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ASSESING THE EFFECT OF CENTRAL OBESITY ON INTRA-ABDOMINAL PRESSURE

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ABSTRACT
The increase of the intra-abdominal volume and the reduction of the compliance of the abdominal wall are associated with increased intra-abdominal pressure. The amount of adipose tissue of the abdominal wall and the abdominal space change the compliance and the intra-abdominal volume. These are the factors that affect the intra-abdominal pressure (IAP).
Objective: To establish how obesity affects intra-abdominal pressure.
Materials and methods: The IAP was measured by an intravesical validated and reproducible technique used in the clinic. The sagittal abdominal diameter (SAD) was measured by a specially developed for this purpose abdominal caliper, and the results were registered in centimeters.
Results: We studied prospectively 120 patients who underwent extra-abdominal surgery (thoracic, vascular, neurosurgery) and medical patients. They were stratified into 4 groups according to SAD: Group A (n = 30), with SAD below 20 cm H2O, Group B (n = 30) with SAD of 20 to 25 cm H2O, a Group C (n = 30) with SAD of 26 to 30 cm H2O and Group D (n = 30) with SAD above 30 cm H2O.
Demographic characteristics of the patient study group (n=120).
Having made a statistic analysis using a significance level for the null hypothesis P> 0.05, we found that there is a significant difference in the values of IAP of the four studied groups with different SAD. Using the multiple post hoc Dunn's test we found that there was a significant difference between the recorded results of IAP for Group A and Group D, and that there was no significant difference in the other two groups B and C, and that there was also a significant difference in the measured values of Group D and those of the groups B and C.
Conclusion: In spite of the higher values of IAP, almost over 90 % of the patients with SAD>30 cm fall within the range of normotension according to the classification of WASCS.

Key words: intra abdominal hypertension, sagittal abdominal diameter.

INTRODUCTION

The clinical interest and research on intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) as the main causes of significant morbidity and mortality in critically ill patients in intensive care units has increased exponentially around the end of the decade. Early recognition of IAH and its management with appropriate therapeutical methods led to a considerable reduction of morbidity and mortality. Cheatham and Safcsak (2010) after studying a number of 478 patients (traumatic and underwent vascular surgery) with ACS, treated according to the doctrine of the World Society of the Abdominal Compartment Syndrome (WSACS), reported a significant increase in survival from 50% up to 72%, primary fascial closure from 59% up to 81% and reduced hospital costs (1).

The abdominal space may be regarded as a semi-closed box, partly solid (spine, pelvis, rib arches)

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and partly flexible (abdominal wall, viscera and diaphragm). Although a heterogeneous mixture of solid, liquid and gaseous components, the mechanical characteristics of the peritoneal contents may be regarded as a fluid or fluid-like substance, which is a subject of the hydrodynamic laws. According to B. Pasqual's law pressure exerted anywhere in a confined incompressible fluid is transmitted equally in all directions. This means that pressure at every part of intra-abdominal space is exactly the same and represents the pressure of the entire abdominal space. For these reasons, it is expected that the intra-abdominal pressure in any area of the abdominal space should be the same, but actually due to some variables and complex nature of the contents it may differ (2, 3). The intra-abdominal pressure depends on the anatomic features of the face, size of the body, muscle tone, the characteristic of tissues and pathological processes (such as hematomas and scars of the abdominal wall, ascites, peritonitis, ileus, hemoperitoneum, trauma, visceral edema).
The classification of intra-abdominal hypertension is based on our current understanding of IAH/ ACS, and is a modification of the original grading system of Burch et al. (1996), which is suitable for conducting any therapeutic actions - Level I: IAP 12 - 15 mmHg; Level II: IAP 16-20 mmHg; Level III: IAP 21-25 mmHg; Level IV: IAP > 25 mmHg (4, 5).

Nowadays obesity has been shown a major international health problem. The number of patients with different degree of obesity and need of intensive care treatment, increases to a significant extent. Most popular methods for assessing obesity include three main indicators: body mass index (BMI), waist circumference and sagittal abdominal diameter (SAD). SAD is the most appropriate and representative anthropometric index for assessing the amount of visceral adipose tissue when central or abdominal obesity types are concerned. SAD measurement is easily feasible in terms of the intensive care unit (6, 7).

Changes in intra-abdominal volume are related to changes in intra-abdominal pressure. The increase of intra-abdominal volume and reduction of abdominal wall compliance is associated with an increase in intra-abdominal pressure as well. Obesity causes accumulation of adipose tissue both in the abdominal cavity and the abdominal wall. The different amount of adipose tissue leads to a change in the compliance of the abdominal wall and the intra-abdominal volume. These factors affect intelligibly the IAP (8, 9, 10).

The lack of available preliminary values of intra-abdominal pressure (IAP) in patients who are hospitalized for intensive care treatment before developing a critical condition, may result in an incorrect classification of obese patients as ones having IAH, and also lead to an incorrect therapeutic regiment afterwards.(11).

PURPOSE

To determine the effect of obesity on intra-abdominal pressure.

MATERIALS AND METHODS

In our clinic we measured the intra-abdominal pressure by an intravesical validated and reproducible technique using a Siemens SC 6002XL monitor with external pressure transducer (840, 50 μV/ V/ cmHg, Sensonor AS Horten, Norway) and the results were registered in mmHg. The sagittal abdominal diameter, also defined as Supine Abdominal Height (SAH) when measured in a supine position as an indicator of visceral, was measured by a specially developed for the purpose abdominal caliper and the results were registered in centimeters. Patients were positioned horizontally on the bed and at the end of the expirium we measured the distance between the back (bed) and the highest point of the abdomen Patients were chosen randomly until reaching the target number. Inclusion criteria: patients older than 18 years, hospitalized in the intensive care unit without abdominal pathology and not in the risk groups of IAH according to WSACS, with a preliminary placed urethral catheter.

RESULTS

From February 2012 to February 2014 were studied prospectively 120 patients that underwent extra-abdominal surgery (thoracic, vascular, neurosurgery) both postoperative and medical patients. Four groups were stratified according to SAD - Group A (n = 30), with SAD below 20 cmH2O, Group B (n = 30) with SAD of 20 to 25 cmH2O, a Group C (n = 30) with SAD of 26 to 30 cmH2O and Group D (n = 30) with SAD above 30 cmH2O. Patients' demographics and descriptive statistics with D'Agostino & Pearson test for normality of distribution are presented in **Table 1** and **Table 2.**

Table 1. *Demographic data of the studied population (n = 120).*

	Group A (n=30)	**Group B (n=30)**	**Group C (n=30)**	**Group D (n=30)**
SAD	<20cm	20-25 cm	26-30 cm	> 30 cm
Mean SAD	16,50 (± 1,61)	21,77 (±1,30)	27,60 (±1,24)	33,63 (± 2,17)
Age (years)	57,9 (±16,55)	58,47 (±14,48)	57,83 (±11,54)	50,53 (±9,87)
Gender, male (%)	19 (63.3%)	14 (46.6%)	15 (50%)	21 (70%)
BMI (kg/m²)	20,55 (±2,5)	29,12 (±1,4)	36,17 (±2,23)	47,78 (±3,92)

Table 2. *Descriptive statistics of the registered results of IAP in all four groups of patients.*

Groups	Group A	Group B	Group C	Group D
Number of values	30	30	30	30
Minimum	1,000	2,000	2,000	6,000
25% Percentile	3,000	3,000	4,000	8,000
Median	4,000	4,500	5,000	10,00
75% Percentile	6,000	6,000	6,000	12,00
Maximum	7,000	7,000	8,000	13,00
10% Percentile	2,000	2,000	3,000	8,000
90% Percentile	7,000	7,000	6,900	13,00
Mean	4,367	4,467	5,033	10,07
Std. Deviation	1,650	1,814	1,474	1,999
Std. Error	0,3013	0,3313	0,2690	0,3649
Lower 95% CI of mean	3,750	3,789	4,483	9,320
Upper 95% CI of mean	4,983	5,144	5,584	10,81
D'Agostino & Pearson omnibus normality test				
K2	0,8574	11,31	0,03483	2,482
P value	0,6514	0,0035	0,9827	0,2891
Passed normality test (alpha=0.05)?	Yes	No	Yes	Yes
P value summary	ns	**	ns	ns
Coefficient of variation	37.79%	40.62%	29.28%	19.86%
Geometric mean	4,010	4,071	4,804	9,868
Lower 95% CI of geo. mean	3,386	3,433	4,259	9,139
Upper 95% CI of geo. mean	4,747	4,827	5,419	10,66
Skewness	0,005408	-0,01672	0,008109	-0,01472
Kurtosis	-0,6954	-1,439	-0,2917	-0,9623
Sum	131,0	134,0	151,0	302,0

In order to identify the differences in IAP of patients of all four groups and due to the lack of Gaussian type distribution of the data, a non-parametrical analysis of Kruskal-Waliis was used **(Table 3, Figure 1).**

From the statistic analysis with significance level of zero hypothesis P > 0.05, we found that there is a significant difference in the measured values of IAP in all four studied groups of patients with different sagittal abdominal diameter. With the multiple post hoc Dunn test **(Table 3)** a significant difference was found between the results recorded for IAP within groups A, B and C, and values registered in the patients from group D.

Table 3. *Kruskal-Wallis test for comparing the values of IAP recorded in patients with different degrees of obesity and multiple post hoc tests for comparing results for IAP within the study groups.*

Kruskal-Wallis test		
P value	< 0.0001	
Exact or approximate P value?	Gaussian Approximation	
Do the medians vary signif. (P < 0.05)	Yes	
Number of groups	4	
Kruskal-Wallis statistic	65,84	
Dunn's Multiple Comparison Test	Difference in rank sum	Significant? P < 0.05?
Column A vs Column B	-1,750	No
Column A vs Column C	-9,917	No
Column A vs Column D	-62,33	Yes
Column B vs Column C	-8,167	No
Column B vs Column D	-60,58	Yes
Column C vs Column D	-52,42	Yes

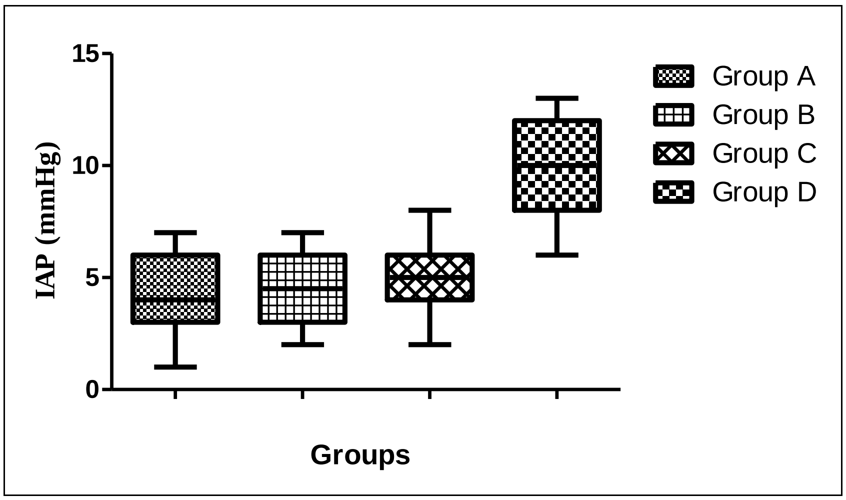

Figure 1. Box & whiskers plot of the values of intra-abdominal pressure as median, quartiles, and extreme values within a category

DISCUSSION

From our results we can conclude that although there is a statistically significant difference between the values of IAP of patients with SAD> 30 cm H2O and other groups with smaller SAD, the arithmetic mean in the study group is 10.07 mmHg, which does not exclude these patients from the values of intra-abdominal normotension. It should be noted that in some of our patients from Group D (SAD > 30 cm H2O) we registered IAP values that defined them as having first level abdominal hypertension according to the classification of the World Society of the Abdominal Compartment Syndrome, which must be considered in the clinical assessment of obese patients suspected for intra-abdominal hypertension.

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