Brief Communication

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Airway management in children with hydrocephalus: A case series

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INTRODUCTION

Hydrocephalus in a neonate may be congenital or acquired. Congenital hydrocephalus is commonly associated with myelomeningocele, Arnold-Chiari or Dandy-Walker malformation, arachnoid cysts and vascular malformations. Acquired hydrocephalus at birth may be a consequence of infection, intraventricular hemorrhage, trauma and tumors [1].

Anaesthetic induction and airway management in children with acute hydrocephalus for various procedures may be quite challenging. The large occiput, in these patients, places the neck in extreme flexion and the large forehead may obscure the line of sight in laryngoscopy, so elevating the body with pillows or towels is necessary in order to facilitate laryngoscopy[2].

While obtaining a preoperative history and developing an anaesthetic plan for these patients, the possibility of other congenital and genetic anomalies and neurologic abnormalities should be considered. A good physical examination prior to surgery should document any neurologic deficits, as well as any signs of increased intracranial pressure (frontal bossing, dilated scalp veins, cranial nerve palsies)[3].

MATERIAL AND METHODS

We conducted an observational study at our institute, related to airway management in children with hydrocephalus. All children in the age group of 3 days to 3 years, who presented with hydrocephalus and were scheduled for elective procedures between December 2013 till July 2015 were included in the study. Data regarding age, sex, head circumference and any congenital anomaly was noted. Head circumference was calculated in terms of percentile for each child, using the Centre for Disease Control/ National centre for Health Statistics (CDC/NCHS) infant head circumference for age percentiles calculator. Normal head circumference, Microcephaly and Macrocephaly were defined as follows:

Microcephaly: Head circumference < 3 percentile (greater than 2 standard deviation below the mean).

Normal: Head circumference between 3 and 97 percentiles Macrocephaly: Head circumference > = 97 percentile (greater than 2 standard deviation above the mean). After shifting the patients to operating room, patients who already had an intravenous line secured, were induced with injection Fentanyl 2mcg/kg and Propofol 2 mg/kg. Patients who did not have an intravenous line secured, were induced with Sevoflurane 2% and later on an intravenous line was secured in these patients. Injection atracurium was used to facilitate tracheal intubation. Laryngoscopy was done by a consultant anaesthesiologist having at least 5 years of experience after obtaining post graduation. Following parameters were observed and recorded:

Ability to ventilate the baby with simple chin lift manoeuvre; inability to ventilate with simple chin lift and the need to use Guedel airway; use of a shoulder pad or small rolled towel to facilitate intubation; use of external laryngeal pressure for better visualization of glottis; use of bougie to facilitate intubation; whether the patient was intubated at the single attempt or after multiple attempts; any adverse respiratory complication such as bronchospasm, laryngospasm, apnoeic spells and inadequate reversal; and any major hypoxic episodes, which were defined as hypoxia for minimum duration of 30seconds with oxygen saturation (SaO_2) of <= 85% .

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RESULTS

A total of 45 patients were studied during this period, who were in the age group of 3 days to 3 years. Their mean age was around 9.75 months and the male-female ratio was 28:17.

The patients were divided into 3 age groups: 0 - 1month (12 patients), 1 month-1 year (24 patients), and 1year-3years (9 patients).

Out of 45 patients, only 8 patients had macrocephaly i.e., a head circumference >= 97th percentile. For rest 37 patients, head circumference measurements were in the range between 85 and 96 percentiles. All the patients were not ventilated adequately with simple chin lift manoeuvre. Guedel airway had to be used in 5 patients to facilitate ventilation. A shoulder pad or a rolled towel had to be placed under the shoulders of the patient to provide neck extension.

30 patients were intubated easily without applying any external laryngeal pressure. However in 10 patients external laryngeal pressure had to be applied to facilitate intubation. In 5 patients bougie was needed in addition to external laryngeal pressure. Out of 10 patients in whom external laryngeal pressure was applied 5 patients had macrocephaly and out of 5 patients in whom bougie was used, 3 patients had macrocephaly.

3 patients were intubated after multiple attempts while the rest were intubated at single attempts. During our study 4 children had to be reintubated; 1 had apnoeic spells, 1 bronchospasm and 2 inadequate reversal. We also observed in our study that 13 patients had major hypoxic episodes. There were no failures to intubation or need for tracheostomy during our study.

DISCUSSION

The paediatric airway is often considered more difficult than the adult airway due to five main anatomical differences: A larger tongue in relation to oral cavity; a cephalic-located larynx; anteriorly slanted vocal cords which increases the chances of endotracheal tube abutting the anterior commisure during intubation; a large stiff and omega-shaped epiglottis, and the narrowest portion located in the subglottic region at the level of the cricoid cartilage[3–5].

Even well trained anaesthesia provider with limited paediatric experience may find the normal airway of younger children and infants challenging[6].

Also the paediatric airway is very susceptible to trauma when compared with the adult airway, and repeated attempts at intubation may result in more swelling and subsequent airway compromise. Rapid desaturation during apnoea and lack of patient cooperation are additional significant considerations in children[7].

In the anaesthetic management of our cases, anticipating difficult intubation due to large head size circumference, we had done a preoperative preparation for difficult airway management. We arranged additional equipment for this purpose including facemasks, oropharyngeal airways, tracheal tubes, laryngeal mask airways of different sizes, laryngoscope blades of different types and bougies appropriate for our patient. Standard monitoring like pulse oximetry, electrocardiogram, non-invasive blood pressure, capnography and nasal temperature measurements were instituted.

For proper alignment of oral, pharyngeal and laryngeal axis to facilitate intubation, we used an adequate sized shoulder pad or small rolled towel under both the shoulders of the patient. In patients who had macrocephaly, an assistant was asked to raise the upper chest by his hands to provide neck extension, if needed.

Although difficult Direct Laryngoscopy (DL) is rare in healthy children, respiratory complications continue to be a major source of morbidity in children requiring airway management[8–10].

Sebastian et al., conducted a retrospective study of 11,219 paediatric general anaesthetics in a tertiary care centre. They found that the overall incidence of difficult DL (Cormack-Lehane grade 3 or 4 views) was 1.35%. The incidence was found to be higher (4.7%) in children less than one year of age than in children older than one year (0.7%)[11]. In another study of 24,165 anaesthetics in a tertiary care paediatric centre conducted by Murat et al., the frequency of unanticipated difficult tracheal intubations was found to be 0.24% in children less than one year of age and 0.07% in children older than one year[9].

In our study, incidence of difficult DL (Cormack-Lehane grade 3 or 4 views) was found to be 11.1% (5/45). This was considerably higher than the normal patients observed in the above mentioned studies. However in our study the incidence of difficult intubation was found to be greater in children older than 1 year of age (22.2%) than in children less than 1 year of age (8.3%). This could be possibly as a result of increased head size (macrocephaly) in children with hydrocephalus Table 1a, Table 1b.

Ivana et al., conducted a prospective study on 682 children, to evaluate the frequency of perioperative airway complications in children undergoing general anaesthesia and to identify independent risk factors which are commonly associated with a high incidence of airway complications. They found that the overall incidence of airway complications was 5.7% (39/682). The most common respiratory complications observed during their study were laryngeal inspiratory stridor, breath holding, complete laryngeal spasm, cough, hiccups, apnoea, excessive secretion and obstruction by the tongue. They also observed that the frequency of respiratory complications was more in children < 1 year of age (11.6%) than in older children (5.1%)[12]. In our study, incidence of adverse respiratory events was found to be 8.8% i.e., 4 out of 45 patients (apnoeic spells n = 1, bronchospasm n = 1, inadequate reversal n = 2). This was comparable to the frequency of respiratory complications seen in the normal paediatric population in the above mentioned study.

In another study conducted by Schulz et al., they measured the frequency and extent of arterial hypoxaemia during paediatric general anesthesia under routine clinical conditions. Their subjects were 91 children (13 newborns, 27 infants, 37 children under 6 years, 14 children under 14 years) with no cardiac or pulmonary comorbidities, scheduled for extrathoracic surgery. They classified Hypoxic episodes (minimum duration: 30 seconds) as slight (SaO_2 less than or equal to 95%), minor (SaO_2 less than or equal to 90%) and major (SaO_2 less than or equal to 85%). Major hypoxic episodes occurred in 54% of the newborns, 26% of the infants, 8% of the children under 6 years and 7% of the children under 14 years[13]. In our study we noticed major hypoxic episodes in 13 of our patients. Frequency of these episodes was 50% of the neonates (6/12), 25% of the infants (6/25), and 11% of the children in 1-3 years age group (1/9). Hence incidence of major hypoxic episodes in our study was comparable to the incidence in normal paediatric population observed in the above mentioned study [Table 2].

Table 1a: A comparison of the incidence of difficult intubation in children with hydrocephalus with the normal pediatric population

Incidence of difficult intubation	Our study (in hydrocephalus children)	Sebastian et al., (in normal pediatric population)
Overall incidence	11.1%	1.35%
Children < 1year	8.3%	4.7%
Children > 1year	22.2%	0.7%

Table 1b: A comparison of the incidence of difficult intubation in children with hydrocephalus with the normal pediatric population

Incidence of difficult intubation	Our study (in hydrocephalus children	Murat et al., in normal pediatric population
Children <1 year	8.3%	0.24%
Children> 1 year	22.2%	0.07%

Table 2 : A comparison of the incidence of major hypoxic episodes in children with hydrocephalus with the normal paediatric population

Incidence of Major hypoxic episodes	Our study (in hydrocephalus children)	Schulz et al., (in normal paediatric population)
New Borns	50%	54%
Infants	25%	26%
Children < 6 years	11%	8%

CONCLUSION

From our study we concluded that airway management (direct laryngoscopy and intubation) in children with hydrocephalus is difficult as compared to normal paediatric population. In contrast to other studies, incidence of difficult intubation was found to be greater in children older than 1 year than in children less than 1 year of age. This could be possibly as a result of increased head size (macrocephaly) in children with hydrocephalus. Proper positioning of the patient with elevation of body, by use of shoulder pads or rolled towels is needed to facilitate intubation in these patients. We also found that the incidence of adverse respiratory complications and major hypoxic episodes was comparable to the normal paediatric population.

However the results of our study are to be inferred with caution due to the small sample size of our study.

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