

COMPLEX VENTRAL SITUATION

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QUICK HOT SPOT: CALCULATING POST-OPERATIVE RISK OF COMPLICATIONS AFTER LARGE VENTRAL HERNIA REPAIR BASED ON HERNIA VOLUME

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Introduction: Estimating the risk of postoperative complications of large ventral hernia repair remains challenging. Usually only general risk factors such as age, Body Mass Index (BMI), and smoking are used to estimate the postoperative risk of complications. It has been hypothesized that the hernia volume is directly related to postoperative complications because the volume of the hernia sac is reduced into the abdominal cavity, creating tension on the abdominal wall and the diaphragm, thus increasing the risk for wound and pulmonary complications. The primary aim of this study was to analyze the relationship between hernia volume and postoperative complications, the secondary aim was to validate a mathematical formula for calculating hernia volume.

Methods: From 2011 to 2014 all patients with large ventral hernias (width equal or exceeding 6cm) and loss-of-domain that underwent open or endoscopic components separation technique at an expert centre for abdominal wall reconstructions were prospectively registered during inpatient and outpatient care. Using preoperative abdominal CT-scans without Valsalva manoeuvre Hernia Sac Volume (HSV) and Abdominal Cavity Volume (ACV) were calculated by two methods; (1) 3D computer tomography outlining with Multi Plane Reconstruction (MPR), (2) Mathematical volume calculation as introduced by Tanaka et al.1 based on ellipsoid volume ($\frac{4}{3}\pi \times \frac{1}{2}A \times \frac{1}{2}B \times \frac{1}{2}C$). Hernia Volume Ratio (HVR) was calculated by dividing HSV by ACV. All postoperative complications were scored using the Clavien Dindo classification for surgical complications. Follow-up consisted of 3-6 monthly visits to outpatient clinic.

Results: Thirty patients (10 female, 20 male) with median age of 63 years (range 39 to 77), mean body mass index (BMI) of 26.9 (SD6.4)

kg/m² and median American ASA 2 (range 1 to 3) underwent ECST (n = 16) or CST (n = 14). Two patients had COPD gold II and one patient had Asthma, all three received perioperative pulmonary preparation. The median defect volume was 473.8 (range 114 to 2086) cm³, the average width 12.7 (SD3.8)cm. All but three patients received an intra-abdominal mesh. Six patients underwent concomitant enterostomy takedown.

Overall 16 patients had 20 mild (grade 1-2) postoperative complications (seroma n = 4; abscess n = 2; wound dehiscence n = 1; pneumonia n = 5; pulmonary infiltrate n = 2; exacerbation of COPD n = 1, urinary tract infection n = 2, gastroparesis n = 1, mild anaphylactic shock n = 1, deep venous thrombosis n = 1). Five patients had 5 severe (grade 3-5) postoperative complications (skin necrosis n = 1, aspiration pneumonia requiring mechanical ventilation n = 2, anastomotic leak after concomitant enterostomy takedown n = 1, acute respiratory distress syndrome n = 1). One patient died due to sepsis caused by aspiration pneumonia. Median duration of hospital stay was 7 days (range 3-103 days).

The mean difference between mathematical and exact hernia volume was -3.6% (SD 27.2). Paired Wilcoxon Ranks test ($Z = -0.227$, $p = 0.820$ 2-tailed) showed no statistically significant difference between both methods.

A multivariate logistic regression analysis was performed to ascertain the effect of 'age', 'type of operation' and 'volume ratio' on the likelihood that patients have postoperative complications. The logistic regression model explains 62% of postoperative complications (Nagelkerke R²) and correctly classified 86% of patients. Both 'age' (B0.118, $p = 0.042$, Odds ratio 1.125) and 'volume ratio' (B0.442, $p = 0.048$, Odds ratio 1.555) were significant predictors for postoperative complications. Using an ROC-curve (area under the curve 0.838) a volume ratio cut-off point of 0.06 was optimal for predicating complications (sensitivity 0.71, specificity 0.83, relative risk 2.8)

Conclusions: Hernia volume is a useful factor for estimating patient-specific postoperative complications after large ventral hernia repair with endoscopic or open components separation technique. Secondly, hernia volume can be accurately measured with the mathematical formula for ellipsoid volume.