Our recent article opened a valuable discussion on the safety of miniaturized perfusion systems (MPSs) with respect to the risk of gaseous microemboli (GME) [1, 2]. We would like to comment on this.

Although the clinical advantages of MPSs are well known, it is still important to focus on avoiding possible side effects in order to increase patient safety [3].

In our study, we observed excessive negative pressures (ENPs) in the venous line during the use of MPSs, possibly due to volume depletion [2]. ENPs correlate with an increase in the volume of GME. Similar results were published by Simons et al. [1] in their in vitro studies. GME may have clinical consequences, e.g. post-operative stroke or transitory psychotic syndrome [2].

In an effort to minimize this risk, many safety devices were added to MPSs. We distinguish between two groups. The first one includes de-airing devices such as venous bubble traps and the new generation of oxygenators with or without integral arterial filters. The second group focuses on venous line ENPs, either using volume buffer capacity systems such as the better bladder (BB) or an automatic pump flow regulator.

Venous bubble traps connected to the venous line separate air from blood via a 175-µm mesh screen. This leads to a significant reduction in GME [4]. Such traps make use of the bubbles’ buoyancy. The traps prevent larger bubbles from entering the pump where they could be further broken down to smaller emboli, which would then become suspended in blood [5]. This technique, however, does not resolve the problem of ENPs and cavitation phenomena leading to more arterial GME.

Current automatic pump flow regulators do not respond instantaneously and are not fast enough to fully compensate for negative pressure peaks. This may occasionally lead to reduced flows. Even the most careful volume management by an experienced team of perfusionists and anaesthesiologists cannot guarantee 100% safety.

Another device introduced to reduce subatmospheric pressure peaks in the venous line is the BB [6]. The system comprises a flexible thin-walled tube inside a rigid transparent box and is capable of absorbing venous line pressure fluctuations. The adjustable volume of air between the tube and the casing allows buffering.

The study by Simons et al. [6] showed a 40% reduction in venous line pressure fluctuations with the BB. Despite these elegant results, the BB cannot eliminate ENPs completely. In Figure 2 of the study by Simons et al., ENP peaks of up to ~200 mmHg are still observed. The durations of ENPs seem to be longer, as can be inferred from the oblique curve in the graph. However, the main reason for ENPs is volume depletion, which remains untreated in this case. This system would certainly provide more time for perfusionists to replenish the intravascular volume.

We would like to mention that, in our experimental model, the utilization of a one-way-valve connected to the venous side of MPSs for automatic pressure and volume compensation has been evaluated. The results will be published soon.

In summary, to lower complications, optimization and a refined perfusion management of the routinely used MPSs are required.

REFERENCES