User impressions
Anesthesia FLOW-i: O₂GUARD

Hypoxic guard systems
A brief interview with Dr. Jan Hendrickx, an expert in kinetics of inhaled agents and carrier gases

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What is the typical problem with hypoxic guard systems of anesthesia machines?

Hypoxic guard systems are one of the safety systems in anesthesia machines that are designed to avoid the risk of delivering a hypoxic gas mixture to the patient during general anesthesia. Unfortunately, the standards for anesthesia machines are not very clear regarding hypoxic guard systems, which allow the manufacturers to design a system that only prevents the formation of a hypoxic mixture (N_{2}O with an O\textsubscript{2} concentration less than 21 %) in the fresh gas, but not in the inspired gas.

In our studies we have seen that these systems may fail to maintain the inspired O\textsubscript{2} concentration (F\textsubscript{I}O\textsubscript{2}) ≥ 21 % when a second carrier gas is used, especially during low flow anesthesia. Failure can happen, despite a properly functioning hypoxic guard, because re-breathing can lower the F\textsubscript{I}O\textsubscript{2} more than the machine standards anticipated. This means that it is easy for inspired hypoxic mixtures to be formed even when the set O\textsubscript{2} concentration is 21 % or even 25 % or higher!

Clinical study showing the failure of a hypoxic guard system that is even more stringent than required by anesthesia machine standards.2 Videos accompanying the paper can be found here: bit.ly/1UbIH1N (NAVAT’s YouTube channel)
What are the consequences for O₂ concentrations during low flow anesthesia?

Lowering fresh gas flows in a circle system results in a difference between the delivered O₂ concentration (at the common gas outlet; F_D)
and F_I O₂, if a second carrier gas is being used – the result of re-breathing. Consequently, F_I O₂ becomes lower than F_D O₂. 1,2 Unfortunately, this may not always be sufficiently recognized, and if settings are not adjusted, then hypoxic mixtures can develop.

Do you think a F_I O₂ alarm would be enough for the anesthesiologists?

We think that the anesthesia provider may be confused about what causes an alarm, also because existing hypoxic guard systems give a false sense of security. That is why, when F_I O₂ < 21 %, it is very important that the machine overrides the anesthesiologist’s settings if no action is being taken by the provider. 4

What is the difference between the FLOW-i’s O₂ GUARD and the hypoxic guards of conventional anesthesia machines?

The O₂ GUARD™ is a smart hypoxic guard system that actively intervenes when F_I O₂ < 21 %. With the MAQUET FLOW-i®, if F_I O₂ decreases below 21 % for 18 s, the system will automatically increase the O₂ fresh gas flow and the F_I O₂ restoring F_O₂ to at least 25 % within 55 s after its activation 1,3,4

All in all, what is your impression of MAQUET FLOW-i’s O₂ GUARD?

The FLOW-i O₂ GUARD is the only commercially available active inspired hypoxic guard that limits the duration of inspired hypoxic episodes during anesthesia caused by shortcomings of existing delivered hypoxic guard systems. 4

MAQUET FLOW-i’s O₂ GUARD

The O₂ GUARD of the FLOW-i has a unique three step approach:

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Hypoxic guard limits (gray line) did ensure F_O₂ (green lines) remained ≥ 21 % with FGF outside the orange FGF area, but not when the FGF was in the “unsafe zone” between 0.7-3 L min. The yellow arrow represents the zone where F_O₂ might be lower than 21 %.

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References


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