

Awareness and management of intra-abdominal hypertension and abdominal compartment syndrome by paediatric intensive care physicians: a national survey

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Abstract

Background: This study aimed to evaluate the current awareness and management of intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) among paediatric intensivists.

Methods: A web-based electronic survey was sent to all physicians working in paediatric intensive care units (PICUs) in Saudi Arabia. The survey questions obtained information regarding awareness of ACS and IAH, recognition criteria, monitoring of intra-abdominal pressure (IAP), and experience in managing ACS.

Results: A total of 79 physicians responded to the survey (response rate: 53%). Among respondents 48% were consultants. 85% of respondents were familiar with IAP/IAH/ACS. Only 35% and 10% were aware of the Abdominal Compartment Society consensus definitions for IAH and ACS in the paediatric population, respectively. Most respondents considered the cut-off for IAH to be ≥ 15 mm Hg, and approximately two-thirds thought that the cut-off for ACS was higher than the currently suggested consensus definition (10 mm Hg). More than two-thirds of respondents monitored IAP in the PICU, and it was measured almost exclusively via the bladder (96%); the majority (70%) reported that they instilled volumes well above the current recommendations. Medical management was the most frequent therapeutic approach to treat IAH/ACS, while surgical decompression was the least attempted option. Decisions to decompress the abdomen were predominantly based on the presence of organ dysfunction (74.4%).

Conclusions: This survey showed that although most responding physicians claim to be familiar with IAH and ACS, their knowledge of published consensus definitions, measurement techniques, and clinical management must be updated.

Key words: abdominal pressure, abdominal hypertension, abdominal compartment syndrome, paediatric intensive care.

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Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) are not rare in paediatric patients; the incidence of IAH in this population varies between 12.7% and 20% and it is associated with high morbidity and mortality [1, 2]. The Abdominal Compartment Society (WSACS; www.wsacs.org) has published consensus definitions and recommendations for the evaluation and management of IAH and ACS in critically ill adult patients [3–5]. The WSACS has outlined specific considerations for paediatric patients in the latest published guidelines, including precise disease definitions [5]. Previous surveys have demonstrated poor recognition of ACS among paediatric healthcare providers [6–8]. However, with the recent characterisation of the specifics related to the diagnosis of IAH and ACS, the standardisation of the defini-

tion of these clinical conditions, in children, and the recent increase in the number of publications on the subject in the paediatric population, we hypothesised that paediatric healthcare providers, specifically those working in paediatric critical care units (PICUs), are more aware of the diagnosis, monitoring, and management of IAH and ACS [1, 2, 9–14].

This survey aimed to evaluate the current awareness of IAH and ACS among paediatric intensivists and describe the diagnostic and management strategies that are currently being used for the treatment of these conditions.

METHODS

Study design

This was a cross-sectional study, using a de-identified, web-based electronic survey (Survey Monkey)

TABLE 1. Population demographics ($N = 79$)

Factor	<i>n</i> (%)
Profession	
Consultant	38 (48.1)
Assistant consultant	9 (11.4)
Fellow	22 (27.8)
Registrar	10 (12.6)
Type of institution	
Teaching hospital	61 (77.2)
Non-teaching governmental	10 (12.7)
Private	8 (10.1)
Type of PICU	
Mixed	69 (87.3)
Medical	4 (5.0)
Cardiac	6 (7.6)

to assess the awareness and methods for the diagnosis and management of IAH and ACS in PICUs. The survey was sent via electronic mail to all physicians working in the 108 PICUs of Saudi Arabia. This study was approved by the local institutional review board (PSMMC Institutional Review Board, 2018/48). Since the study presented no more than minimal risk of harm to subjects and involved no procedures for which written consent is normally required, the principle of implied consent was used.

Development of the written questionnaire

The survey questions obtained information regarding the awareness of ACS and IAH, criteria for recognising them, how intra-abdominal pressure (IAP) is being monitored, and experience in managing ACS among paediatric healthcare providers (HCP). Information regarding working position, type of practice, such as community or tertiary hospital, and location of practice were also obtained. The data were then entered into an Excel spreadsheet for subsequent analysis. The questionnaire in English is available as Supplementary Material 1.

Study population

All paediatric intensivists practising in Saudi Arabia were considered eligible to participate in the study. These were identified from the Saudi Critical Society database. On 1 January 2019 the survey was sent via email to all eligible participants. To improve the participant response rate, a reminder was sent via email every month until the closure of the study on 2 May 2019.

Statistical analysis

Categorical data are expressed as frequencies (%), whereas continuous data are expressed as median

and interquartile range (IQR). Student's *t*-test was used to compare the knowledge scores of consultants, fellows, and specialists using five knowledge questions: the normal IAP for healthy children, the definition of IAH, the cut-off limit to consider ACS in a child with organ dysfunction, the method to diagnose IAH, and the instillation volume used in the intravesical technique. Statistical significance was set at $P < 0.05$.

RESULTS

Respondent demographics

A total of 79 doctors working in PICUs in Saudi Arabia responded to our survey (response rate, 53%); 48% ($n = 38$) were consultants, 24% ($n = 19$) were specialists, and 28% ($n = 22$) were fellows. The proportion of respondents with more than five years of working experience was 49.47%. A total of 87.3% ($n = 69$) worked in combined medical-surgical PICUs, 5% ($n = 4$) in medical PICUs, and 7.6% ($n = 6$) in cardiac PICUs. The PICUs were located in a teaching hospital in 77.2% ($n = 61$) of cases. The median number of beds in the PICUs was 15 (IQR, 5–32). Demographic data are shown in Table 1.

Awareness of intra-abdominal hypertension and abdominal compartment syndrome

The majority of the PICUs' healthcare providers who participated in the study indicated that they were aware of IAH or the effect of elevated IAP on organ function ($n = 71$, 89.9%). In addition, they mentioned that they were aware of ACS ($n = 74$, 93.7%) and the concept of abdominal perfusion pressure (APP) ($n = 68$, 86%), and a great proportion considered that ACS was an important problem in patients with surgical/trauma conditions ($n = 78$, 98.7%) and medical patients ($n = 77$, 97.5%).

Overall knowledge score

The overall mean knowledge score was $34.3 \pm 20.9\%$; the fellow score ($35.4 \pm 22.3\%$) was higher than the consultant ($34.5 \pm 21.4\%$) and specialist knowledge scores ($29.3 \pm 23.9\%$), but the difference was not statistically significant ($p = 0.9$, $p = 0.4$ respectively).

Knowledge of the WSACS definition of intra-abdominal hypertension and abdominal compartment syndrome

Only 25 respondents (35%) defined IAH as an IAP > 10 mm Hg in children, and 8 (10%) considered that ACS could occur at an IAP > 10 mm Hg. Up to 35% ($n = 27$) of respondents considered the cut-off for IAH to be ≥ 12 mm Hg, and more than one-third of respondents ($n = 28$, 35.4%) believed that the cut-off for ACS was 20 mm Hg.

Measurement of intra-abdominal pressure

Based on the question, "Do you measure IAP in your institution?", 29 (32%) answered no, and the reasons were that they relied on their physical assessment ($n = 14$, 45%), they did not know how to measure IAP ($n = 10$, 32%), or they did not think it was a frequent condition in paediatrics ($n = 7$, 22.5%). Those who monitored IAP ($n = 50$, 68%) were more likely to be working in a teaching hospital (90% vs. 10%, $P < 0.01$); however, respondent position (junior vs. senior), and number of PICU beds (< 10 beds vs. ≥ 10 beds) were not significantly different.

Regarding those who answered yes, the methods they reported for the measurement of IAP were the bladder technique (96%) and direct peritoneal measurement (4%).

Of the respondents who employed bladder pressure measurement, only 14 (29.8%) instilled 1 mL kg⁻¹ in the bladder for the measurement of IAP; the majority ($n = 64$, 70%) reported that they instilled volumes well above the current guidelines.

Clinical causes of intra-abdominal hypertension/abdominal compartment syndrome

Concerning the question, "For which medical patient population(s), do you measure IAP?", organ failure was the most frequent clinical situation that triggered participants to measure the IAP ($n = 30$, 60%), followed by ascites ($n = 28$, 56%), sepsis ($n = 23$, 46%), and massive fluid resuscitation ($n = 12$, 38%). In the surgical patient population, intra-abdominal trauma or bleeding was the most frequent clinical situation that caused the participant to monitor IAP ($n = 41$, 82%), followed by massive fluid resuscitation ($n = 26$, 52%), bowel perforation ($n = 26$, 52%), and gastrointestinal surgery ($n = 25$, 50%).

IAP monitoring was performed every 6 h by 28% of respondents, and every 12 h by 28% of respondents, while 12% monitored IAP when clinically indicated, and none continuously monitored the IAP.

Management of intra-abdominal hypertension and abdominal compartment syndrome

Respondents were asked to designate a numerical score for the frequency of each management option, ranging from 1 (never) to 5 (always used). The average scores for each treatment are shown in Table 2. Participants chose diuresis and sedation/analgesia as the most frequently used therapeutic approaches to treat IAH and ACS. In addition, decompression laparotomy was the less likely reported therapeutic option.

The most common factors that affected respondents' decision to consult a surgeon to discuss the option of a decompression laparotomy in a patient with a known or suspected elevation in IAP were worsening oliguria ($n = 40$, 80%), increased ventilator setting and oxygen requirement ($n = 35$, 70%), worsening acidosis ($n = 35$, 70%), increased vasopressor or inotrope dose ($n = 27$, 54%), and abdominal distension ($n = 22$, 40%).

DISCUSSION

Our study aimed to assess the awareness and management of IAH and ACS among PICU physicians. Our study is one of the few studies targeting paediatric health care providers (HCPs) directly, and the first after the release of the 2013 WSACS consensus definition of IAH and ACS in paediatrics. The survey was conducted several years after the emergence of new consensus definitions, allowing enough time for novel definitions to be adequately disseminated.

The results of this survey show that a majority of responding paediatric intensivists are aware of IAH and ACS, which is similar to adult intensivists and in line with the results of the survey conducted by Ejike *et al.* [7], which showed that ACS awareness among paediatric intensivists (97.4%) was higher than that among paediatric HCPs and similar to adult data [15, 16].

Although most responding physicians claim to be familiar with IAH and ACS, the overall mean knowledge score was only $34.3 \pm 20.9\%$. Regarding the knowledge of definitions, only 10% defined ACS as per the WSACS consensus definition (IAP > 10 mm Hg associated with a new or worsening organ dysfunction), demonstrating that confusion persists among paediatric intensivists regarding the definition of ACS, and apparently, the majority are not aware of the latest WSACS consensus definitions of IAH and ACS in children [5].

IAP measurement provides the most definitive diagnosis of IAH and prevents its progression to ACS. In our study, two-thirds of respondents measured the IAP, which is a great improvement in pae-

TABLE 2. Average numerical score of frequency (1 – never, 5 – always) of interventions to treat intra-abdominal hypertension or abdominal compartment syndrome

Interventions	Average numerical score
Vasopressors/inotropes	3.28
Diuresis	3.82
Sedation, analgesia/muscle relaxant	3.82
Body positioning	3.76
Abdominal paracentesis	3.74
Decompression laparotomy	2.76

diatric intensivist practice when compared to the results of a survey conducted in 2012 by Kaussen *et al.* [6], where only 20% of paediatric intensivists were monitoring IAP. Although abdominal examination has been shown to have low sensitivity for IAH diagnosis, a few paediatric intensivists continue to rely on physical examination to diagnose and monitor IAH [17].

Similar to previous surveys conducted in paediatric and adult healthcare providers, our study found that among the participants who measured IAP, the bladder technique was the most commonly used method [15, 16, 18]. Our study showed that despite the use of the bladder technique by most participants, only one-third of them instilled the appropriate amount of fluid. In children only 1 mL kg⁻¹ (maximum 25 mL) of saline should be instilled in the bladder for priming prior to IAP measurement. Instilling a larger amount of saline can lead to incorrect IAP interpretation and inappropriate management.

Regarding the perception of risk factors for IAH/ACS, most of the respondents were concerned about the risk of IAH and ACS in medical patients with organ dysfunction, which could be a late sign and the final stage of IAH. Massive fluid resuscitation triggered the intensivists to monitor the IAP more frequently in surgical patients than in medical patients, most likely as paediatric intensivists still consider surgical patients as a population at a higher risk of IAH and ACS compared to medical patients. It has been previously reported that ACS and its risk factors are often overlooked in medical patients in intensive care units [19].

Concerning the therapeutic management of ACS, similar to Wise *et al.* [18], our survey results show that diuretics were more commonly used than inotropes, while decompression laparotomy was the least likely therapeutic option, which is in line with a previous survey that showed that paediatric intensivists rarely consider decompression laparotomy as a therapeutic option in the management of ACS. In a survey by Kimball *et al.* [16], 33% of paediatric intensivists compared to 19.6% of medical intensivists and 3.6% of intensivists with surgical training would not use decompression laparotomy to treat ACS. Most surveyed intensivists graded increasing ventilator settings and worsening oliguria as the clinical indicators considered for determining when to consult a surgeon for a decompression laparotomy. These were similar to the decision criteria for decompression laparotomy reported in a survey of intensive care physician members of the Society of Critical Care Medicine reported by Kimball *et al.* [16], which reflects an understanding of the effects of abdominal hypertension on the respiratory system and renal function.

Limitations

Only 53% of the doctors working in PICUs in Saudi Arabia responded to the survey; some of the respondents provided incomplete responses, which could reduce the strength of our conclusions. This reduced response rate to certain questions may be interpreted as being due to respondent discomfort or a lack of knowledge of the subject.

CONCLUSIONS

This study highlights the need to increase awareness regarding the diagnosis and management of IAH and ACS among PICU physicians. Despite the current large body of ACS literature, educating paediatric intensive care HCPs remains necessary to improve timely diagnosis and appropriate management of this relatively common life-threatening condition.

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