Comparison of Induction and Recovery Characteristics of Halothane and Sevoflurane among Infants

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ABSTRACT

Objectives: The aim of this study was to compare the induction and recovery characteristics associated with Halothane and Sevoflurane anesthesia in infants undergoing herniotomy.

Methods: A total number of 100 infants who underwent herniotomy at King Hussein Medical Center between July 2008 and February 2009, under general anesthesia were allocated to receive either Sevoflurane (*n*=50) or Halothane (*n*=50) anesthesia. Induction times, recovery times and induction and recovery complications were recorded.

Results: The time of induction was shorter with Sevoflurane than with Halothane. The incidence of excitement was higher in Sevoflurane group than in Halothane group during both induction and recovery. Recovery time was significantly shorter with Sevoflurane group than halothane group.

Conclusion: Sevoflurane, when used for infants, has the advantage of faster speed of induction and more rapid recovery than Halothane, which may make it suitable alternative to the later.

Key words: Halothane, Herniotomy, Pediatric anesthesia, Sevoflurane

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Introduction

Induction of and recovery from anesthesia is influenced by the choice of volatile agent. Agents with lower blood gas solubility have been associated with faster times of induction and recovery.[1] Halothane is a volatile anesthetic agent which has been the most commonly used agent in pediatric anesthesia. Sevoflurane has several properties which may make it a suitable agent for pediatric practice.[2] Among these properties is low blood gas solubility with the potential for more rapid onset and offset of anesthesia. Also it is non-pungent and has low airway irritability allowing smooth inhalational induction.[3] These properties may make sevoflurane especially suitable for day surgery. We conducted this study to compare the induction and recovery criteria of sevoflurane with those of halothane in infants undergoing herniotomy under general anesthesia.

Methods

After institutional ethics committee approval and parental consent, 100 infants (ASA I or II) who underwent herniotomy under general anesthesia at King Hussein Medical Center (KHMC) between July 2008 and February 2009 were included in this study.

All patients were unpremedicated and allocated into one of the two study groups according to a table of random numbers, to receive either Halothane (group H) or Sevoflurane (group S) respectively. Inhalational induction has been performed by

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Table I. Patient characteristics (Mean ± SD) and clinical data

	Group H	Group S
Number of patients	50	50
Age (months)	4.47 ± 1.40	4.91 ± 1.41
Weight (kg)	6.07 ± 1.79	6.75 ± 1.81
Gender M/F	44 / 6	43 / 27
ASA I/II	49 / 1	48 / 2
Duration of surgery (min)	14.44 ± 9.1	15.84 ± 8.9
Duration of anesthesia (min)	24.72 ± 11.3	25.32 ± 12.2

Table II. Induction characteristics (Mean ± SD)

	Group H	Group S
Loss of eye reflex (sec)	60 ± 11	51±6.9
Induction time (sec)	141±26.3	129±21.5
Cough	4	3
Laryngospasm	4	3
Excitement	2	10
Breath holding	2	4

Table III. Emergence characteristics

	Group H	Group S
Eye opening and or purposeful movement to gentle stimulation (sec) mean ± SD	360 ± 90.5	277.3 ± 68.7
Cough	10	8
Laryngospasm	6	4
Excitement	2	12
Vomiting	1	4

delivering the anesthetic agent by Mapleson F breathing system and using halothane Tec 5 or sevoflurane Tec 5 vaporizers. Anesthesia was induced via facemask by inhalation of 40% oxygen with 60% nitrous oxide.

The patients were breathing spontaneously and the anaesthetic agent was added to the system and gradually increased, for halothane in increments of 0.5% to a maximum of 4% and for sevoflurane in increments of 1% to a maximum of 8%.[4] As soon as consciousness was lost, vaporizer was covered and one of the senior anesthetists who was unaware for the agent assessed the patient. The time taken to loss of eye lash reflex as a sign of loss of consciousness and the time to complete induction (small pupils, no body movements and regular respiration), were recorded for all patients. After that, a 22G intravenous cannula was inserted, atracurium 0.5 mg/kg as a muscle relaxant was administered followed by endotracheal intubation with the proper endotracheal tube.

During the maintenance phase, the aim was to provide a relatively constant inspired anesthetic concentration of 0.8% halothane or 2% sevoflurane. After completion of the procedure, the inhalational agent was discontinued abruptly. Infants were allowed to breathe 100% oxygen and the muscle relaxant was reversed by neostigmine-atropine.

The time from discontinuation of inhalational agent until the patient opened his/her eyes or responded purposefully to non-painful stimulus (emergence time) was recorded and the trachea was extubated. Induction and emergence complications (cough, laryngospasm, excitement, breath holding, vomiting) were recorded. Pulse, blood pressure, ECG, and oxygen saturation were recorded from the start to the end of the procedure every five minutes.

Analgesia was achieved by performing ilioinguinal nerve block and skin infiltration with bupivacaine 0.25% (Max 2mg/kg) in addition to paracetamol suppositories (20-30 mg/kg) preoperatively after induction.

Statistical analysis was performed by student *t* test and chi square test.

Results

Both groups were comparable regarding age, weight, sex and ASA physical status (Table I). The time to loss of eyelash reflex was significantly faster with sevoflurane than with halothane, also the time to complete induction of anesthesia was significantly shorter with sevoflurane than with halothane $P<0.05$. (Table II).

The incidence of complications during induction was slight and similar in both groups except for excitement which was high in sevoflurane group

(Table II). Mean duration of surgery and anesthesia was similar in both groups (Table I).

The time from stoppage of inhalational agent to eye opening and or purposeful movement to gentle stimulation was significantly shorter with sevoflurane group than with halothane group ($P<0.05$) (Table III). Regarding emergence complications, cough and laryngospasm were comparable between two groups while vomiting and excitement were more common with the sevoflurane group.

Discussion

Halothane has been the most commonly used inhalational agent for induction and maintenance of anesthesia in children and is still used frequently in developing countries, probably because of its low cost. Sevoflurane, with several attractive physical characteristics which make it suitable alternative for halothane anesthesia in children, is used commonly worldwide nowadays.

In our study, the loss of eyelash reflexes with loss of consciousness was significantly faster with sevoflurane than with halothane. Also the induction time was significantly faster with sevoflurane. These results are in agreement with various studies[2,3] and may be explained by several factors including the blood gas solubility of sevoflurane being less than that of halothane, the rate of increase in inspired concentration, the maximum concentration achieved and the degree of airway irritation being less.

Samer *et al.* and other authors have not been able to demonstrate any significant differences between induction time of sevoflurane and halothane.[1,5,6] The authors of these studies explained that by the use of nitrous oxide.[1,6] Paris *et al.*[7] compared sevoflurane and halothane in out patient dental anesthesia and found that the time to loss of eyelash reflex was shorter with sevoflurane but the time of complete induction was significantly longer with sevoflurane than halothane.

Our study showed that recovery from sevoflurane was more rapid than halothane with agreement to the results of several studies,[8,9] although other studies found slower awakening time of sevoflurane than halothane.[10]

We did not extend our study into the recovery period and discharge from hospital but many studies have shown that both agents are suitable for day case surgery with no essential differences between them.[11] Other studies showed that sevoflurane leads to reduced hospital stay of adult patients.[12] However, most of our patients were discharged from the hospital on the same day. Herniotomy for infants is considered an outpatient procedure in our hospital. However, it depends on accurate selection of suitable patients.

We found that excitement associated more with sevoflurane anesthesia and this observation has been mentioned in several studies.[13] Also recent meta analysis has revealed that emergence agitation occurred more frequently with sevoflurane than with halothane anesthesia in children.[14]

In our study, we compared the effect of halothane with sevoflurane on infants. Most of the mentioned studies compared sevoflurane with halothane in children including infants but not infants in particular.

Cost effectiveness is an important issue in deciding which drug to use, although sevoflurane is more expensive than halothane, the issue is not easy to measure and depends on the scope of the analysis and circumstances under which they occur. For example, time must enter into the equation as personnel are the most costly item in the surgical setting and delay in patient awakening can block an operating theatre and increases the number of cancelled operations. Also post operative complications such as nausea and vomiting will affect the equation, so more specific studies should be conducted to determine the cost effectiveness of sevoflurane versus halothane.[15] Also the effect of both agents on other systems such as cardiovascular system should be considered in the comparison between them.

Conclusion

Sevoflurane, when used for infants, has the advantage of faster speed of induction and more rapid recovery than halothane, which may make it suitable alternative to the later. Further research regarding its cost effectiveness and emergence complications is needed.

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