# Using 'Catheter à Fentes' for Management of Childhood Hydrocephalus: A Prospective Study of Ninety-six Cases

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## ABSTRACT

**Objective**: To evaluate the management of childhood hydrocephalus using the 'catheter à fentes' as a ventriculoperitoneal shunt. **Materials and Methods**: A prospective study from January 2003 to January 2004 was carried out in the Neurosurgery Department of the National Hospital Niamey (Niger-Republic). Ninety-six infants with hydrocephalus, between the ages of 1 to 22 months were treated with 'catheter à fentes' as a ventriculoperitoneal shunt. **Results**: Ninety-six infants with hydrocephalus, between the ages of 1 and 22 months were included in this study, over a period of 31 months; 53% of the infants were females. The symptoms evolved over three months in 89.55% of the cases (n = 85). Hydrocephalus was post-infective in 51% of the cases, associated with spina bifida in 32% of the cases, neonatal bleeding in 7.2% of the cases; brain abnormalities were found in 6.2%, and tumor in 3.1% of the cases. The head circumference was greater than 2SD in all cases; 87.53% of the infants had psychomotor retardation (less than 80 QD according to the Lezine score). Ventricular dilation was triventricular in 17.70% and tetra ventricular in 82.29% of the cases. 'Catheter à fentes' models of high pressure, medium pressure, and low pressure were used. Hydrodynamic complications (hyperdrainage, obstruction, underdrainage) occurred in 7.9% of the cases, and these were handled with simple observation in follow-up clinics. The average regression of head circumference three months postoperatively, for all the three models of 'catheter à fentes,' was 3.73 cm. **Conclusion**: This study shows that the usage of 'catheter à fentes' for treatment of childhood hydrocephalus gives satisfactory results.

**Key words:** 'Catheter à fentes', hydrocephalus, Niamey, treatment

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## INTRODUCTION

The treatment of hydrocephalus has evolved from the description in the Ebers papyrus, by the Egyptians (1900 AD), of the work of Dandy (1886 – 1946).[1] The history of treatment of hydrocephalus is parallel to the history of the development of civilization. After a skull puncture, the treatment became medical (thyroid extract, diuretics, and radiation) and later medicosurgical.[1] In 1914, Heile used a simple ventriculoperitoneal catheter for the treatment of hydrocephalus, and in 1927,insertion of a placement of a shunt between the lumbar subarachnoid space and the pelvis of the kidney was performed.[1] Problems relating to overdrainage when using a single catheter led to the creation of a one-way valve by hydrodynamic engineer Donald Matson and Franck Ingraham, in 1946.[2] Later, the differential pressure valve was born and the use of a silicone catheter was popularized.

Other types of valves, different from the differential pressure valves, have been developed, to alleviate the problem of overdrainage.[3] Soleto *et al*.[4] have reported satisfactory results with the use of an open ventricular shunt, which is an open distal part catheter with 0.51 mm internal diameter. The 'catheter à fentes' operates as an open ventricular shunt, similar to differential pressure valves.[5] In this study, we have analyzed the clinical outcome, after usage of the 'catheter à fentes,' in 96 infants.

## MATERIALS AND METHODS

A prospective study from January 2003 to January 2004 was carried out in the Neurosurgery Department of our hospital. Ninety-six infants with hydrocephalus, between the ages of 1 and 22 months, were treated with 'catheter à fentes' as a ventriculoperitoneal shunt. Infants with ventricular dilatation and macrocrania on an ultrasound or CT scan, with a QD (development quotient) of more than 40[6] were included. Infants with altered mental status or a cortical mantle of less than 1 cm on CT scan were excluded. The catheter used was the Intégra silicone catheter, with 1.1 mm internal diameter [Figure 1].

The choice of 'catheter à fentes' (high pressure, medium pressure or low pressure) is a function of ventricular pressure measured during the procedure. The high pressure model was used for ventricular pressures between 10 and 18 cm of water. The medium pressure was used for ventricular pressures between 18 and 25 cm of water. The

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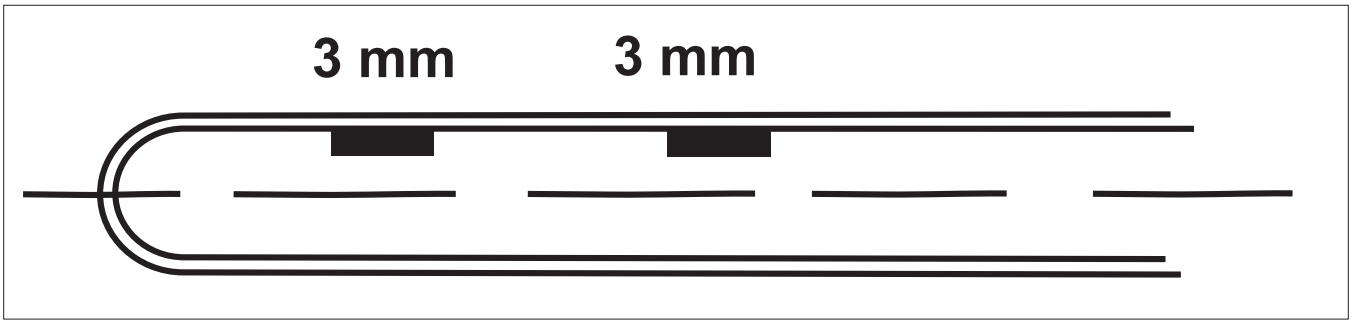


**Figure 1:** The distal end of the catheter with two slots of 3 mm, one after another

low-pressure model was used for pressures between 25 and 33 cm of water. The catheter models were selected in the same manner for each procedure, for all patients. The ventricular catheter was connected to the distal catheter through a connector attached to the temporal fascia, to prevent migration. The ventriculoperitoneal procedure was performed for all patients.

The course was assessed by measuring the head circumference and the listing of psychomotor acquisitions after one week, one month, and three months.

## RESULTS

The series included 96 infants, 50 females (53%) and 46 males (47%). Their age ranged from 1 to 22 months and the mean age was 11.5 months; 73% (n = 71) of infants were more than six months. The symptoms evolved over three months in 89.55% of the cases (n = 85).

Post-infective hydrocephalus was 51% in all cases, Table 1. The clinical evaluation was dominated by physical signs (100% increase in head circumference), and psychomotor retardation (87.53% with a QD under 80), Table 2.

The trans-fontanelle ultrasound or CT scan showed tri-ventricular hydrocephalus in 17.70% of the cases (17 patients) and tetra ventricular hydrocephalus in 82.20% of the cases (79 patients). Ventricular dilation predominates in the frontal horn in more than 80% (n = 66) of the cases in this study. The high pressure model was used in 56 patients. There was a progressive reduction in the circumference round of postoperative head. The average gap of the head circumference between preoperative and postoperative, three months later, was 2.15 cm. Obstruction of the catheter interpreted as a hypo-flow was observed in three cases for this model. The medium model was used in 28 patients. The average gap between the preoperative head circumference and three months post-surgery was 3.35 cm. The low-pressure model was used in 17 cases. Here the average difference between the preoperative head circumference and three months post-surgery was 3.55 cm. Three cases of overdrainage were observed with this model. Thus, in seven cases (7.9% of cases) hydrodynamic problems (under drainage, obstruction, hyper drainage) were observed. In the case of hyper drainage, conversion of the low-pressure model to medium-pressure or high pressure models helped to stop the hyper drainage and ventricular collapse. In the case of under drainage, the conversion of the high pressure model to medium pressure model has allowed the regression of head circumference. Conversion means the shortness or length of the intraperitoneal catheter. Other complications were: migration of the catheter in three cases (3.125%), disconnection in one case (1.04%), infection in four cases (4.16%), and death in one case (1.04%). The evaluation of the QD at three months showed that all patients with a QD of over 60 were significantly improved, as against only 11 of 31 patients who had a QD under 40. Figures 2a and 2b show one of the children successfully treated with this system.

**Table 1: Etiological factors**

| Etiological factor | Number | Percentage |
|---|---|---|
| Meningitis | 37 | 38.5 |
| Congenital factors | 6 | 6.2 |
| Neonatal fever | 12 | 12.5 |
| Spinal bifida | 31 | 32.2 |
| Tumor | 3 | 3.1 |
| Brain damage-bleeding | 7 | 7.2 |

**Table 2: Preoperative clinical evaluation**

| Clinical evaluation | Number | Percentage |
|---|---|---|
| Head circumference > 2DS | 96 | 100 |
| Vomiting | 26 | 27.08 |
| Convulsions | 14 | 14.58 |
| Psychomotor status | | |
| 40 < QD < 60 | 31 cases | 15.62 |
| 60 < QD < 80 | 54 cases | 56.25 |
| QD > 80 | 11 cases | 11.45 |

## DISCUSSION

In the treatment of hydrocephalus two groups of valves


**Figures 2:** (a,b) Baby four months before bypass and at the age of five years

were used: differential pressure valves or standard valves and flow pressure valves.[3,6-8] The difference between these valves was related to the risk of hyper drainage in the long-term, for standard valves.[3] A recent study by Soleto *et al.*[4] reported satisfactory results with the use of an open ventricular shunt, in adults. This was an open catheter whose distal end had an internal diameter of 0.51mm. The 'catheter à fentes' functioned in a manner similar to this open catheter. In this study we analyzed the results of using this shunt in infants with hydrocephalus. Analysis of these results were related to intracranial hypertension signs, reduction of head circumference, psychomotor improvement, and various other complications.

In the postoperative period, signs of intracranial hypertension had disappeared in all the patients, within the first week. This was reported by several authors using other types of equipment.[9,10] The head circumference was reduced by an average of 2.15 cm with the high pressure model of 'catheter à fentes', 3.35 cm with the medium pressure model, and 3.55 cm with the low-pressure model, three months post surgery. The average gap was greater with the low pressure model, and this would explain the cases of hyper drainage encountered with this model. This was reported in several studies.[11,12] In our study, the head circumference remained over 2DS three months postoperatively in almost all the cases, despite an average decline of 3.73 cm.

Psychomotor assessment of patients was done by calculating the score of Gesell-Lezine, three months post surgery. Postoperative psychomotor improvement was observed in all patients with preoperative QD higher than 60. This corroborated with the findings of Bruce[11] on postoperative psychomotor recovery in pediatric neurosurgery. In that study, Bruce focused on the impact of early surgery (before three months of evolution) on the psychomotor table. In our study, only 11% of patients were operated before three months of evolution.

In four cases (4.16%), infection led to the removal of material, with one death by ventriculitis. Beverly[12] reported 15% infection. According to the studies, the infection rate varies between 2.3 and 29%.[13,14] Our patients were always operated in the first position of the operational program and the antibiotics were routine from the induction to seven days post surgery. Our study focused on infants from 1 to 22 months of age, with 51.04% under six months. In a multicenter randomized study of 345 patients, Drake *et al.*[15] reported that the mechanical and infectious complications, regardless of the type of valve, was more common before six months and the risk of infection was age-dependent.

In our series, we reported 7.29% of hydrodynamic complications (under and hyper drainage) at three months post surgery. Mechanical (migration, disconnection) and hydrodynamic complications of this series were 11.45%. Santa Rosa and Hoffman, cited by Drake, reported in a study of 1700 patients treated with conventional valves, 30% of mechanical complications before one year. Oregon and Bierbaeur, citing the same study, found similar results one year post operation. These complications were partly related to the hyper drainage in the upright position.

In this study, hyper drainage was reported especially with the low pressure model. This could be partly explained

by the duration of the development of hydrocephalus. Depending on the length of evolution, some cases of infant hydrocephalus must be understood as chronic hydrocephalus in infants, as reported by Chazal and Bret.[16]

## CONCLUSION

The 'catheter à fentes' in the treatment of hydrocephalus allows the improvement of signs of intracranial hypertension, a regression of macrocrania, and an improvement of psychomotor retardation for patients with a QD higher than 60. It is an inexpensive material that can meet the great demand for valves in poor countries.

## REFERENCES


1. Keit E, Aronyk D. Management of hydricephalus. Neurosurg Clin N Am 1993;4:4.
2. Ingraham FD, Alexander E Jr, Matson DD. Synthetic plastic materials in surgery. N Engl J Med 1947;236:362-8, 402-7.
3. Sprung C, Miethke C, Trost Ha, Lanksch Wr, Sttolk D. The dual-switch valve: A new hydrostatic valve for the treatment of hydrocephalus. Childs Nerv Syst 1996;12:537-81.
4. Sotelo J, Izurieta M, Arriada N. Treatment of hdrocephalus in adults by placement of an open ventricular shunt. J Neurosurg 2001;94:873-9.
5. Buchheit F, Boyer PD. Maitrot D. How to choose the best valve? Monogr Neuralsci 1982;8:184-7.
6. Gesell A, Lezine M, Pertuis J. The young child in modern civilization. Cahiers Universitaires Francophones 1980;19:97-103.
7. Foltz El, Blanks J, Meyer R. Hydrocephalus: the zero ICP ventricle shunt (zips) to control gravity shunt flow. A clinical study in 56 patients. Childs Nerv Syst 1994;10:43-8.
8. Fox JL, Mc Cullough DC, Green RC. Cerebrospinal fluid shunt: an experimental comparison of flow rates and pressure values in various commercial systems. J Neurosurg 1972;37:700-5.
9. da Silva MC, Drake JM. Complications of cerebrospinal fluid shunt antisiphon devices. Pediatr Neurosurg 1991;17:304-9.
10. Drake J, Sainte Rose C. Shunt complications. The shunt book. New York: Blackwell; 1995. p. 234.
11. Bruce DA. Consensus, craniofacial synostoses: Apert and Crouzon syndromes. Child's Nerv Syst 1996;12:734-6.
12. Chapman PH, Cosman ER, Arnold MA. The relationship between ventricular fluid and body position in normal subjects and subjects with shunts: a telemetric study. Neurosurg 1990;26:181-9.
13. Walters BC, Hofman HJ. Cerebrospinal shunt infection. J Neurosurgery 1984;60:1014-21.
14. Choux M, Genitori L, Lang D, Lena G. Shunt implantation: reducing the incidence of shunt infection. J Neurosurg 1992;77:875-80.
15. Drake JM, Kestle J. Rationale and methodology of the multicenter pediatric cerebrospinal fluid shunt design Trial. Pediatric Hydrocephalus Treatment Evaluation Group. Childs Nerv Syst 1996;12:434-47.
16. Bret P, Chazal J. Chronic "normal pressure" hydrocephalus in childhood and adolescence: a review of 16 cases and reappraisal of the syndrome. Childs Nerv Syst 1995;11:687-91.


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