The Potential for Savings with Innovative Medical Technology in Healthcare

(Extract)
Dräger Medical GmbH: Dräger Zeus IE (Infinity Empowered) anaesthesia system
A control loop-based anaesthesia system for general and regional anaesthesia

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A joint study by

med tech

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ZVEI

SPECTARIS
Verband der Hightech-Industrie

Foreword

When discussed in public, medical technology is often portrayed as driving up healthcare costs. In actual fact, the very opposite is true: innovative medical technology can help save costs in healthcare. Modern operation techniques, therapeutic options and product solutions to optimise processes in hospitals and for resident doctors reduce operation times and lay days, accelerate healing processes, and reduce the administrative effort involved. This makes it possible to reduce personnel costs and save material.

In order to use a concrete example to prove these potential savings, a series of studies was established in 2006 and the Internet portal www.einsparpotenzial-medizintechnik.de was launched in 2009. The joint editors of the website and publications, which generally appear annually, are Prof. Dr. Marc Kraft from the Medical Technology department of the Technical University Berlin, a team from the competence centre for medical technology at Droege & Comp. management consultants, SPECTARIS, and the Central Association of the German Electrical and Electronics Industry (ZVEI). 46 product and process examples have since been used to demonstrate a potential saving of several billion euros.

Whether, and to what extent, the potential savings displayed can/could be implemented in practice is obviously dependent on various factors. On the one hand, the concrete situations in individual hospitals or doctors' surgeries are important. On the other hand, however, the issue of reimbursement also plays an important role.

In the examples used in the series of studies, these uncertainties are taken into account to such an extent that the projections are only ever based on a partial, rather low market penetration.

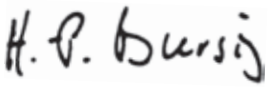
Four earlier examples from the studies refer to the field of ventilation/anaesthesia. These are:

- A system for the rapid weaning of intensive care patients requiring ventilation
- A device to treat sleep apnoea syndrome using the automatic determination of the ventilation pressure
- A system to improve the ventilation of newborns by guaranteeing the volume
- A pumpless artificial lung to replace mechanical ventilation

A fifth example was added in 2011: a control loop-based anaesthesia system for general and regional anaesthesia, with which it is possible to significantly reduce consumption costs.

The examples provide impressive evidence of that potential for savings provided by innovative medical technology in the field of ventilation/anaesthesia alone.

We hope you enjoy the lecture and hope that the often one-sided cost debate is conducted much more openly.



Hans-Peter Bursig
Managing Director of the Electromedical Technology Association in the Central Association of the German Electrical and Electronics Industry (ZVEI e.V.)

Dr. Tobias Weiler
Managing director of SPECTARIS e.V.

A control loop-based anaesthesia system for general and regional anaesthesia

*Fig.: **Anaesthesia system** Zeus IE in combination with SmartPilot View*

Overview/product description

The Zeus IE (Infinity Empowered) is an anaesthesia system, which allows all forms of general anaesthesia (inhalation anaesthesia, balanced anaesthesia and total intravenous anaesthesia) and regional anaesthesia.

Application range

The Zeus IE is suitable for use in operating theatres, prep and recovery areas, as well as other rooms used for medical purposes. The application range covers adults, children and premature babies.

- Invasive and non-invasive ventilation
- Patient monitoring
- Intravenous therapy

Function

The Zeus IE anaesthesia system combines various anaesthesia technologies in one system and supports anaesthetists in the making and implementing of decisions thanks to its integrated patient monitoring and the integration of IV syringe pumps. Anaesthetists can view and control all the functions via a joint user interface. Interfaces such as USB and Ethernet ensure that the Zeus IE can be integrated in the IT system landscape today and in the future.

Features

As well as the anaesthesia technology, the Zeus IE also integrates patient monitoring and the control of intravenous medication. Unlike standard anaesthesia systems, the Zeus IE is equipped with control loops and can be used in a closed loop system with complete rebreathing. This allows a reduction in interactions with the device and fresh gas, including volatile anaesthetics.

Innovation

Technical description of the innovation

The Zeus IE anaesthesia system consists of an electronically controlled and driven anaesthesia ventilator, an electronic gas and anaesthetic dosage, an integrated patient monitor, and the ability to control intravenous syringe pumps remotely.

All of the system's functions are controlled from a central computer via a touch screen. All patient parameters also converge on this screen.

The automatically controlled ventilation and anaesthetic metering unit forms the innovative core of the Zeus. The synchronised modules are optimised on the one hand to offer a function comparable to ventilation in an intensive-care area and, on the other hand, to use control loops to structure the metering of volatile anaesthetics in such a way that requires the minimum consumption whilst at the same time reducing operating effort.

In order to achieve these goals, the system was equipped with innovative, patented solutions. A blower integrated in the breathing system is used for the ventilation. This layout makes it possible to generate a circular flow in the breathing system. The layout also allows for a compact design with very low, compressible volumes. The anaesthetic agent is introduced using a metering module, which uses an injector valve. This makes it able to apply the smallest possible volumes directly into the breathing system and to accurately determine the anaesthetic consumption. The gas metering uses an array of valves, which are controlled by computer and can meter fresh gas quantities of 0-18 l/min into the breathing system.

New content of solution/ market penetration

As well as classic, manual fresh gas metering, the Zeus IE also possesses an automatic metering mode. In this so-called "TCA® mode (Target Controlled Anaesthesia), control loop functions are used to keep the desired end tidal anaesthetic concentration and the desired inspiratory O_2 concentration constant. An additional controller ensures that the fresh gas flow is adjusted to suit the respective situation. In addition, the use of a direct injection anaesthetic meter and a blower-driven ventilation unit is also new. An adequate safety system with redundant sensors also ensures that disturbances are identified automatically.

Improvements to existing solutions/ history/effectiveness

A classic anaesthesia rebreathing system allows anaesthesia ventilation with reduced fresh gas flow. The gas exhaled by the patient is removed via a CO_2 absorber and then fed back to the patient. This method with reduced fresh gas flow allows a limited reduction in anaesthetic consumption compared to systems without rebreathing. However, the reduction of fresh gas does have its limits. For example, the quantity of gas must constantly be adjusted to suit the patient's ever-changing intake.

Changes to the anaesthetic concentration are associated with large delay times. The concentration of O_2 and anaesthetic introduced to the patient must constantly be checked and corrected by altering settings.

None of this is necessary when using TCA. Sensors and a computer system take on the control of the concentrations and fresh gas quantity, in accordance with the desired concentrations configured by the user. The fresh gas flow is always adjusted automatically whenever the uptake changes or when a change in concentration makes it necessary. The special layout of the anaesthetic vaporizer as a direct injection allows the anaesthetic agent to wash in while the fresh gas flow remains low. The system remains closed; the consumption of anaesthetic agent remains at the lowest possible level.

Qualitative benefits

A benefit for the patient is that the introduction of the anaesthetic takes place exactly as specified by the anaesthetist. Overdoses and underdoses caused by system-related limitations are avoided. One particularly positive property of the Zeus ventilation drive can also be seen in its particular suitability for (assisted) spontaneous respiration. It is also acknowledged that systems with a high portion of rebreathing allow a good breathing gas climatisation. This property can reduce post-operative complications.

For the doctor, the main benefit is the reduced workload. When using the Zeus IE, the number of settings the doctor must make can be reduced by more than half compared to when using classic systems. The benefit for the hospital or payer can be seen in the reduced anaesthetic consumption. Studies show that the consumption of desflurane could be reduced by 65 % within two hours.

This also has positive ecological effects. By reducing anaesthetic consumption to a physiological minimum, the Zeus IE significantly reduces the environmental pollution caused by halogenated fluorocarbons (basis of volatile anaesthetics).

Cost-benefit analysis

Description

In the study "Assessing the clinical or pharmaco-economical benefit of target controlled desflurane delivery in surgical patients using the Zeus anesthesia machine" carried out by Lorat-Jacob, Billard, Buschke and Severin, which was published in 2009, the authors draw attention to the reduction in desflurane (volatile anaesthetic) consumption, oxygen consumption, and nitrous oxide consumption when using a Zeus IE anaesthesia system. When comparing a general anaesthesia performed with the Zeus with a general anaesthesia performed with a standard anaesthesia

device, the use of the standard anaesthesia device produces general anaesthesia consumption levels of 0.34 ml desflurane, 1772 ml O_2 and 618 ml N_2O per minute. In contrast, the consumption levels in the case of a Zeus general anaesthesia are considerably lower: 0.14 ml desflurane, 767 ml O_2 and 173 ml N_2O per minute. Assuming that an operation lasts on average 61 minutes, the use of standard technology to perform the general anaesthesia produces total consumption levels of 20.74 ml desflurane, 108,092.00 ml O_2 and 37,698.00 ml N_2O per operation. The Zeus general anaesthesia, on the other hand, produces lower total consumption levels of 8.54 ml desflurane, 46,787.00 ml O_2 and 10,553.00 ml N_2O per operation. At average prices per litre of 541.67 euros for desflurane, 0.0008 euros for O_2 and 0.0045 euros for N_2O, the total ongoing cost per operation for a standard general anaesthesia is 11.49 euros, whilst this figure is 4.71 euros for a Zeus general anaesthesia.

Working on an assumption of an average 250 operation days per year and an average number of four operations per day, this results in 1,000 operations per year for one operating theatre. For this operating theatre, the annual ongoing cost per operating theatre using standard technology to perform general anaesthesia is 11,490 euros. In contrast, the annual ongoing cost per operating theatre using Zeus general anaesthesia is 4,710 euros. To contrast the two alternatives, the extra expense involved in procuring the ZEUS general anaesthesia equipment must be compared to the costs incurred by using the standard technology. In the case of a depreciation period of five years, an extra annual cost for the linear depreciation per operating theatre of 2,000 euros must be applied. This increases the total annual costs per operating theatre to 6,710 euros per year.

Compared to general anaesthesia performed using standard technology, this results in a potential annual saving of 4,780 euros per operating theatre. With approx. 8,000 operating theatres in Germany, and given a 10% market penetration with the ZEUS general anaesthesia technology, this results in a potential annual saving of 3,824,000 euros compared to standard general anaesthesia technology.

Fig.: Anaesthesia system Zeus IE
in combination with SmartPilot View

Cost-benefit effect	ZEUS general anaesthesia	Standard technology general anaesthesia
Desflurane consumption per minute	0.14 ml	0.34 ml
Consumption of O_2 per minute	767 ml	1 772 ml
N_2O consumption per minute	173 ml	618 ml
Average time per OR in minutes (assumption)	61	61
Desflurane consumption per OR	8.54 ml	20.74 ml
O_2 consumption per OR	46,787.00 ml	108,092.00 ml
N_2O consumption per OR	10,553.00 ml	37,698.00 ml
Price of desflurane per litre	541.67 €	541.67 €
Price of O_2 per litre	0.0008 €	0.0008 €
Price of N_2O per litre	0.0045 €	0.0045 €
Desflurane costs per OR	4.63 €	11.23 €
O_2 costs per OR	0.037430 €	0.086474 €
N_2O costs per OR	0.047489 €	0.169641 €
Ongoing costs per operation	4.71 €	11.49 €
Average operation days per year	250	250
Average number of operations per day	4	4
Number of operations per year	1,000	1,000
I. Ongoing annual costs per operating theatre	**4,710.00 €**	**11,490.00 €**
Extra expense for procurement of ZEUS vs. use of standard technology	10,000	0
Depreciation period (in years)	5	5
II. Extra annual expense for depreciations per operation theatre	**2,000.00 €**	**0 €**
I.-II. Total annual costs per operating theatre	**6,710.00 €**	**11,490.00 €**
Potential annual saving per operating theatre		**4,780.00 €**
Operating theatres in Germany (assumption)		8,000
Degree of market penetration of ZEUS (assumption)		10 %
Potential annual savings at a penetration degree of 10 %		**3,824,000.00 €**

The potential savings result from the fact that the Zeus IE, unlike standard anaesthesia devices, is equipped with control loops and can be used in a closed loop system with complete rebreathing. This means that it must only meter the patient's oxygen and anaesthesia uptake. Additional savings, which are not included in the

cost-benefit analysis, result from the fact that patient monitoring and the control of intravenous medications are also possible with the Zeus IE. This allows a reduction in interactions with the device and fresh gas, including volatile anaesthetics.

Summary

Purpose

The Zeus IE device is a completely integrated, controlled anaesthesia system, which offers far more than the functions previously provided by anaesthesia ventilation systems. It is not only suitable for inhalation anaesthesia, but also for balanced anaesthesia, total intravenous anaesthesia and regional anaesthesia. This means it can be used in operating theatres, prep and recovery areas, and in all other medical treatment rooms.

Innovation

The combination of all important forms of anaesthesia is among the most important innovations of the Zeus IE anaesthesia system. As well as controlled anaesthetic metering, it also integrates syringe pumps for balanced and intravenous anaesthesia. All device components are operated via a patient monitoring system with a joint user interface. A second innovation is the control of the anaesthesia ventilation system, in which only the quantity of gas that corresponds to the patient's actual uptake is introduced into the closed system. With an automatic metering mode, the desired concentration of anaesthetic and oxygen remains constant while the fresh gas flow is adjusted accordingly. A direct injection anaesthetic meter and an innovative ventilation unit drive are used for this purpose.

Savings

The economic advantage for the user of the Zeus IE anaesthesia system lies in the reduction of the anaesthetic consumption, thanks to the system control. The reduced desflurane consumption results in a potential annual saving of 4,780 euros per operating theatre. In addition, the anaesthetist's workload is also reduced significantly. It is hugely beneficial for the patient that the introduction of the anaesthetic is accurate and the high portion of rebreathing allows good breathing gas climatisation.

List of references

Lorat-Jacob, Billard, Buschke und Severin (2009): Assessing the clinical or pharmaco-economical benefit of target controlled desflurane delivery in surgical patients using the Zeus anesthesia machine, in: Anaesthesia, 64 (11), S. 1,229 – 1,235.

List of authors

Mike Bähren

Leiter Volkswirtschaft, Betriebswirtschaft
und Marktforschung, SPECTARIS e.V.

Andreas Bätzel

Referent im Fachverband
Elektromedizinische Technik des ZVEI

Dr. Marcus Fuchs

Principal, Droege Group
Internationale Unternehmer-Beratung

Prof. Dr.-Ing. Marc Kraft

Leiter des Fachgebietes Medizintechnik
der Technischen Universität Berlin

Dr. Christian M. Strothmann

Senior Consultant, Droege Group
Internationale Unternehmer-Beratung

Drägerwerk AG & Co. KGaA

Moislinger Allee 53-55
23558 Lübeck

Telefon: +49 (0) 451-882 0
Telefax: +49 (0) 451-882 2080

info@draeger.com
www.draeger.com