CLINICAL STUDY

Effects of abdominal compartment syndrome on gastric emptying time

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Abstract: Introduction: Increase in intra-abdominal pressure may affect gastric emptying time but the precise effect has not been demonstrated. Effects of acute increase of intra-abdominal pressure on gastric emptying time can not be demonstrated in clinical or experimental studies. In this study we aimed to study the effect of increased intra-abdominal pressure on gastric emptying time.

Methods: Six male stray dogs that weighed 20–25 kg were studied. Following the induction of general anaesthesia, an abdominal catheter was placed and intra-abdominal pressure was raised at a rate of 5 cm H2O every 10 minutes using intra-abdominal administration of physiologic saline solution until 45 cm H2O pressure was reached. Gastric emptying time was measured scintigraphically at the beginning of the study (IAB 0 cm H2O) and again four hours later when pressure reached the maximum value (IAP was 45 cm H2O).

Results: Gastric emptying time for baseline pressure was in average 51.83±13.16 whereas for 45 cm H2O pressure it was in average 90.83±26.96. This difference was found statistically significant (p<0.05). The differences between baseline values and values after increased intra-abdominal pressure were statistically significant (Tab. 4, Fig. 1, Ref. 26).

Key words: abdominal compartment syndromes, scintigraphy, gastric emptying.


Abdominal Compartment Syndrome (ACS) is characterised by respiratory, renal and cardiovascular disturbances due to suddenly raised intraabdominal pressure (IAP), the result of an increase in volume of intra-abdominal or retroperitoneal contents (1, 2). The condition is associated with abdominal traumas (3, 4) intra-abdominal or retroperitoneal bleeding (5) ascites (6), ruptured abdominal aortic aneurysm (7, 8), pneumonia (9), pancreatitis (10), after liver transplant (1), or neoplasm (2). Often, intra-abdominal infections lead to peritonitis, intra-abdominal sepsis and are usually fatal if not treated (11–15). Normal IAP values are below 13 mmHg (13, 14); when it exceeds 10 mmHg, cardiac output decreases, and over 15 mmHg renal and splanchnic perfusion falls due to mechanical vascular compression. IAP between 20–25 mmHg increases peak alveolar pressure (12).

Although the current authors advocate that a link between ACS and gastric emptying time (GET) is feasible, no report related to the effect of ACS on GET has been published. Thus, this paper using scintigraphy aims to investigate the possible associations between increased IAP and GET.

Materials and methods

The study was conducted under the approval of the animal ethical committee, Afyon Kocatepe University, Turkey. Six adult, male, healthy stray dogs that weighed 20–25 kg were used in the research.

Anaesthesia and monitoring

After fasting for 12 h, dogs were premedicated with 0.045 mg/kg atropine sulphate, 1 mg/kg xylazine hydrochloride and 2 mg/kg ketamine hydrochloride and ECG, peripheral oxygen saturation (SpO2), heart rate and mean arterial pressure were monitored. General anaesthesia was induced using 3 mg/kg propofol; and muscle relaxation was achieved using 0.6 mg/kg rocuronium bromide. Anaesthesia was maintained using 1.0–0.5 % sevoflurane and 50 % O2, and analgesia provided using 3 microgram/kg fentanyl as required.

Ventilatory management

The lungs were ventilated mechanically (Viasys Healthcare, USA) at a compression pressure of 20–25 cm H2O, the tidal vol-
ume was 10 mL/kg, and the fresh gas flow adjusted to maintain the end-tidal CO₂ level at 30–35 mmHg using a Capnomac CO₂ monitor (Detax, Helsinki, Finland). Peripheral oxygen saturation was measured by pulse oximetry (Datex) and was kept at >95 %.

Surgery
The ventral abdomen was prepared for an aseptic surgery in a routine manner. A plastic sterile 5 mm diameter tube was inserted into the abdomen through a 2 cm midline incision cranial to the umbilicus to avoid any abdominal leakage. A nasogastric tube was introduced into the stomach and its position confirmed by palpation through the abdominal incision. Then, the abdominal incision was closed using purse-ring. A three-way valve was connected to the tip of the naso-gastric tube, one connected to a bag containing normal saline solution, and the other to a linear manometric-Hg system. Thus, the IAP was measured continuously, and increased gradually. IAP value at the linear manometric-Hg device was increased gradually by 5 cm H₂O every 10 mins to reach 45 cm H₂O. Heart rate, mean arterial pressure, ECG and SpO₂ were monitored (Petas, Turkey). After the study, the abdominal incision was closed routinely, all tubes removed, and the dogs allowed to recover. They were all subsequently placed in a shelter for rehousing.

Scintigraphic method
A mixture of 500 μCi (18.5 MBq) Technetium 99m-sulphur colloid (Tc99m-SC) in 150 ml of orange juice was administrated through the nasogastric tube. Baseline dynamic images, 30 consecutive frames of 1 min each, were obtained. GET (T₁/₂) was measured by using a time-activity curve. After 4 hours when IAP reached 45 cm H₂O a similar mixture of 10 mCi (370 MBq) Tc₉⁹m-SC was given, the nasogastric tube was removed and an identical scintigraphic procedure was repeated.

Statistical analysis
The data were analysed using paired samples t-test and the significance level was set at p<0.05.

Results
There was no significant difference between 1, 2, 3 and 4 hours SPO₂, heart rate and mean arterial pressure of control group, statistically (Tabs 1, 2 and 3). Before the study (baseline pressure, 0 cmH₂O) and after 4 hour of induced ACS (45 cmH₂O) the values of GET are shown in Table 4. Means of baseline and induced pressure values were 51.8 and 90.5 while SDs were 13.2 and 27.0, respectively, and the difference was statistically significant (p<0.05) (Tab. 4). It was observed that GET values significantly extended in concordance with IAP increase (p<0.05). Scintigraphic image is shown in Figure 1.

Discussion
Pathophysiology of ACS mainly relies on sudden increase in IAP. Therefore organ damages are proportionally caused by values of IAP (16–18). Generally pressures at 20 mmHg or over should be closely monitored. It was reported that pressures exceeding 25 mmHg require abdominal decompression due to severe systemic physiological effects (19–21). There was no difference between

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Clinical importance of extended GET may be attributable to pulmonary aspiration due to reflux. Generally in critical care units there were a little pulmonary aspirations. The main source of the aspirations were oral and nasal secretions. The oral and nasal secretions were accumulated posterior of the cuff in the patients who were entubated and tracheally. Cuff of the tube can block the pulmonary aspiration but it can not block minimal pulmonary aspirations and can be a source of nosocomial infections frequently. Gastric reflux can occur in the patients who are fed by nasogastric tube. Gastric reflux increases the amount of pulmonary aspirations with insoutuling intraoral secretions. In intensive care units for protecting the patients from gastric reflux the patients heads must be positioned at 30 degrees and the feeding tube must be placed at the lower part of the stomach and frequent intraoral aspiration must be done.

Deterioration of lung function may increase the severity of hypoxia and acidosis due to imbalance of oxygenation. In our study, we only investigated the GET not the aspiration, therefore future work is required to show detailed features of histopathology and scintigraphy of pulmonary aspiration.

In conclusion, patients with respiratory disorders and pulmonary pathologies undergoing anaesthesia should be closely monitored because of the possible association between IAP and GET. As a result GET can be expected when IAP increases and preventive precautions must be introduced to prevent gastric reflux and pulmonary aspiration in patients with diagnosis of ACS who are specially followed at intensive care units.

### References


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