# The Incidence of Bradycardia During Endoscopic Third Ventriculostomy

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The incidence of bradycardia during endoscopic third ventriculostomy (ETV) is unknown. In an attempt to determine that incidence, we studied 49 pediatric patients with obstructive hydrocephalus who underwent ETV during general anesthesia. The median age was 54.5 mo (range 1–108 mo) and the median weight was 12.2 kg (range 2.4–22 kg). The heart rate was measured continuously in which four stages were identified for data analysis. Stage A is the preoperative phase, stage B is 5 min before perforating the floor of the third ventricle, stage C during perforation, and stage D after perforating the floor of the third ventricle. Three readings were recorded at each stage, then averaged. The mean values of the heart rate at stages A, B, C, and D were 146 ± 27, 151 ± 26, 87 ± 32, and 143 ± 24 bpm respectively. A significant decrease in the heart rate was determined in stage C compared with stage B ($P < 0.05$). The incidence of bradycardia was 41%. Alerting the surgeon to perforate the floor of the third ventricle or withdraw the scope away from it was sufficient to resolve the bradycardia. We concluded that serious bradycardia might occur during ETV, mostly because of mechanical factors and can be resolved without medications.

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Endoscopic third ventriculostomy (ETV) has been accepted as the method of choice in the treatment of obstructive hydrocephalus (1). The complications of ETV are well documented. Two groups reported hemiparesis (2); others observed a transient third cranial nerve paresis (3). Moreover, patients might develop transient fever because of aseptic irritation of the ependyma or manipulation of the hypothalamus (2). McLaughlin et al. (4) reported severe life-threatening hemorrhagic complication resulting from traumatic basilar artery aneurysm after ETV. Handler et al. (5) reported an intraoperative cardiac arrest during ETV in a patient with aqueduct stenosis and an infected shunt. Experimentally, the stimulation of the hypothalamic nuclei can cause a variety of sympathetic and parasympathetic responses (6,7). In an attempt to identify the possible mechanisms of the hemodynamic changes, namely, bradycardia during ETV under anesthesia, we compared the intracranial pressure and the hemodynamic changes. A negative correlation was obtained (8). However, the true incidence of bradycardia during ETV has not yet been evaluated because of the small number of patients studied. Therefore, in the present study, we studied a larger number of patients to determine the incidence of bradycardia during ETV.

## Methods

This study was approved by the hospital ethics committee. We studied 49 pediatric patients (34 males) who underwent ETV for the treatment of obstructive hydrocephalus under general anesthesia. None of the patients were receiving cardiac medications. On arrival of the patients at the operation room, an IV cannula was inserted and the usual monitors were used. Anesthesia was induced with thiopental 4 mg/kg, and the trachea was intubated with the help of atracurium 0.5 mg/kg IV. Anesthesia was maintained with isoflurane in 50% nitrous oxide in oxygen.

The heart rate via the electrocardiogram was recorded continuously in which four stages were identified for the purpose of data analysis. Stage A is preoperative, stage B 5 min before instrumentation of the floor of the third ventricle, stage C during perforation of the floor of the third ventricle, and stage D

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after perforating the floor of the third ventricle. Three readings of the heart rates were recorded at each stage, then averaged. The procedure as previously discussed (9) was performed with the patient in supine position and the head in neutral position by using a rigid pediatric nephroscope (Karl Storz, Tuttlingen, Germany), size 17F. The scope was then introduced through the anterior fontanelle or a burr-hole (according to the patient age) just anterior to the coronal suture in the midpupillary line. The scope was passed from the lateral ventricle through the foramen of Monro toward the floor of the third ventricle. After visualization and confirming the relevant anatomical structures, the floor of the third ventricle was punctured posterior to the infundibular recess with the tip of the scope. The fenestration was enlarged slightly with gentle movement of the tip of the scope and passed through the hole. Irrigation with saline at body temperature at different rates as required was used for the clarity of the field only if hemorrhage occurred. The cerebrospinal fluid was then allowed to drain into the basal cistern, bypassing the aqueduct stenosis to the surface of the brain. We considered bradycardia to be present if the heart rate decreased to <80 bpm. We subjected the heart rate data at stages A,B, C, and D to the Wilcoxon's test in which $P > 0.05$ was considered significant.

## Results

Preoperative complete blood picture, urea, and electrolytes were within normal ranges. Intraoperative electrolytes and body temperature were within the normal ranges. The median age was 54.5 mo (range 1–108 mo). Twenty patients were <1 yr old, 23 patients were between 1 and 5 yr old, and 6 patients were between 5 and 10 yr old. The median body weight was 12.2 kg (range 2.4–22 kg). Nine patients were <5 kg, 26 patients were between 5 and 10 kg, and 14 patients were >10 kg. The surgery was electively performed in 34 patients. Thirty-four patients received no premedication, 7 patients received trimeprazine syrup, 2 patients received phenobarbital syrup, and 6 patients received diazepam syrup 1 h before surgery. Bradycardia occurred in 20 patients (41%), which warranted the surgeon to temporarily stop the procedure. Withdrawing the scope away from the floor of the third ventricle successfully resolved the bradycardia. However, once the heart rate was stabilized and the floor of the third ventricle was perforated the bradycardia resolved immediately. None of the patients required atropine. The mean value of the duration of the surgery was 34 ± 13 min. The mean values of the heart rates at stages A, B, C, and D were 146 ± 27, 151 ± 26, 87 ± 31, and 143 ± 24 bpm, respectively. Comparing the mean values between stages A and C as well as stages B and C revealed a significant decrease in the heart rate at stage C compared with stages A and B ($P < 0.05$). The heart rate mean value decreased in stage C by 59.5% compared with stage A. Comparing the results between stages A and B and A and C revealed nonsignificant differences ($P > 0.05$). The results between stages C and D revealed a significant increase in heart rate during stage D compared with stage C ($P < 0.05$) (Table 1).

**Table 1.** The Heart Rate (bpm) at Stages A, B, C, D

| Stages | Mean | SD | Range | % Change |
|---|---|---|---|---|
| A | 146 | 27 | 86–214 | control |
| B | 151 | 26 | 82–214 | — |
| C | 87 | 31 | 36–162 | 59.5%* |
| D | 152 | 22 | 120–170 | — |

* Significant decrease in heart rate ($P < 0.05$).

## Discussion

ETV is now an accepted treatment for hydrocephalus associated with aqueduct stenosis (10,11). Usually, patients with conventionally inserted shunts would be subjected to shunt revision because of either block or infection. That is why some neurosurgeons today consider extracranial shunting an unsatisfactory method for the treatment of hydrocephalus (12). Over the past 20 years, the success of ETV has been compared with the conventional shunt placement (13). There are no reports on the incidence of bradycardia or other hemodynamic changes in this relatively new procedure, yet isolated cases have been described. A near-fatal cardiac arrest during ETV was described in which ventricular fibrillation occurred, requiring cardiac resuscitation (5).The authors concluded that the sudden increase in the intracranial pressure by using a high speed of fluid irrigation caused this arrest. That case report has alerted us to further study the anticipated problems during ETV. In a previous study, we reported a negative correlation between the bradycardia and third ventricle pressure during ETV. We postulated that bradycardia recorded in our series was a result of stimulation of the floor of the third ventricle by the endoscope tip (8). This was further supported by the present study, in which significant bradycardia was reported in 41% of the patients.

In conclusion, ETV is now the preferred treatment of obstructive hydrocephalus. With the increased use of ETV, understanding pathophysiological changes that occur could be important. We believe that persistent bradycardia could be a serious complication. Alerting the surgeon and pulling the scope away from the floor of the third ventricle should be adequate to resolve the bradycardia. Atropine in a prefilled syringe should be available for use if needed.

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