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ORIGINAL RESEARCH

Evaluation of intra- abdominal pressure in critically- ill children

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ABSTRACT
Background: An unpleasant consequence that many critically ill and post-operative children experience is increased intra-abdominal pressure (IAP). The present study was conducted to evaluate intra- abdominal pressure in critically- ill children. **Materials & Methods:** 50 critically-ill children admitted in PICU of both genders were selected. A urine catheter was used to assess the intra-abdominal pressure twice daily. A three-way stopcock was attached to the urine catheter. The urine bag was attached to one end of the stopcock, while the other end was connected to a manometer (a disposable manometer that is frequently used to assess cerebrospinal fluid pressures). To provide a constant fluid column, sterile normal saline (1 ml/kg; maximum 25 ml) was infused into the bladder. After 60 seconds of fluid instillation to allow for equilibration, the intra-abdominal pressure was measured. IAP was measured twice a day for seven days or till discharge from the PICU or death. **Results:** T h e mean IAP in age group <1 year was 4.4±1.5 mm Hg, in age group 1-5 years was 4.6±1.8 mm Hg and in age group was 4.2±1.3 mm Hg. The difference was non- significant (P> 0.05). The mean IAP in respiratory patients was 6.8±1.1 mm Hg, in sepsis patients was 6.2±1.7 mm Hg, in renal patients was 4.2±1.3 mm Hg, in tetanus patients was 2.5±1.3 mm Hg, in CNS patients was 4.9±1.3 mm Hg and in metabolic patients was 4.3±1.3 mm Hg. The difference was non- significant (P> 0.05).10 died with IAP of <5 mm Hg, 7 died with 5-7 mm Hg, 6 died with IAP between 8-11 mm Hg and 3 died with IAP between 12-15 mm Hg. **Conclusion:** It's necessary to reevaluate the criteria used to define intra-abdominal hypertension in youngsters. Microprocessor-equipped transducer sets are being utilized more and more to measure IAP; they might be more effective for continuous measurements.
Keywords: intra-abdominal pressure, metabolic, sepsis

INTRODUCTION
An unpleasant consequence that many critically ill and post-operative children experience is increased intra-abdominal pressure (IAP). Elevated IAP leads to the development of abdominal compartment syndrome (ACS) and intraabdominal hypertension (IAH).[1] Increased IAPs can cause organ failure and death as well as negatively impact the functions of multiple body organs. IAP measurement in the pediatric age range is still relatively new, nevertheless, and most PICUs do not use it as routine procedure.[2]
According to Abdominal Compartment Society recommendations, measurement of intra-vesical pressure (IVP) is the current reference method of IAP determination in children.[3] In clinical practice, regular measurement of IAP remains the exception due to the fact that IVP recording is known to be time-consuming and observer-dependent as it requires manual handling, with associated work load, source of sampling error and risk of urinary tract infection.[4] Moreover, IVP measures discontinuously and therefore may not capture acute IAP changes. Experienced clinicians rely on their clinical “semi-quantitative” estimation of IAP through palpation. Unfortunately, this practice has been shown to only poorly correlate with quantitative IAP measurement and cannot replace it.[5]Recently, an air-capsule-based measurement of intra-gastric pressure (ACM-IGP) has become available for continuous, fully automated, operator-independent IAP monitoring via a customized nasogastric tube. This technique works through compression of an air-filled capsule with the pressure transmitted through an additional lumen of a nasogastric tube to an outside monitor.[6]The present study was conducted to evaluate intra-abdominal pressure in critically-ill children.

MATERIALS & METHODS
The study was carried out on 50 critically-ill children admitted in PICU of both genders. All parents gave their written consent to participate in the study.
Data such as name, age, gender etc. was recorded. A urine catheter was used to assess the intra-abdominal

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pressure twice daily. A three-way stopcock was attached to the urine catheter. The urine bag was attached to one end of the stopcock, while the other end was connected to a manometer (a disposable manometer that is frequently used to assess cerebrospinal fluid pressures). To provide a constant fluid column, sterile normal saline (1 ml/kg; maximum 25 ml) was infused into the bladder. After 60 seconds of fluid instillation to allow for equilibration, the intra-abdominal pressure was measured. The zero reference point was the mid-axillary line at the iliac crest. IAP was measured twice a day for seven days or till discharge from the PICU or death. Pressure was measured in cm of water and converted to mm of Hg.Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Intra-abdominal pressure in the various age groups

Age group (years)	Mean	P value
<1 year (14)	4.4±1.5	0.75
1-5 years (26)	4.6±1.8	
>5 years (10)	4.2±1.3	

Table I shows that mean IAP in age group <1 year was 4.4±1.5mm Hg, in age group 1-5 years was 4.6±1.8mm Hg and in age group was 4.2±1.3mm Hg. The difference was non- significant (P> 0.05).

Table II Intra-abdominal pressure in various conditions

System	Mean	P value
Respiratory	6.8±1.1	0.85
Sepsis	6.2±1.7	
Renal	4.2±1.3	
Tetanus	2.5±1.3	
CNS	4.9±1.3	
Metabolic	4.3±1.3	

Table II, graph I shows that the mean IAP in respiratory patients was 6.8±1.1mm Hg, in sepsis patients was 6.2±1.7mm Hg, in renal patients was 4.2±1.3mm Hg, in tetanus patients was 2.5±1.3mm Hg, in CNS patients was 4.9±1.3mm Hg and in metabolic patients was 4.3±1.3mm Hg. The difference was non- significant (P> 0.05).

Graph I Intra-abdominal pressure in various conditions

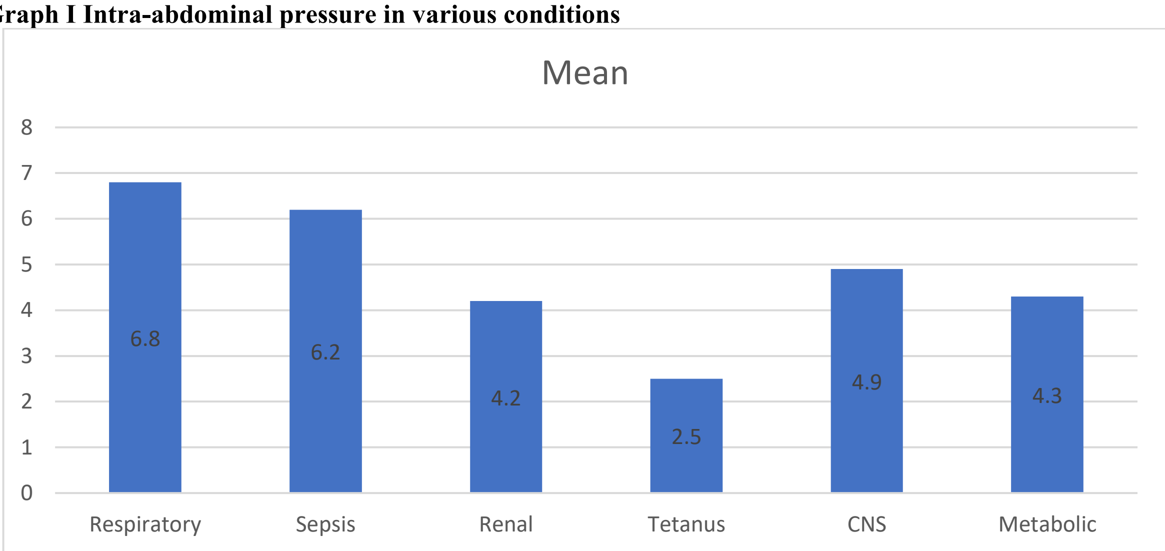

Table III Outcome in patients

IAP	Number	Died
<5mm Hg	24	10
5-7mm Hg	16	7
8-11mm Hg	7	6
12-15 mm Hg	3	3

Table III shows that 10 died with IAP of <5 mm Hg, 7 died with 5-7 mm Hg, 6 died with IAP between 8-11 mm Hg and 3 died with IAP between 12-15 mm Hg.

DISCUSSION

Elevated intra-abdominal pressure (IAP) can lead to intra-abdominal hypertension (IAH), which is associated with dysfunction of the cerebrum and the digestive, respiratory, cardiovascular, and renal systems.[7,8] Additionally, IAH has been reported as an independent risk factor for mortality in the pediatric intensive care unit (PICU).[9]Thus far, the predictive value of IAP for mortality in PICU patients has not been reported in the pediatric literature. Moreover, only few studies have examined the normal reference range of IAP in PICU patients.[10,11] According to the updated World Society of the Abdominal Compartment Syndrome (WSACS) guidelines, the normal IAP value in a critically ill child was 4–10 mmHg; IAH was defined as a sustained IAP elevation of >10 mmHg; the guidelines are based on data collected from a single-center study of children who were put on mechanical ventilation (MV).[12,13] The present study was conducted to evaluate intra-abdominal pressure in critically- ill children.

We found that mean IAP in age group <1 year was 4.4±1.5 mm Hg, in age group 1-5 years was 4.6±1.8 mm Hg and in age group was 4.2±1.3 mm Hg. Singhal et al[14]determined the feasibility of measuring intra-abdominal pressures (IAP) in critically-ill children using simple inexpensive equipment available in the PICU. Thirty-two consecutive patients admitted to the PICU, staying for more than 24 h and requiring a urinary catheter were studied. IAP was measured by the intravesical method, using a disposable manometer, twice a day for seven days or till discharge/death, Risk factors associated with IAH were recorded. The majority of the patients had an IAP less than 5 mm Hg. Three patients had grade 1 intra-abdominal hypertension (IAP>12 mm Hg).

We found that the mean IAP in respiratory patients was 6.8±1.1 mm Hg, in sepsis patients was 6.2±1.7 mm Hg, in renal patients was 4.2±1.3 mm Hg, in tetanus patients was 2.5±1.3 mm Hg, in CNS patients was 4.9±1.3 mm Hg and in metabolic patients was 4.3±1.3 mm Hg. We found that 10 died with IAP of <5 mm Hg, 7 died with 5-7 mm Hg, 6 died with IAP between 8-11 mm Hg and 3 died with IAP between 12-15 mm Hg. Kaussen et al[15]sought to validate air-capsule-based measurement of intra-gastric pressure (ACM-IGP).In tertiary care PICU setting, finally, $n = 97$ children were enrolled (median age, 1.3 years [range 0 days–17 years], LOS-PICU 8.0 [1–332] days, PRISM-III-Score 13 [0–35]). In $n = 2.770$ measurements pairs, median IAP was 6.7 [0.9–23.0] mmHg, $n = 38$ (39%) children suffered from IAH > 10 mmHg, $n = 4$ from ACS. In vitro against water column, ACM-IGP correlated perfectly (r^2 0.99, mean bias − 0.1 ± 0.5 mmHg, limits of agreement (LOA) − 1.1/+ 0.9, percentage error [PE] 12%) as compared with IVP (r^2 0.98, bias + 0.7 ± 0.6 mmHg, LOA − 0.5/+ 1.9, PE 15%). With larger IVP catheters at higher pressure levels, IVP underestimated pressures against water column. In vivo, agreement between either technique was strong (r^2 0.95, bias 0.3 ± 0.8 mmHg, LOA − 1.3/+ 1.9 mmHg, PE 23%). No impact of predefined control variables on measurement agreement was observed.

The shortcoming of the study is small sample size.

CONCLUSION

Authors found that it's necessary to reevaluate the criteria used to define intra-abdominal hypertension in youngsters. Microprocessor-equipped transducer sets are being utilized more and more to measure IAP; they might be more effective for continuous measurements.

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