

GE Healthcare Symposium at SSAI 2019:

Low Flow Anesthesia and High Level Transport Monitoring

– a summary

During the busy days at this year's congress for the Scandinavian Society of Anesthesiology and Intensive Care Medicine (SSAI) held late August in Copenhagen, Denmark, GE Healthcare hosted two clinical keynotes on: Automated low flow anesthesia – and on high level monitoring during intra hospital patient transport.

LOW FLOW ANESTHESIA: Which number to pick?

"Of course we do not pick *just any* number!"

Dr. Hendrickx, OLV Hospital, Aalst, Belgium



Continuous transport monitoring: A lifesaver?

The speakers Dr. Jan Hendrickx (right) from OLV Hospital in Aalst, Belgium, and Prof. Thorsten Steinfeldt (left) from Diakonie-Klinikum at Schwäbisch Hall, Germany, delivered lots of insights into each of their fields of expertise. Led by Chair Eske Aasvang (middle), University Hospital Copenhagen, interesting questions and perspectives were raised and discussed along the way.

Automated or autonomous workflows with low flow anesthesia?

Dr. Jan Hendrickx from OLV Hospital in Belgium and Consulting Assistant Professor (Alumnus) at Stanford University, California, has a life-long interest in the quantitative aspects of low flow and closed-circuit anesthesia. As the first of the two speakers he set the bar high by unfolding the details of personalized and automated low flow anesthesia. Speaking on top of several decades of studies and work with gas anesthesia, Hendrickx pointed to the fascinating future scenario of a truly autonomous workflow when subjecting patients to low flow anesthesia.

“Are we really headed that way?”, he asked and went on to answer: “Yes, I believe we are. Even though this will not happen tomorrow or even within the next few years, I’m sure that when we are eventually able to fully utilize the potential of AI (Artificial Intelligence) and hence enable our already advanced machines within the field of anesthesia to ‘learn by themselves’, then we will arrive there.”

“At that point, we will see anesthesia workflows that will resemble those of the autopilot in airplanes or autonomous, self-driving cars. This will enable us to personalize the process of subjecting patients to anesthesia to an even greater extent than possible today and to individualize the amount of drug for each patient in order to minimize the risk for side effects while simultaneously providing cost-efficient, safe care.”

The lower the flow, the lower the cost

Meanwhile, the machine guided process of conducting low flow anesthesia has already come a long way. Hendrickx stressed the fact that low flow anesthesia is most often preferable to reduce waste and thus cost and pollution of anesthesia gas during surgery. However, in many cases the advantages of low flow anesthesia are not fully accomplished when the process is conducted manually or not properly automated.



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For example, real life situations prove, according to a study by Dr. Hendrickx, that the actual use of anesthesia can be as much as 100 % higher when ideally using only 1 liter per minute instead of 2 liters of fresh gas flow per minute in real life¹.

The answer to this is the automated low flow anesthesia process. Hendrickx demonstrated how different phases during a surgery require different anesthetic depths – from initially obtaining unconsciousness towards also ensuring immobility and stress response control through the phase of maintaining the proper level and finally on to the wash-out and emergence phase.

Which number to pick: Preset agent targets is best way to control end-expired concentrations

And he explained how the most ergonomic way to control the different end-expired concentrations that help ensure the correct anesthetic depth during specific stages of the surgical procedure is to use a set of default or preset agent targets in the system - also known as Quick Picks in GE Healthcare’s Anesthesia solutions.

“These Quick Picks are really very useful to integrate low flow anesthesia into the workflow. They make it easy to use target controlled low flow anesthesia in such a manner that one can rapidly, smoothly, and ergonomically navigate anesthetic depth to match changing clinical conditions.

“Of course, it must also be noted, that they do not define the envisioned end-goals per se and that the anesthesia provider always has to observe what the clinical effect of these default targets are and adjust accordingly as individual factors such as the patient’s age and weight, hemodynamics of blood flow etc. which of course may vary significantly,” said Dr. Hendrickx.

Table 1. (A) Consumption (mL liquid) after 60 min in each group².

FGF (L/min)	0.2	0.3	0.5	1	2	4	8
A. Consumption after 60 min (mL liquid agent)							
Halothane			5.6**	5.8	7.9	11.8	21.3
Isoflurane		3.8*	4.3	5.3	6.7	13.3	28.7
Sevoflurane	6.7*	5.6*	5.5	7.5	12.2	22.6	50.0
Desflurane		9.6*	12.3	20.0	34.2	68.1	140.7

Initial FGF (fresh gas flow) of 4 L/min for 30 s (*) or 5 min (**).

1, 2) The Pharmacokinetics of Inhaled Anesthetics and Carrier Gases Thesis. Thesis submitted in fulfillment of the requirements for the degree of Doctor in Medical Sciences, Jan F. A. Hendrickx June 18, 2004, Clinical evaluation of the general anesthetic equation for halothane, isoflurane, sevoflurane, and desflurane in oxygen. Hendrickx JFA, Van Zundert AAJ, De Wolf AM.

Continuous monitoring saves lives

Professor Thorsten Steinfeldt from Diakonie-Klinikum at Schwäbisch Hall, Germany, addressed the importance of continuous hemodynamic monitoring (i.e. of the oxygen level in the blood), and in fact monitoring on a higher level in general, of patients during transport in and out of operating rooms (OR); for example, when a patient is gradually regaining consciousness and is transported out of the OR and into a the PACU (post-anesthesia care unit).

How well is the patient monitored, if monitored at all?

"The fact of the matter is that in many hospitals continuous monitoring is still not in place today even though it ought to be. Continuous monitoring is important and should be mandatory because it saves life – it is in fact that simple. It is not just 'nice to have' but something that all hospitals 'need to have' in place – from a patient goes into surgery, during the surgery and not least after surgery when the patient is transferred to either the PACU or an intensive care unit. The whole process is not stronger than the weakest part of the chain, and we must be more aware of that," said Prof. Steinfeldt.

Well known causes for stroke also happen during transports

According to Steinfeldt, no one really argues that capnography and ECG are not essential to monitor in order to secure an optimal outcome of a surgery. In fact this is so obvious to everyone that only a few studies have been published addressing this. But when it comes to monitoring a patient's blood pressure and oxygen saturation (pulse oximetry), this is not recommended to the same degree as ECG. Even though it is very easy to enable

pulse oximetry monitoring, it is far from standard procedure in many places.

Pointing to different studies, Prof. Steinfeldt explained that cases of abnormally low level of oxygen in the blood (Hypoxemia) which is a well-known cause for stroke and cardiac events also happen during transport, and that in many transports there are no reliable means in place to properly monitor the oxygen level, let alone means to give the patient more oxygen if needed.

Just 5-10 minutes of transportation can prove vital

Scientific data from different European countries show that when patients were monitored for signs of Hypoxemia through clinical observations, only in 15 % of the cases were the hospital staff – experienced anesthetists as well as less experienced – able to correctly detect if a patient was in fact experiencing Hypoxemia¹.

Another study revealed that when the systolic blood pressure is reduced by more than 50 % from the baseline, this can be an independent risk factor for having a cardiac event². The duration of this can be only five minutes which must be compared to the fact, that it normally takes longer, up to 10 minutes, to transfer a patient from the OR and on to the PACU³. In other words, the lack of proper monitoring during this short time can still prove vital.

Lack of mobile monitoring devices is a barrier

"The question is, if we know this, how well do we then in fact use and implement the knowledge in our daily practice – for example when transporting patients into the ICU or from the OR into the PACU?"



"Continuous monitoring is important and should be mandatory because it saves life – it is in fact that simple."

The answer is, not in that many places, at least in Germany, and perhaps this calls for the question to be rephrased: Why are continuous monitoring on these important parameters not obligatory and a standard procedure in more hospitals? "In my own experience that answer was in fact very simple: We just didn't have a proper mobile monitoring system in place that allowed us to easily follow and monitor the patient through the whole process from A to Z. But I can assure you that we do have such devices now," said Steinfeldt.

Checklist of requirements for the monitoring technology

In conclusion, Prof. Steinfeldt presented the audience with a checklist of requirements for the monitoring technology to be implemented. It must;

- be stable during function;
- have a physical robustness to it;
- be adapted to the hospital's workflow;
- be relatively easy to use by the staff;
- be mobile in order to follow the patient from induction, through OR to the recovery room.

1) Impact of medical training and clinical experience on the assessment of oxygenation and hypoxemia after general anesthesia: an observational study. Hansjörg Aust, Peter Kranke, Leopold H.J. Eberhart, Arash Afshari, Frank Weber, Melanie Brieskorn, Julian Heine, Christian Arndt, Dirk Rüsch. In Aust H et al. J Clin Monit Comput 2015, 29:415-426

2) Intraoperative hypotension is associated with myocardial damage in non-cardiac surgery. An observational study. Linn Hallqvist, Johan Mårtensson, Fredrik Granath, Anders Sahlén and Max Bell. In Eur J Anesthesiology 2016, 34:1-7

3) Professor Thorsten Steinfeldt, Diakonie-Klinikum at Schwäbisch Hall, Germany, 2019



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