Journal of Critical Care 30 (2015) 584–588

Contents lists available at ScienceDirect

Journal of Critical Care

journal homepage: www.jccjournal.org

The prevalance of and factors associated with intra-abdominal hypertension on admission Day in critically Ill pediatric patients: A multicenter study

Ozden O. Horoz, MD [a,*], Dincer Yildizdas, MD [a], Nazik Asilioglu, MD [b], Tanil Kendirli, MD [c], Nilgun Erkek, MD [d], Ayse Berna Anil, MD [e], Benan Bayrakci, MD [f], Tolga Koroglu, MD [g], Basak Nur Akyildiz, MD [h], Ali Ertug Arslankoylu, MD [i], Oguz Dursun, MD [j], Selman Kesici, MD [f], Esra Sevketoglu, MD [k], Ilker Unal, MD [l]

[a] *Cukurova University, School of Medicine, Department of Pediatrics, division of Pediatric Intensive Care Unit, Adana, Turkey*
[b] *Ondokuz Mayıs University, School of Medicine, Department of Pediatrics, Division of Pediatric Intensive Care Unit, Samsun, Turkey*
[c] *Ankara University, School of Medicine, Department of Pediatrics, Division of Pediatric Intensive Care Unit, Ankara, Turkey*
[d] *Marmara University, School of Medicine, Department of Pediatrics, division of Pediatric Emergency Department, Istanbul, Turkey*
[e] *Tepecik Training of Research Hospital, Pediatric Intensive Care Unit, Izmir, Turkey*
[f] *Hacettepe University, School of Medicine, Department of Pediatrics, Division of Pediatric Intensive Care Unit, Ankara, Turkey*
[g] *Dokuz Eylul University, School of Medicine, Department of Pediatrics, Division of Pediatric Intensive Care Unit, Izmir, Turkey.*
[h] *Erciyes University, School of Medicine, Department of Pediatrics, Division of Pediatric Intensive Care Unit, Kayseri, Turkey*
[i] *Mersin University, School of Medicine, Department of Pediatrics, Division of Pediatric Intensive Care Unit, Mersin, Turkey*
[j] *Akdeniz University, School of Medicine, Department of Pediatrics, Division of Pediatric Intensive Care Unit, Antalya, Turkey*
[k] *Bakirkoy Dr. Sadi Konuk Research and Training Hospital, Pediatric Intensive Care Unit, Istanbul, Turkey*
[l] *Cukurova University, School of Medicine, Department of Biostatistics, Adana, Turkey*

ARTICLE INFO

Keywords:
Intra-abdominal pressure
Lactate
Hypothermia
Abdominal compartment syndrome
Organ dysfunction
Oligo-anuria

ABSTRACT

Purpose: To investigate admission prevalence of intraabdominal hypertension (IAH) and to determine clinical and laboratory characteristics on admission day associated with IAH in critically ill pediatric patients.
Materials and Methods: One hundred thirty newly admitted critically ill pediatric patients were included. Intra-abdominal pressure (IAP) was measured 4 times (every 6 hours) with the bladder pressure method. Data included the demographics, diagnostic category, pediatric logistic organ dysfunction score and pediatric risk of mortality score II, clinical concomitant factors, and conditions potentially associated with increased intra-abdominal pressure.
Results: Seventy patients (56.1%) had a normal IAP (≤10 mmHg, mean IAP [mmHg] 7.18 ± 1.85), while 60 patients (43.9%) had IAP >10 mmHg (mean IAP [mmHg] 15.46 ± 5.21). Hypothermia frequency, lactate levels, number of patients with oligo-anuria, and mechanical ventilation requirement were higher among patients with IAH compared to patients without IAH (both, $P < .05$). Hypothermia (OR, 3.899; 95% CI, 1.305-11.655; $P < .03$) and lactate levels (OR, 1.283 for each mmol/L increase; 95% CI, 1.138-1.447; $P < .001$) were only significantly associated with IAH.
Conclusions: Intra-abdominal hypertension seems to affect nearly half of newly admitted critically ill pediatric patients. Lactate level and the presence of hypothermia seem to be the independent predictors of the presence of IAH.

1. Introduction

Intraabdmominal pressure (IAP) is the steady-state pressure concealed within the abdominal cavity [1]. Intraabdmominal hypertension (IAH) is defined as a sustained increase in intraabdominal pressure and, especially, if it develops over hours, can lead to the development of abdominal compartment syndrome (ACS), which clearly worsens patient outcome even further and carries up to 60% mortality in affected pediatric patients [2–4].

Given the growing awareness of IAH and ACS, The World Society of the Abdominal Compartment Syndrome (WSACS) has first developed definitions and recommendations consensus guidelines published at 2006 and 2007, respectively [5,6]. Until updated consensus definitions and clinical practice guidelines from the WSACS were published at 2013 [1], no consensus guidelines were available for pediatric patients, and guidelines developed for adult patients were also applied for pediatric patient population. Fortunately, pediatric consensus definitions and management statements for pediatric patients were included in the 2013 updated consensus guidelines from WSACS, and IAH was

* Corresponding author at: Cukurova University, School of Medicine, Department of Pediatrics, division of Pediatric Intensive Care Unit, Balcalı, Sarıcam, Adana, Turkey. Tel.: +90 505 515 3830.
E-mail address: oozgurhoroz@yahoo.com (O.O. Horoz).

http://dx.doi.org/10.1016/j.jcrc.2015.01.021

defined as a sustained or repeated pathological elevation in IAP >10 mmHg [1]. In the 2013 updated consensus from WSACS, however, it has been stated that although the Pediatric Sub-Committee reviewed and made recommendations regarding the appropriateness of the updated consensus definitions and management statements for pediatric patients, further work in this area is needed. It has also been stated that as overt ACS becomes less common [7], further researches must be performed in order to delineate the role of IAH without ACS in clinical situations which may be associated with increased IAP [1].

According to WSACS [1], risk factors that predispose patients to IAH/ACS can be categorized into 5 major conditions including diminished abdominal wall compliance, increased intra-luminal contents, increased intra-abdominal contents, capillary leak/fluid resuscitation and others/miscellaneous. WSACS has also recommended to perform IAP measurement when at least one risk factor for IAH or ACS is present [1]. The prevalence of IAH is variable ranging from 18 to 81 per cent depending on the IAP threshold used to define it and on the patient population studied, differing in trauma, surgical, or medical patients [8]. To the best of our knowledge, there is no study reporting the prevalence of IAH in children.

Therefore, in the present multicenter prospective study, in a mixed medical-surgical population of newly admitted critically ill pediatric patients, we aimed:

1. To investigate the prevalence of IAH on admission day using the definitions and recommendations specified by the 2013 updated consensus guidelines from WSACS,
2. To determine clinical and laboratory characteristics on admission day which are associated with the presence of IAH.

2. Material and methods

2.1. Setting

The study was conducted as a 1-day snapshot study on the prevalence of IAH in 11 pediatric intensive care units (PICU) located in university or medical education and training hospitals in Turkey. The study protocol was approved by the local institutional ethics committee of each participating center and was performed in accordance with the Helsinki Declaration. Written parental consents were obtained from all participants.

2.2. Patients

There were a total of 130 eligible newly admitted critically ill pediatric patients included in the present study. Exclusion criteria consisted of PICU admission for monitoring only, PICU less than 24 hours, or having contraindication for intravesical pressure measurement, eg, pelvic fracture, hematuria, or neurogenic bladder.

2.3. Data collection

On admission, age, gender, weight, height, diagnostic category (medical/surgical/trauma), Pediatric Logistic Organ Dysfunction (PELOD) score, and Pediatric Risk of Mortality (PRISM) score II were recorded. Predisposing conditions for the development of IAH were recorded according the risk factors presented in Table 1[1].

Clinical concomitant factors and conditions potentially associated with increased IAP at intensive care admission were recorded for each patient. Clinical concomitant conditions were defined as follows: acidosis, arterial pH <7.2; hypothermia, core temperature <35 °C; coagulopathy, platelet count <55,000/mm^3, or activated partial thromboplastin time more than 2 times normal or prothrombin time <50% or an international standardized ratio >1.5; sepsis, defined according to the American-European consensus conference definitions; and liver dysfunction, de-compensated or compensated cirrhosis, or other liver failure with ascites, eg, paraneoplastic, cardiac failure, portal vein thrombosis, or ischemic hepatitis. As massive fluid resuscitation and polytransfusion definitions for children are not still clear, we calculated and recorded the total amount of fluid and blood product received.

Table 1
Risk factor for intraabdominal hypertension/abdominal compartment syndrome

1. Diminished abdominal wall compliance
Acute respiratory failure, especially with elevated intrathoracic pressure
Abdominal surgery with primary fascial closure
Major trauma/burns
Prone positioning
2. Increased intra-luminal contents
Gastroparesis
Ileus
Colonic pseudo-obstruction
3. Increased abdominal contents
Hemoperitoneum/pneumoperitoneum
Ascites/liver dysfunction
4. Capillary leak/fluid resuscitation
Acidosis
Hypotension
Hypothermia
Polytransfusion
Coagulopathy
Massive fluid resuscitation
Oliguria
Sepsis
Major trauma/burns
Damage control laparotomy

2.4. Measurement of intra-abdominal pressure

Intra-abdominal pressure was measured through a Foley bladder catheter as defined in the *Final 2013 adapted pediatric consensus definitions* section of the 2013 updated consensus from WSACS [1]. Briefly, in a complete supine position, 1 mL/kg of normal saline, with a minimal instillation volume of 3 mL and a maximum installation volume of 25 mL, was instilled in to the bladder through a Foley catheter. The end of the catheter was connected to transparent, open ended plastic tubing, and the level of the water column above the midaxillary line reflects IAP. Intra-abdominal pressure was measured 4 times at 6-hour intervals during 1 day.

2.5. Definitions

In accordance with 2013 updated consensus guidelines from WSACS, IAH in children was defined as a sustained or repeated pathological elevation in IAP >10 mmHg [1]. Thus, we preferred to use mean IAP (mean of 4 measurements), not the single elevated IAP value (IAP_{max}, the highest daily value), either to define IAH or to use for analysis.

2.6. Statistical analysis

Categorical variables were expressed as counts and percentages, while numerical variables were expressed as mean ± SD or median (minimum, maximum) where appropriate. Categorical variables were compared by means of χ^2 test. Kolmogorov-Smirnov test was used to assess the normality of the distribution of numerical variables. Normally distributed continuous variables were compared with the Student *t* test, while Mann–Whitney *U* test used for non-normally distributed variables. To assess the independent predictors of IAH, all the variables that differed significantly between patients with and without IAH were entered in a backward multiple logistic regression models. Because of the study design, a 1-day snapshot study, not a prospective or a retrospective study, we chose odds ratio (ORs) instead of relative risk for statistical analysis. Odds ratios are given with 95% confidence intervals (CIs). $P < .05$ was considered to be statistically significant.