ANAESTHETIC GAS MONITORING COMPARISON BETWEEN TWO SIDE-STREAM MONITORS

H. Heijbel3, J. Östblom, ME3, M. Brattwall, MD1 and Jan Jakobsson, MD, PhD2

ABSTRACT. End-tidal gas monitoring has become standard of care during inhaled general anaesthesia. We studied the performance of a new side stream gas monitor the ISA multi-gas monitor. The performance was studied at constant low flow of calibration gas and end-tidal anaesthetic measure was studied during routine day case anaesthesia. Pair wise readings of end-tidal halogenated anaesthetic concentration were recorded during low flow anaesthesia. Performance was found to be high; all calibration gas measures were within 0.1 vol% deviation. During routine anaesthesia mean bias was −0.036 vol% and 93 out of 97 pair-wise readings were within the agreement limits as compared to the reference Datex instrument.

KEY WORDS. anaesthesia, anaesthetic agent monitoring, sevoflurane, desflurane.

INTRODUCTION

Low-flow anaesthesia with one of third generation halogenated inhaled anaesthetic, desflurane or sevoflurane has been shown cost-effective and is becoming more and more commonly adopted [1–4]. Effective end-tidal anaesthetic monitoring is thus of increasing importance. Simple but reliable techniques feasible for the office based practice are warranted. The ISA multi-gas monitor is a newly introduced small side stream device available as stand alone anaesthetic gas monitor. With its convenient small size and easy to use features it is a seemingly interesting option for day case and office based anaesthesia.

The aim of the present study was to study the performance of the new ISA multi-gas anaesthetic monitor.

METHODS

The IR-based side-stream gas monitoring ISA multi-gas monitor (PHASEIN AB, Svärdvägen 15, 182 33 Danderyd, SWEDEN) was compared to standard side-stream anaesthetic gas monitor Datex (Datex-Ohmeda S/5 compact anaesthetic monitor, Datex-Ohmeda, Madison, USA).

The performance was evaluated by studying measurements of calibration gas (Scott Medical Products) and during routine anaesthesia as compared to the Datex reference instrument.
The test devices, the ISA and the Datex reference instrument, were compared to calibration gas during a constant flow of 0.8 l/min. The calibration gas was Sevoflurane at the different concentrations 0.5, 1, 3, 5 and 8%, all balanced in nitrogen, accuracy within ±0.03 vol%.

The ISA was further compared during routine clinical anaesthesia to the Datex reference instrument. Parallel readings of end-tidal inhaled anaesthetic gas concentration in vol% were performed every 3rd minute during routine clinical day case anaesthesia in patients breathing spontaneously through a disposable laryngeal mask airway. The digital values displayed at 3 min interval, when the stop watch alarmed for 180 s, were recorded.

All patients had general anaesthesia in accordance to the routine of the department, intravenous co-induction with propofol and small dose alfentanil or remifentanil. No interventions or deviation from the standard clinical practice was done apart from adding an extra coupling at the Y-peace adapter in order to have dual side stream anaesthetic gas monitoring. After induction a disposable laryngeal mask airway was place and the inhaled anaesthetic sevoflurane or desflurane was introduced in a fresh gas of oxygen in air at a fresh gas flow of 1 l/min. The fresh gas flow was subsequently reduced to 250 ml/min and the end-tidal concentration adjusted to clinical needs. All patients breathed spontaneous and respiration was assisted only when found necessary.

Statistics

All values are given mean and standard deviation unless others stated. All gaseous measures are presented in vol%. Agreements between readings were studied by Bland–Altman plot. The bias calculated as the mean difference, and at the limits of agreement defined as the mean difference plus and minus 1.96 times the standard deviation of the differences between the two studied variables of end-tidal anaesthetic gas concentration (vol%).

RESULTS

The results of the calibration gas measurements are presented in Table 1. The Datex reference instrument showed a increasing deviation in measures at higher concentrations.

In all 97 pair wise readings in 13 ASA 1–2 patients (7 females and 6 males mean age 48 years (34–61 years) and mean weight 79 kg (55–115)) was recorded. Evaluated of the performance of the new ISA gas monitor was done by means of Bland-Altman plot; the bias was found to be −0.036 vol% and agreement 0.134 to −0.206 vol%, see Figure 1.

![Fig. 1. Bland–Altman plot of the agreement between pair-wise readings derived from the ISA multi-gas monitor and the Datex S/5 monitor. X-axis end-tidal sevoflurane concentration (vol%), Y-axis difference between ISA and Datex S/5. (Increasing size of circles for multiple readings of identical values).](image)

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<tr>
<th>Calibration gas</th>
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Fig. 1. Bland–Altman plot of the agreement between pair-wise readings derived from the ISA multi-gas monitor and the Datex S/5 monitor. X-axis end-tidal sevoflurane concentration (vol%), Y-axis difference between ISA and Datex S/5. (Increasing size of circles for multiple readings of identical values).

All 97 readings were within the agreement limits. Correlation analyses reveal a correlation coefficient of $r^2$ 0.992, see Figure 2.

DISCUSSION

We studied performance by studying measurements of calibration gas and compared clinical performance by mean of Bland-Altman plot comparing the new device to a standard clinical Datex reference instrument and found the performance of the new IR–based ISA multi-gas monitor seemingly clinically acceptable for routine monitoring of end-tidal inhaled anaesthetic concentration.

Decreasing fresh gas flows reduces the reliability of the dial vaporiser setting [5, 6]. Thus end-tidal anaesthetic gas monitoring has become a basic component of anaesthetic monitoring. Side-stream IR–based monitoring of inhaled