (1): 139-45, 2014.

## دقة جهاز الأشعة ذو الذراع المتحرك C-Arm فى إدخال أنبوب خزان أومايا فى علاج الأورام القحفية البلعومية الكيسية المتكررة

الخلفية: الأورام الكيسية البلعومية على الرغم من كونها أورام حميدة، إلا أن معدل تكرارها المرتفع بسبب التكيسات يشكل معظم الأسباب للإرتجاع. نظام خزان أومايا (ORS) هو تقنية بسيطة لتصريف التكيسات.

الغرض من الدراسة: تقييم فعالية إستخدام جهاز الأشعة ذو الذراع المتحرك كأداة إرشادية لوضع أنبوب خزان Ommaya فى الأورام القحفية البلعومية المتكررة فى الغالب الكيسى.

المرضى وطرق البحث: إشتملت هذه الدراسة على ٨ مرضى يعانون من ورم قحفى بلعومى متكرر مؤكد من الناحية الإكلينيكية والإشعاعية مع جزء مهم من التكيسات. تم علاج هؤلاء المرضى عن طريق إدخال موجه عن طريق إستخدام جهاز الأشعة ذو الذراع المتحرك C-arm لأنبوب خزان أومايا وتمت مقارنة التقييمات السريرية والإشعاعية بعد العملية الجراحية بما كانت قبل الجراحة.

النتائج: شملت هذه الدراسة ٦ ذكور و٢ إناث تتراوح أعمارهم بين ٥ سنوات و٣٨ سنة بمتوسط عمر ١٨.٤ سنة. كان الصداع أكثر الشكاوى تقديماً، يليه ضعف البصر. بعد العمليات الجراحية الموثقة للوضع المرضى تم وضع الأنبوب بطريقة صحيحة فى ٧ حالات وحالة واحدة فقط تتطلب جراحة ثانية لإعادة وضع الأنبوب بنفس التقنية. تم إكتشاف تحسن ملحوظ بعد الجراحة للصداع والأعراض البصرية فى جميع الحالات بسبب تخفيف الضغط عن العصب البصرى عن طريق تصريف الكيس.

الخلاصة: إن إدخال أنبوب خزان Ommaya بمساعدة جهاز الأشعة ذو الذراع المتحرك هو طريقة موثوقة يمكن أن تقلل من أخطاء تقنية اليد الحرة وقد تكون طريقة فعالة فى المراكز التى لا تمتلك تقنيات عالية.