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## Assessment of measurement validity

To the Editor:

We read with great interest the innovative article, "Ringer's lactate solution remains in the peritoneal cavity after laparoscopy longer than expected" (1). The methodology used to calculate the peritoneal volume from ultrasound measurements is, however, poorly documented. It is unclear why the sum of three pockets was chosen and why the volumes were approximated as a cube, which is an obvious overestimation. We understand that the authors have chosen simple curve fitting without assumption of an underlying model. Simple simulation shows, moreover, that the formula is either not appropriate or unnecessarily complicated. Using the authors' formula to calculate volumes up to 300 mL, the relationship between the measured and calculated volumes approximates a straight line and could thus more easily be approximated as  $y = a + bx$ . Simulation for volumes of >300 mL reveals an increasingly exponential relationship. That the V2 part of the formula is negative is probably an artefact of the curve-fitting calculations used.

As an hypothesis to be proven, we would suggest that the relationship between measured and calculated volume will be exponential because for lower volumes relatively more fluid will be accumulated between the bowels, leading to an underestimation of the fluid accumulated within the pockets. The advantage of using simple model assumptions to calculate the volume would be that SEs can be estimated, which is useful for clinical conclusions. It would not be surprising if SEs would be much more important at low volumes, and indeed variability of remaining volumes after 24 hours is very important. Therefore, instead of the conclusion that after 24 hours an important amount of Ringer's lactate is still present, the reality might be that after 24 hours the volume is hardly different from that in the control group. This is, moreover, suggested by the disappearance curve of Ringer's lactate, which is more likely to be exponential than linear, as shown.

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## REFERENCE

1. Muzii L, Bellati F, Mancini N, Zullo MA, Angioli R, Panici PB. Ringer's lactate remains in the peritoneal cavity after laparoscopy longer than expected. *Fertil Steril* 2005;84:148-53.

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Reply of the Authors:

We thank Dr. Koninckx and colleagues for their interest in and appreciation of our work (1). We agree that the methodology used to calculate the intraperitoneal volumes according to ultrasound measurements was not described in full detail. However, we do not think the main issue of our article was the method of calculation of fluid volumes but rather the comparison at different times of the volumes remaining in the peritoneal cavity between patients in the experimental (intraperitoneal infusion of 300 mL of Ringer's lactate) and control arms. To highlight any difference and minimize any operator bias, a double-blind, randomized setting was chosen.

In the only similar study published in the literature (2), the comparison of the measured volumes in different groups was reported without any description of the methodology used. We can only guess that the formula adopted was the one for the prolate ellipsoid (volume =  $0.523 \times \text{width} \times \text{length} \times \text{height}$ ). The use of a simple formula such as this could have been undoubtedly more convenient; however, the prolate ellipsoid formula has not been validated for the calculation of volumes in the pelvis. This is the reason we conducted a preliminary study (which, we think, is reported in sufficient detail on page 150 of our article), in which we instilled incremental amounts of fluid in the pelvis, up to 300 mL, obtaining real-time measures of any fluid pocket observed at ultrasound. These measurements were given to a statistician, who elaborated the best-fitting mathematical model (not the most practical!) to our set of data. This formula is not intended for volumes >300 mL.

As to the last comment of Dr. Koninckx and colleagues, we are convinced of the opposite: the measurements are more accurate for lower volumes, in which the fluid is confined in a small pocket in the Douglas, with relatively fix boundaries, and in which bowel loops can displace only minimal amounts of fluid. For larger volumes, the surface of the fluid collection that comes into contact with the bowel loops is much greater, and the measurements probably become much more inaccurate and with greater intraobserver and interobserver variability. We therefore cannot assent to the conclusion that after 24 hours the volumes might hardly be different in the two groups.

Again, we thank Dr. Koninckx and colleagues for their thoughtful comments.

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## REFERENCES

1. Muzii L, Bellati F, Mancini N, Zullo MA, Angioli R, Benedetti Panici P. Ringer's lactate remains in the peritoneal cavity after laparoscopy longer than expected. *Fertil Steril* 2005;84:148-53.