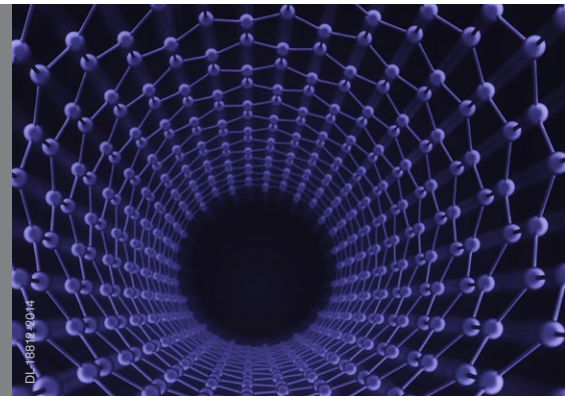


## Technology Insights

### for transition to spontaneous breathing during recovery

Protective ventilation in the OR poses major requirements to anaesthesia workstations. Dräger works closely with clinicians and nursing staff around the world to understand the precise needs and requirements for protective ventilation in the OR.

Below we describe the latest ventilation technologies in our anaesthesia workstations, which enable successful protective ventilation strategies.



Most anaesthesia aims to allow patients to wake up at the desired time and with sufficient spontaneous breathing so that they can be transferred to the recovery room in a state of respiratory and haemodynamic stability. If this is not achieved, the patient may need to be given prolonged ventilation in the OR or the recovery room, and more intensive monitoring if necessary. To avoid this, the anaesthetic agents must be either dosed as appropriately as possible, or else reversed wherever possible. The latter can harbour considerable risks. The washout of anaesthetic agents by hyperventilation is one popular method if the effects of the anaesthetic agents extend for too long after the end of the operation. However this procedure, too, is problematic for pharmacokinetic reasons. You can find some more background information about this topic in the section „Obese patients during recovery“ on our website.

Certain aspects have to be taken into consideration during the recovery of obese patients. During recovery, the ventilation successes before and during the operation

have to be maintained, because when the patient begins to breathe spontaneously again, and especially after extubation, there is a risk that obese patients in particular will develop repeated or additional atelectases and may therefore be exposed to a greater risk of postoperative pulmonary complications.

During the recovery phase, precise management of the anaesthetic agents, a successful transition to spontaneous breathing and – especially in the case of obese patients – non-invasive support for spontaneous breathing are necessary to prevent atelectases. Anaesthetic workstations should provide the best possible technical support for these measures.

Below we describe technologies that can assist anaesthetists in their work.

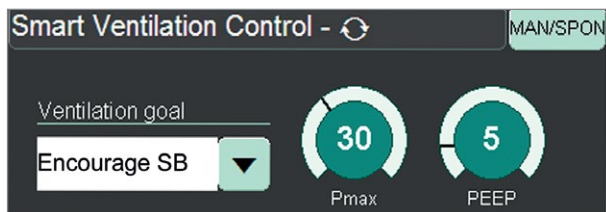
## TECHNOLOGY SUPPORTING THE MANAGEMENT OF ANAESTHESIA IN OBESE PATIENTS

### Smart Ventilation Control (SVC)\*

SVC is the first assistance system for ventilation during general anaesthesia that supports users during the entire course of the operation, from intubation all the way to extubation. In contrast to conventional modes of ventilation, here users can specify directly the therapeutic objective of ventilation. In this context, the objective of ventilation refers to the definition provided by the anaesthetist concerning whether the patient should have complete controlled ventilation or whether spontaneous breathing should be permitted or forced. At the start, the system suggests target ranges adapted to each individual patient for tidal volume and end tidal CO<sub>2</sub>. Users then have the option of adjusting these target ranges as they see fit. With automatic titration of the relevant ventilation parameters, SVC ensures that the values for tidal volume and end-tidal CO<sub>2</sub> are always kept within the target ranges. This results in ventilation tailored to the individual patient while simultaneously ensuring a protective ventilation regime.

SVC was developed in co-operation with clinicians to promote spontaneous breathing as early as possible and to the best possible extent. SVC can provide classic mandatory ventilation. Anaesthetists can select a new ventilation objective with a single interaction, for example to prepare the patient for extubation. SVC gradually reduces the frequency of mandatory ventilation and pressure support in order to allow the patient to breathe spontaneously. This objective-oriented user guidance greatly reduces the number of required interactions, for example during recovery, and at the same time guarantees the quality of the ventilation by maintaining adequate tidal volumes and a stable end-tidal CO<sub>2</sub> level.

\*Dräger is planning to integrate the software option "Smart Ventilation Control" into its Zeus® IE anaesthesia machine. For more information about availability, please contact your Dräger representative.



Smart Ventilation Control (SVC)

### Active CPAP

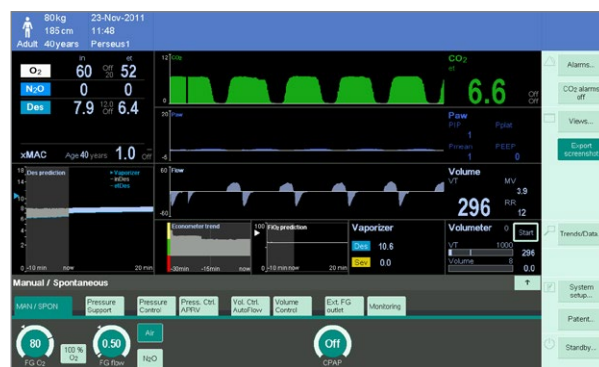
In order to actively counteract the intrinsic PEEP in obese patients during recovery, it should also be possible for the anaesthesia machine to apply an active CPAP in this phase. A real CPAP supports the patient with a continuous flow that actively counteracts the intrinsic PEEP and thus reduces the work of breathing. In the absence of a real CPAP, attempts are often made in Man./Spont. mode to simulate a CPAP by setting the APL valve to the desired pressure. However, the pressure set at the APL valve acts primarily as a resistance instead of providing active support. This means that the APL valve does not reduce

the work of breathing but merely makes expiration more difficult. Furthermore, the pressure is not maintained at a constant level during spontaneous breathing.

The Dräger ventilation units TurboVent 2 (installed in the Dräger anaesthesia machines Zeus® IE and Perseus® A500) have a blower ventilator that can deliver an active CPAP without any interruptions. The blower delivers a continuous circle flow, thus enabling the rapid mixing of gases in the breathing system and with it rapid changes in gas concentrations. The blower can adjust its speed extremely rapidly, thus reacting to pressure changes during spontaneous breathing and maintaining the constant pressure at the level set. The E-Vent plus piston-based ventilator installed in the Primus® family is also capable of applying a real, active CPAP in Pressure Support mode. To achieve this, the pressure support is reduced to 0 mbar. If you would like to know more about ventilator technology please click [here](#).

### Pressure support + CPAP

Pure CPAP may be a great help for moderately obese patients during recovery, given that it can facilitate independent spontaneous breathing in the supine position. However in cases of advanced obesity this may not be sufficient, rendering it necessary to support breaths in order to achieve adequate tidal volumes. The very high trigger sensitivity, which can be adjusted to the individual patient, coupled with the fast reactions of the electronic ventilators E-Vent/E-Vent Plus, and in particular TurboVent 2, ensure rapid and synchronous pressure support for spontaneous breathing. The rate at which the pressure rises can be adapted using slope adjustment to take account of the individual lung mechanics.



Spontaneous breathing without CPAP



Spontaneous breathing with activated CPAP

During the expiration phases PEEP (CPAP) is maintained appropriately. This option is available with all Dräger anaesthesia machines. Synchronisation and the reaction times of current Dräger ventilator technologies, especially the TurboVent 2 blower, correspond to the performance of intensive care ventilators.

### Resistances in the breathing system

In the blower-driven anaesthesia machines, the circle flow reduces the resistances arising due to the breathing system to facilitate spontaneous breathing at the PEEP (CPAP) level and thus to reduce the required work of breathing. During expiration, the E-Vent plus piston-driven ventilators synchronise themselves with the expiration flow, and actively support the patient's expiration by means of controlled ventilator piston return.

### Predictive functions

The Perseus offers intelligent predictive functions when used in conjunction with the Vapor 3000 and D-Vapor 3000 anaesthetic vaporisers. The machine calculates how the gas concentration will develop, based on the fresh gas settings, the handwheel position communicated by the Vapor, the demographic patient data that have been entered, and the current measured gas values. The Perseus predicts both the inspiratory and the expiratory volatile-agent concentration, and the inspiratory oxygen concentration. These features therefore offer higher levels of safety and transparency during anaesthesia. At the same time, the number of steps for the user is reduced and precise recovery is facilitated. The vaporisers are also equipped with visual alarms to support the user, and low vaporiser filling levels are indicated in good time by the Perseus® A500.

### SmartPilot® View – visualisation of level of anaesthesia

SmartPilot® View calculates the full pharmacokinetics and pharmacodynamics of the anaesthetic agents administered on the basis of the patient data entered by the user, and thus offers an additional information base for assessing the level of anaesthesia. For pharmacokinetics, the effect site concentrations of common opioid analgesics and volatile anaesthetics are calculated, along with those of propofol and various muscle relaxants. The machine displays the current and a 20-minute prediction of the effect site concentration for each medication. Changes in dosage trigger recalculation.

The pharmacodynamic display shows the combined effect of Propofol / volatile anaesthetics and the opioid analgesics.

The 2-D display showing the depth of anaesthesia enables rapid recognition of the combined effect and facilitates titration of the medication for each patient.

SmartPilot® View can also support precise recovery in particular because the user has the course of the calculated effect site concentration of the individual medications and the synergistic effect of hypnotics and opioids in view. This can help the user to estimate the effect of the level of anaesthesia and that of the muscle relaxants, and to dose the medications for successful, well-timed recovery.

The SmartPilot® View can be combined with products from the Primus®- and Zeus® family and the Perseus® A500. Furthermore, Dräger is planning to integrate SmartPilot® View into the next generation of Zeus® IE anaesthesia systems as an application in the cockpit.



SmartPilot® View

### Mask fit in non-invasive support for spontaneous breathing

As in pre-oxygenation and induction in obese patients (click [here](#) for the white paper), after extubation the patient may also require support for spontaneous breathing using CPAP and possibly also Pressure Support, in order to prevent repeated or increased formation of atelectases. Here, too, the increased amount of adipose tissue in the face can make it difficult to get a good mask fit and, if the choice of mask is incorrect, can lead to leakages that reduce the efficacy of the measure. Both the size and type of the mask should therefore be selected with care.

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