**Reviewer's report**

**Title:** Sensitivity of intra-abdominal, intra-organ and intravascular pressures in detecting changes induced by external abdominal pressure with and without PEEP: an experimental study

**Version:** 2  **Date:** 27 September 2009

**Reviewer:** Alexander Schachtrupp

**Reviewer's report:**

Major Compulsory Revisions.

In this investigation, 12 pigs were subjected to increased intra-abdominal pressure (via placement of an external weight of 7 kg) and or increased PEEP of 10 cm H2O. Each period lasted for 10 minutes. Resulting pressures as well as those before and after the intervention were measured in the stomach, the urinary bladder, the peritoneal cavity, pulmonary artery and inferior vena cava. The animals then underwent another investigation on hepato-splanchnic blood flow regulation.

There were significant differences between the locations of pressure measurement at baseline as well as after application of the external weight with highest readings derived from the inferior vena cava.

When comparing readings derived from one measurement location, the application of external weight (with or without increase of PEEP) increased the readings when compared to baseline. This could be observed at every measurement place excluding the pulmonary artery where only the combination of PEEP and weight was leading to a significant increase.

The authors that changes in intraabdominal pressure can be accurately measured either from the urinary bladder, stomach or inferior vena cava.

In the title, the authors refer to the sensitivity, a term that is common for diagnostic tests. In order to calculate the sensitivity of test, the true result has to be known using the goldstandard. In pigs however, the goldstandard of IAP measurement is not defined yet.

Consequently, the sensitivity is not given in this manuscript and should therefore not be referred to. It rather seems that different tests were compared with each other which could normally be done using a Bland & Altman analysis with the calculation of mean difference and limits of agreement. The conclusion, that the IAP can be accurately measured from either depends on the clinical perspective. Therefore, limits of agreement should be given.

This basically calls for the use of a parametric analysis of data. It is not explained why a non-parametric test was chosen. In general, a non-parametric test is not more precise but is certainly less powerful to detect differences. An ANOVA for repeated measures is likely to be appropriate. In any case, a global test should
be combined with an adequate post-hoc test. In case of multiple pairwise testing, the level of significance has to be adjusted regardless if parametric or non-parametric tests were used. This would be applicable for the underlying study.

Moreover, the value of this study is to be discussed as only a small increase of IAP was to be observed. As pointed out by the authors, the pathological level is reached with a value of 12 mmHg or higher. This however, was only noticed in the inferior vena cava. Relevant pressures ranging from 12-25 mmHg as seen in severe hypertension were not induced in this study. It therefore remains unknown whether the observation made here would have also been made in relevant pressure ranges.

As the abdomen can be considered a liquid system (Tzelepis 1996), it can be expected that pressures measured at different points within the system agree with each other. Several porcine studies have compared different sites of pressure measurement. Despite the – here undiscussed - anatomical variance of the porcine bladder which is intraperitoneally most investigators used bladder pressure measurement to assess intraabdominal hypertension.

Gudmundsson 2002 described, that the pressures recorded in the urinary bladder, the inferior caval vein, and the femoral vein reflected the pressure (range 8-20 mmHg) in the abdominal cavity very well. Engum described 2002, that continuous direct intraabdominal pressure monitoring ... correlates well with indirect bladder or gastric pressure measurement. In 1987, Lacey observed that vesical and inferior vena caval (IVC) pressures had good statistical correlation with IAP should be used to be used to evaluate IAP in the clinical setting. The results of underlying study however have not been compared to the results of Gudmundsson and Lacey although both are listed in the reference list.

So it is basically already well known, that changes in intraabdominal pressure can be accurately measured either from the urinary bladder, stomach or inferior vena cava. This leads to the rationale of this study which remains completely unclear. A clear hypothesis is not given and it can be argued, that this investigation is not much more than a spin-off product of a study, aiming to evaluate hepato-splanchnic blood flow regulation.

Minor comments

Introduction

Prolonged IAH > 25 mmHg with at least one organ failure, defined as abdominal compartment syndrome (ACS), is known to be associated with a higher risk of developing renal [14] and multiple organ failure and with increased mortality [15, 16].

Sentence is irritating as ACS is defined by organ failure. So far, there is no data on the natural course of ACS available. After decompression, De Waele summarized mortality to be still 50%.

Despite widespread awareness of IAH and ACS, many intensive care units never
measure the intraabdominal pressure
Substitute widespread awareness with “increasing evidence regarding the relevance of”

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The effects of pressure changes on both sides of the diaphragm on lower and upper intraabdominal pressure, and on intrathoracic and intraabdominal intravascular pressures, have not been well established.
What is meant by well established and why should this be important? A rationale for this study or a hypothesis is not given.

Methods Page: 6
A pulmonary artery catheter...
Please explain which technique/ equipment was used
..via the right internal jugular vein..
This vessel is relatively small while the external jugular vein is often larger in diameter. Why was this vessel used?

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..was confirmed by ultrasound.
How was the right position confirmed? Please describe technique and landmarks.

Additional Ringer’s lactate solution and hydroxyethyl starch were administered in equal amounts to keep the pulmonary artery occlusion pressure between 6 and 12 mmHg.
As the pulmonary artery occlusion pressure is known to interact with increased intraabdominal pressure (Malbrain and Wilmer 2007), discuss why this is not of relevance in this experiment. How much fluid was given in each animal.

The position of the catheters was checked by palpation during surgery and by direct visualization after the experiments had been completed
How can catheters checked by palpation, please explain.

All pressure transducers were simultaneously zeroed to the level of the heart.
How was this determined. Give landmarks and references.

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In patients with acute lung injury, an increase and decrease in PEEP from 8-13 H2O and back did not change total hepato-splanchnic blood flow or the gastric mucosal-arterial pCO2 gradient [43].
What is the relevance of this statement as the underlying study did not measure organ perfusion and is not about patients with acute lung injury?
Nevertheless, we believe that with the small changes in pressures produced (around 5 mm Hg), significant flow changes are unlikely.

This should not be a question of believe but a question of literature search. Several porcine models were described in which organ perfusion was measured.

Accordingly, our results do not support the use of higher filling pressure targets in situations with borderline IAH.

The transdiaphragmatic pressure transduction is variable. It has been shown, that IAP may lead to increased so-called filling pressures. Consequently, a higher pulmonary artery occlusion pressure may or may not be the result of increased IAP. On the other hand, a normal "filling pressure" in the presence of IAH is considered be an indicator of fluid demand. Nevertheless, intravascular volume parameters should be measured and this has not been performed in the underlying study, consequently, this statement bears only little weight. (in this regards see also Malbrain and Wilmer 2007)

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Reference list
54 references are too much while the latest citation is from 2006.

Page: 21
Table 2
The pressure in the inferior vena cava is higher than at other places. Why this is not discussed regarding the results of others.

Peep alone was not tested for statistical significance, please explain why.

Page: 23
Figures
Figures do not provide more information than the table. Moreover, they could be confusing and should better be avoided. Additionally, all the relevant data is already given in the table.

Level of interest: An article whose findings are important to those with closely related research interests

Quality of written English: Acceptable

Statistical review: Yes, and I have assessed the statistics in my report.

Declaration of competing interests:
I declare that I have no competing interests