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Pattern of Anaesthesia Techniques for Herniotomy at a Southwestern Tertiary Health Institution: A 5-Year Review

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Abstract: *Background:* Anaesthesia for herniotomy may be challenging because the margin of error in managing such a young patient can be extremely small since the body reserves are limited and the organ systems may not be fully developed. Also, the psychological, physiological and pharmacological responses to anaesthesia are quite different from adult. Safe and effective care of children under anaesthesia is therefore crucial. This study aims to audit the pattern of anaesthetisia techniques used and their associated complications during herniotomy procedure in our health facility.

Material and methods: This is a retrospective review of patients' files, theatre records and anaesthetic-record charts of herniotomy cases performed in a tertiary health Institution from January 2011 to December 2015. Relevant clinical information were entered into proforma designed for the study. Data was analysed with descriptive statistics using the Statistical Package for Social Sciences (SPSS) version 20 Chicago IL (U.S.A). Inferential statistics of Chi-Square, Mann-Whitney and Kruskal-Wallis Test were also performed.

Results: One hundred and forty-four in-patient children who belonged to American Society of Anesthesiologists Physical Health Status (ASA) grade I and II had herniotomies during the study period. The mean age is 4.21±3.72years (range, 6months – 16years) with male to female ratio of 47:1 (i.e 141 to 3). General anaesthesia (135, 94%) of various techniques was the most common technique while regional anaesthesia was only employed in nine (6%) children. The regional anaesthesia techniques were caudal block 1 (0.7%) and subarachnoid block 8 (5.5%) and were sedated to allow for cooperation in some of the cases. One hundred and twenty -four (86%) children presented as simple, elective cases while twenty (14%) children as complicated or emergency cases.

Conclusion: This study showed that herniotomy can be safely performed under various options of anaesthesia techniques depending on the expertise of the anaesthetists involved. The simple, electives inguinal hernia and hydroceles could have been performed as day cases.

Key words: Audit, herniotomy, Anaesthesia techniques, Complications.

Introduction

Herniotomy is mostly performed under general anaesthesia in all age groups.[1,2,3] Even though when regional anaesthesia (caudal block or subarachnoid) is employed in young children (infants and toddlers), it is usually in combination with inhalational anaesthesia technique or mild sedation with midazolam in order to gain the patient's cooperation.[4] Regional anaesthesia technique may be used as a sole anaesthesia in older children for most urogenital surgeries.[5] Local anaesthetic infiltration or field block alone is suitable only in adult population.[6]

Infants with body weight greater 5kg could have inhalational or intravenous induction with laryngeal mask or face mask.[7] Caudal or ilioinguinal block or intraoperative opioid would then be employed as intraoperative analgesia.[3,4,5] Infants with body weight less than 5kg, general anaesthesia with controlled ventilation and endotracheal intubation is be the preferred anaesthesia technique. General anaesthesia relaxant technique is preferred in neonate to ilioinguinal block only because airway protection is highly essential in them.[7]

Good postoperative analgesia may be achieved with suppository diclofenac (1mg/kg) or paracetamol (30-40mg/kg) in children greater than one year and below one year old respectively.[7] Some anaesthetic techniques can still provide residual postoperative analgesia, these include the use of parenteral opioid, caudal epidural and ilioinguinal block during surgery.[4,5,7]

This retrospective study intends to investigate the pattern of anaesthesia techniques in children presenting for herniotomy in our health facility.

Methods

This retrospective study was carried out after approval from Health Research Ethics Committee, Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State with approval number NHREC/28/11/2017. A five (5) year review of the pattern of anaesthetic techniques employed for herniotomy performed (both elective and emergency cases) in paediatric surgical unit (of surgery department) in a state owned government University Teaching Hospital, located in south-west Nigeria.

The indications for the herniotomies included simple and complicated inguinoscrotal hernias or hydroceles. Inclusion criteria were patients aged between six months old and sixteen years old and those who belonged to ASA I and II. Patients who had exploratory laparotomies as a result of complicated inguinoscrotal hernia, presence of serious congenital anomalies or missing records were excluded.

Data collection

Data of subjects who had herniotomies on in-patient basis from 1st January 2011 to 31st December 2015 (five years) were critically reviewed retrospectively because herniotomy procedures are not routinely done as day cases in our health facility. Data were obtained through Information Management Department from patient case files, paediatric surgical records in Modular theatres, wards and anaesthetic records of all herniotomies performed during the study review periods. Relevant clinical information were entered intodata sheet designed for the study. This information included: patient demographics, distance of patient's home to the hospital, indication of the herniotomy, sites of hernia or hydroceles (left, right, unilateral or bilateral), presence of other groin swellings, presence of other regional or body swellings, uncomplicated or complicated inguinoscrotal or scrotal swellings. ASA (America Society of Anesthesiologist) physical health status classification, packed cell volume, choices of anaesthetic techniques, intraoperative analgesia, blood loss, volume of blood transfused, duration of surgery, intra-operative anaesthetic complications, post-anaesthetic outcome, time of resumption of feeding were noted as well as number of days spent on hospital bed admission. The distance of patient's home to the hospital was assumed to be within 2kilometres if it is just within an hour's drive while it is considered to be more than 2kilometres if it is more than one hour drives by extrapolation from the patient's residence Local Government area.

Data analysis

The data obtained were analysed using the statistical package for social sciences (SPSS, version 20 Chicago IL. U. S. A). Inferential statistics of Chi-Square, Mann-Whitney and Kruskal-Wallis Test were also performed. Frequencies and percentages were computed for categorical variables, while means and standard deviations of the continuous variables were also determined. The results obtained were presented in prose, tables and figures.

Results

A total of one hundred and forty-four (144) children had one hundred and fifty-four (154) herniotomies for either unilateral or bilateral inguinal hernia or hydroceles during the period of study. Table 1, shows the demographics profiles. The age ranges were from six months to sixteen years. The mean age was 4.21± 3.72years. Gender distribution ratio of 141 males to 3 females was 47: 1.

Table 1: Demographics profiles of children presented for the study

Clinical parameter	Frequency (%)
Age group	
Infants <//= 1 year	42(29.2)
Younger children >1 to 10 years old	92(63.9)
Older children >10years old	10(6.9)
Total	144(100)
Gender	
Male	141(97.9)
Female	3(2.1)
Total	144(100)
Distance of patient's home to hospital In kilometer	
Within 2 kilometres	82(56.9)
Above 2 kilometres	62(43.1)
Total	144(100)

Most of the children belong to age ranged between >1 to 10 years old. Figure 1 illustrates the sites of the body in which the herniotomies were performed. Among the 144 participants, 86 (60%) had herniotomy done on the right side, 48 (33%) were on the left side and 10 (7%) were bilateral.

The packed cell volume of the patients ranged between 22.0% and 45.0%, the mean standard deviation packed cell volume was 31.47±3.93. Figure 2, shows that majority (104, 72%) of the

Fig 1: illustrates the sites of herniotomies

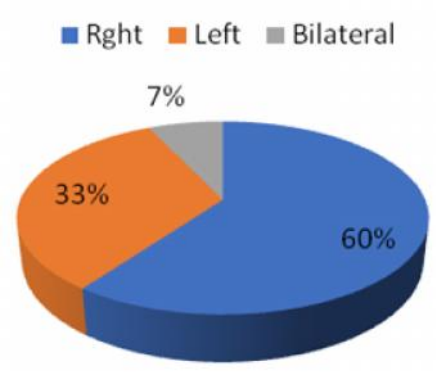
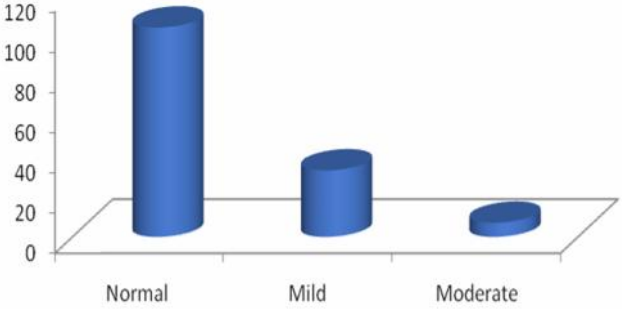


Fig 2: illustrates the distribution of the packed cell volume



children had packed cell volume within the normal ranges (i.e 30-45%). Thirty-three (23%) children had packed cell volume between 26-29.8% (mild anaemia), while seven children (5%) had packed cell volume between 22-25% (i.e moderate anaemia). A total of one hundred and two (71%) children belonged to ASA I, twenty-two (15%) children belonged to ASA II, while twenty (14%) children were classified as ASA IIE. None of the children belonged to ASA III or IV.

Table 2 shows that there is association between the choice of anaesthetic techniques and the patient's age, e.g. subarachnoid blocks were mainly used for older patients in this study.

Table 2: Association of clinical outcomes with socio-demographics characteristics of participants

Clinical Variable	Age group		Sex	
	χ^2	p-value	χ^2	p-value
Anaesthetic technique	55.02	0.0001*	0.552	0.
Duration of surgery	4.60	0.1000	4.540	0.0330
Estimated blood loss	2.14	0.3430	0.065	0.798
Time of establishment of oral fluid	2.52	0.2830	0.352	0.553
Length of hospital stay after surgery	11.80	0.0030*	1.059	0.303

Key *Significant at $p < 0.05$

The table 3 shows the mean standard deviation of the packed cell volume was within normal ranged in all the children and minimal blood was loss. Also most of the surgeries were completed within an hour in all the age-group. Intraoperative fluid maintenance varies with the patients' age and body weight.

Table 3: Clinical characteristic of the participants using Kruskal Wallis Test

Clinical Variables	Infants (n=42) Mean±SD	Younger Children (n=92) Mean±SD	Older Children (n=10) Mean±SD	K– value	p-value
Body weight (kg)	7.05±2.67	14.38±4.23	24.80±7.83	10.223	0.17
Packed cell volume (%)	31.44±6.16	31.58±2.61	30.90±2.13	1.191	0.76
Duration of the surgery (minutes)	40.21±18.00	37.00±18.22	57.10±24.66	7.325	0.62
Estimated blood loss (ml)	17.50±16.24	15.24±11.03	20.10±12.74	2.232	0.526
Intravenous fluid (ml)	81.55±44.59	176.14±145.59	500.00±278.89	12.197	0.007*
Length of hospital stay (days)	1.79±1.14	1.27±0.88	2.70±3.16	5.469	0.141
Time of feeding establishment (minutes)	468.17±80.55	432.16±77.78	468.00±88.48	3.920	0.270

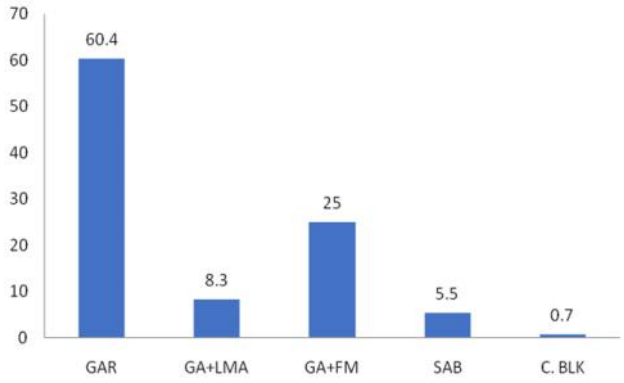
* = p- value is <0.005 is significant

Table 4: Indications for the surgery and surgery (s) performed

Surgical cases	Surgery performed	Frequency (%)
Simple /Electives		
Inguinoscrotal hernia only	Herniotomy	77 (53)
Hydroceles only	Herniotomy	28 (19)
Complicated (Electives)		
Inguinoscrotal hernia + Undescended testis	Herniotomy + Orchidopexy	11(8)
Inguinoscrotal hernia + Uncircumcised phallus	Herniotomy+ Circumcision	4 (3)
Hydrocele +Undescended testis	Herniotomy+ Orchidopexy	2(1)
Hydrocele +Uncircumcised phallus	Herniotomy + Circumcision	1(0.7)
Hydrocele +Dermoid cyst	Herniotomy + excisional biopsy	1(0.69)
Complicated (Emergency)		
Obstructed inguinoscrotalhernia	Herniotomy	10 (7)
Inguinoscrotal hernia + obstructed umbilical hernia	Herniotomy + Umbilical herniorrhaphy	7 (5)
Inguinoscrotal hernia + obstructed epigastric hernia	Herniotomy + epigastric herniorrhaphy	3 (2.08)
Total		144 (100)

Table 4 below shows the frequency distribution of indications for the surgery and the surgery (s) performed. Most common indication for herniotomy is inguinoscrotal hernia accounting for 53% (77). Some children had only herniotomy while others had herniotomy and other urogenital or regional surgeries. Also most 72%(105) of the children presented as simple or uncomplicated cases and had their surgeries performed as electives procedure.

Fig 3: Anaesthetic techniques for herniotomies



Key: GAR: General Anaesthesia relaxant technique; GA+LMA: General Anaesthesia with laryngeal mask airway; GA+FM: General Anaesthesia with face mask; SAB: Subarachnoid block; C. BLK: Caudal block

The major anaesthesia technique (135, 94%) employed in this study was general anaesthesia while regional anaesthesia was only employed in nine (6%) children.
The mean estimated blood loss was 17.16±17ml and no one was transfused with blood. Mean duration of the surgery was 39.48±19. The duration of the surgery was within 30 minutes in fifty-eight (40.3%) children who had unilateral simple inguinoscrotal hernias or hydroceles. The surgery was longer lasting more than 30minutes to one hour in 59.7% (86) children who had bilateral herniotomies, and in other surgery in addition to herniotomies. Majority (122, 84.7%) of the cases were performed in the morning, while eighteen (12.5%) cases were done in the afternoon and only few (4, 2.8%) cases were done in the evening. Intraoperative anaesthetic complications encountered were tachycardia (4, 2.8%) and difficult intubation (3, 2.0%) and these were promptly attended to and there was no death on table. All the patients were transferred to the paediatric surgical ward in stable clinical state even though there was a case of delayed awakening and a case of desaturation at extubation which was promptly attended to. No mortality was recorded.

Review of followed-up during hospital admission after the surgery showed that there were no post-anaesthetic complications in one hundred and thirty six cases (94.4%) however nausea was reported in three children (2%) while vomiting occurred in five (3.5%) children. Oral fluids/ feeding were established early at least between five and six hours post-operatively in 115 (79.86%) children and twenty-six (18.06%) children were able to tolerate orally after six to twelve hours while 3(2.08%) children after twelve hours to forty-eight hours postoperatively. Majority 107 (74%) of the children were discharged home a day after surgery. Twenty-two (15%) children were discharged on the second day after surgery, seven (5%) children on third day after surgery, while the remaining eight (5.5%) children were part of those that have emergency complicated inguinal hernia and were discharged within seven to ten days.

Discussion

In this study, we have reviewed retrospectively the patterns of anaesthesia techniques by different anaesthetists for herniotomy in a south-west tertiary health facility. Herniotomy is the surgical treatment for inguinal hernias and hydroceles in children. Male to female gender ratio has been reported to varied from 3:1 to 19:1.1 [3, 4, 6,8] which may be related to descent of testis through the inguinal canal in male. This was confirmed in this study with the gender ratio (male: female) of 47: 1. Hernia was more common on the right side with 60% occurring on the right side, 30% on the left and 10% are bilateral. [6', 8] The right sided preponderance of inguinal hernia or hydroceles as shown by previous studies [4, 6, 8,] was also confirmed in this study with eighty six children (60%) occurring on the right, forty-eight (33.3 %) on the left side and ten (7 %) are bilateral.
The profile of most of the subjects recruited for the study shows that those cases could have been performed as day case to harness the numerous benefits of ambulatory anaesthesia. Such profiles observed in this study include:

i. Majority (82, 56.9%) of the subjects recruited lived within two kilometres drive from the hospital i.e Sagamu and Ikenne.
ii. Most of the subjects belonged to either ASAI or II.
iii. Most of the cases were simple, uncomplicated and were performed as elective in-patient cases (105, 73%)
iv. Majority of the herniotomies were mostly performed in the morning (122, 84.7%).
v. Most (104, 72%) of the subjects had packed cell volume within the normal range (30-45%) with minimal mean intraoperative blood loss (17.16 ±17ml) and there was no requirement for blood transfusion.
vi. Minimal anaesthetic complications were observe during surgery and follow-up on the ward.
vii. Early feeding (at least between five to six hours post operatively) were established in majority (115, 79.86%) of the children.

We therefore advocate for the possibility of establishing day case anaesthesia for simple uncomplicated inguinoscrotal hernia or hydrocele in children.

General anaesthesia is safe, and most commonly employed technique for herniotomy in infants and children.[2, 3, 8, 9] Findings from our study also agreed with the previous studies in that the major anaesthesia technique (135, 94%) employed in this study was general anaesthesia while regional anaesthesia was only employed in nine (6%) children. Different types of general anaesthesia techniques were employed and these include: general anaesthesia relaxant technique with endotracheal intubation 87 (60.42%), inhalational with face mask spontaneous 36 (25%), and general anaesthesia with laryngeal mask airway 12 (8.3 %). One would have thought that majority of the cases would have been done under general anaesthesia with the use of laryngeal mask airway as reported in the previous study [10,11,12] because of its numerous advantages over endotracheal intubation such as ease of insertion, less invasive, less discomfort thus less haemodynamic parameters changes in the postoperative period. However, this was not so because the paediatric sizes of laryngeal mask airway devices were not available in our centre until around the year 2014.

In this study, subarachnoid block alone was used in older children 7 (4.82%) while younger children who had regional anaesthesia technique (caudal block 1 (0.69 %), subarachnoid block 1(0.69%) were sedated with ketamine to allowed for cooperation. Kokki et al[13] demonstrated the safety and effectiveness of spinal anaesthesia in 195 children aged six months to ten years undergoing herniotomy as a day case. Findings from their study [11] showed that spinal anaesthesia was successful in most of the children with only two patients being given general anaesthesia. Also, he recommended that postoperative analgesics given for the first two or three days would be adequate because subarachnoid provide some residual analgesia in the immediate postoperative period. However in this study, regional anaesthesia techniques (caudal block or subarachnoid block) were infrequently used.

During the period of study review, awake- spinal anaesthesia without sedation was only allowed to be used in older children aged ten years and above, who were willing to cooperate for the technique. Spinal anaesthesia or caudal blocks with sedation were only performed by more experienced senior anaesthetists for younger children. Also this may be partly due to due to proficient and skills which is lacking by the Anaesthesia residents and acceptability of the techniques by the parents. Caudal block combined with general anaesthesia provides good analgesia in the postoperative period.[7]Ilioinguinal block and caudal anaesthesia had been reported by some authors to provide excellent analgesia for herniotomy procedure especially in the postoperative period as demonstrated in the study by Willschke et al[14] and Bhattarai et al[15] but this was used sparingly in this study. The success rate of caudal or ilioinguinal block can be improved with ultrasound guided as demonstrated by Willschke et al[14] and jagannathan et al.[16] We therefore recommended that surgeon in training in the specialty of Anaesthesia should be equipped with skills on the use of caudal block and general anaesthesia with laryngeal mask airway insertion as part of anaesthesia technique for elective herniotomy.

Records showed that intravenous paracetamol 10-15mg/kg with or without pentazocine 0.5mg/kg were the main stay of intra-operatory analgesia for those children who had general anaesthesia for herniotomy. Intravenous paracetamol 10mg/kg was prescribed for all the patients in the immediate postoperative periods. Oral paracetamol was then continued as the only analgesic for postoperative pain control in all the patients when they started tolerating orally, though syrup ibuprofen was occasionally prescribed for older children. Antibiotics were not routinely used unless indicated.

Records of hypotension, (one of the common complications of spinal anaesthesia) could not be assessed probably because blood pressure was not routinely monitored in children under anaesthesia. We therefore suggest routine non-invasive blood pressure monitoring for children under anaesthesia. Complains of headache that may suggested post-dura puncture headache, urinary retention and low back ache among children who had regional anaesthesia as commonly reported in adults were not documented in the patient's case notes probably because of the retrospective nature of the study even though subarachnoid block were used mainly in older children (greater than 10years old). We therefore, recommend prospective study on effectiveness of regional anaesthesia and post-anaesthetic follow-up for simple uncomplicated herniotomy procedures.

Laryngoscopy and tracheal intubation can cause raised plasma cathecolamine with increase changes in haemodynamic variables.[10] This could be harmful in children with cerebrovascular or cardiovascular pathology. The use of larygngeal mask airway (LMA) is a suitable alternative to endotracheal intubation to circumvenge the intraoperative tachycardia (4, 2.8%) and difficult intubation (3, 2.0%) resulting from general anaesthesia relaxant techniques observed among the infants in this study. Shahin NJ et al [10] reported in their prospective randomized trial, comparing the use of LMA and endotracheal intubation in children, using 100 ASA I and II children weighing between 10-20kg in the range of 2-10 years of age, scheduled for elective surgery were randomised into one of the two groups of 50 children each. Shahin NJ et al[10] found that insertion of LMA was easier in 94% children while endotracheal intubation was done easily in 53% of children only ($p< 0.05$). The changes in haemodynamic parameters were observed to be significantly higher after endotracheal intubation as compared to LMA placement in Shahin NJ et al[10]. Also these changes persisted for longer duration after endotracheal intubation in comparison to LMA insertion (5 minutes versus 3 minutes). Shahin NJ and his co-worker[10] also discovered that incidence of post-anaesthetic complications i.e bronchospasm, laryngospasm and soft tissue

trauma was significantly higher ($p<0.05$ after endotracheal intubation as compared to LMA. The incidence of nausea and vomiting that was reported in eight children in this study was found among those who had general anaesthesia relaxant techniques with endotracheal intubation for obstructed inguinoscrotal hernia, and those who had in addition to inguinoscrotal hernia, obstructed umbilical hernias or obstructed epigastric hernias. This could probably due to stimulation of afferent nerves fibres originating from gastrointestinal tracts when feeding was established too early or possibly side-effects of residual intra-operatory opioid (pentazocine). In these cases, feeding was interrupted and recommenced four hours later and there was no recurrence of nausea or vomiting.

Conclusion

This study has shown that herniotomy can be safely performed using various options of anaesthetic techniques depending on the expertise of the anaesthetist concerned. We advocate for Day case anaesthesia for simple uncomplicated herniotomy in our health care facility by appropriate scheduled patients selection. The preparation of selected surgical patient can be carried out on out -patient clinic and patient admitted on the day of surgery. The observable complications are within the acceptable limits. We recommended that surgeon in training in the specialty of Anaesthesia should be equipped with skills on the use of caudal block and general anaesthesia with laryngeal mask airway insertion as part of anaesthesia technique for elective herniotomy.

Author contributions

EEA: research idea; study design; planning; data analysis; interpretation and draft the manuscript; FOM: data analysis and interpretation; NCC: data analysis and interpretation; SRO: data acquisition and interpretation. All authors contributed to important intellectual content during manuscript drafting or revisions. All authors read and approved the final manuscript.

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