Journal of Cardiovascular and Thoracic Research, 2012, 4(3), 69-71
doi: 10.5681/jcvtr.2012.017
http://jcvtr.tbzmed.ac.ir

Inferior Vena Cava Index in Edematous Patients

Shamsi Ghaffari[1], Majid Malaki[2*], Mohammad Reza Ghaffari[3], Kamran Asiaie[2]

[1]*Department of Pediatric Cardiology, Tabriz University of Medical Sciences, Tabriz, Iran*
[2]*Pediatric Health Research Center,Tabriz University of Medical Sciences, Tabriz, Iran*
[3]*Department of Tuberculosis and Pulmonary Diseases Research Center, Tabriz University of Medical Sciences, Tabriz, Iran*

ARTICLE INFO

Article Type:
Research Article

Article History:
Received: 10 June 2012
Accepted: 20 Aug 2012
ePublished: 23 Sep 2012

Keywords:
Inferior Vena Cava Index
Edema
Children

ABSTRACT

Introduction: To find a relation between extracellular over fluid and inferior vena cava index as a noninvasive, cost effective and accessible method .**Methods**: In a cross sectional study 54 cases (no edema 30, mild and moderate 13 and significant edema 11 cases) entered to study. Inferior vena cava index (IVCi) measured by difference of inspiration to expiration divided to maximum size multiply by 100, we also find delta ratio as difference of maximum to minimum size of inferior vena cava. All data expressed by rate and ratio, relation of edema severity to IVCi or delta ratio performed by mann whitney and regression test, *P* less than 0.05 was significant.**Results**: IVCi in 30 cases with no edema ,13 cases with mild to moderate and 11 cases with significant edema were %46±16 , %42±16 , %38±17, there is a reverse relation of IVCi and edema severity but these relations were not significant (*P*>0.05).Averaged Delta ratio(millimeter) decreased in severe edema but it was not significant(3.7mm±2 vs. 2.8mm±1.6). **Conclusion**: In edematous conditions IVCi and delta ratio decrease but these changes are not significant for edema severity estimation.

Introduction

Identification of volume overload as the cause of a patient's respiratory distress can be difficult particularly in patients with co morbid condition such as chronic obstructive pulmonary disease (COPD) . In this conditions physical examination is unreliable in addition there are no imaging or laboratory test for this purpose specially.[1] Ultrasonographic measurement of respiratory variations of inferior vena cava (IVC) diameter have been shown that can be correlated with volume depletion in patients with septic shock[2,3] the necessary to find a non invasive , low cost and accessible method for evaluation of body fluid status is an obligatory reason for us to evaluate IVCi in edematous state as a condition with extracellular fluid overload although the affectivity of this method has been tried for intravascular fluid estimating of adults group earlier.[4]

Materials and methods

Fifty -four children admitted to pediatric ward of Madani heart center below age 7 years were enrolled into the study including of non edema 30 cases, mild to moderate edema 13 cases and significant edema 11 cases In the ultrasound examination, we concentrate on assessment of IVC diameters. The measurements were performed twice, initially The IVC index was introduced into clinical practice with inferior vena cava diameter (IVCd) measurement in maximum and minimum values at diaphragm level by using standard formula [(IVCmax - IVCmin)/IVCmax] × 100 .Delta ratio of IVC diameter were also measured both during inspiration (maximum) and during expiration(minimum) delta ratio was difference of IVC maximum and IVC minimum in millimeter unit. We define edema as clinical practice in assessment to assign a positive number for the severity of pitting edema in the lower extremities as follows: +1 = a normal foot and leg contour with a barely perceptible pit; +2 = fairly normal lower extremity contours with a moderately deep pit; +3 = obvious foot and leg swelling with a deep pit; +4 = severe foot and leg swelling that distorts the normal contours with a deep pit.

Grade +1 consider as normal Grade +2 and +3 as non significant and +4 was considered as significant edema. Exclusion criteria were: shock state and congenital anomaly of vascular malformation.

All ultrasound examinations were taken with GE Logiq 500 (GE Medical Systems, Waukesha, WI, USA) with a 3.5-to 5-MHz convex probe. For statistical analysis, the formula for differences for mann whitney test and wilcoxon test and regression tests were used for relation of edema and IVCi in SPSS 16 software, *P* less than 0.05 consider significant. An informed written consent was obtained from all volunteers and the procedures followed were in accord with the ethical standards of our institution's committee on human experimentation. The ultrasound examination was taken with the subject in a supine position with the transducer placed underneath the xiphoid process in a longitudinal direction. The IVC diameter was measured beneath the confluence with

***Corresponding author:** Majid Malaki , E-mail: madjidmalaki@gmail.com

hepatic veins, where its anterior and posterior wall were parallel. The IVC diameter was measured during a regular breathing cycle, and the maximum value was recorded. The aorta diameter was taken in a similar way, 5 to 10 mm above the celiac trunk.

Results

54 patients include 18 female and 38 male entered to this study their means ±SD age were 27±20 months from 54 patients who entered to this study 30 patients had no clinical edema , 13 patients had mild edema and 11 other cases had severe edema .

Means ±SD (minimum, maximum) of IVC diameters values in children were 4.5mm ±1.7 (minimum 2mm, maximum 8mm) in non edema group it was 4.36 ±1.8 mm ,mild to moderate edema group. 5.2±1.7 mm, severe form 3.6±0.5 mm maximum diameter of IVC in non edema group was 7.5±2mm in mild to moderate edema 8.2±1.8 and in severe edema it was 7.3±2 mm.

Means±SD of IVCi in patients without considering of edema was 44%±16 and delta ratio was 3.7± 1.6 (Table 1).

IVCi in patients without clinical edema was higher compared to patients with mild (46%±16 vs. 42%±16) and significant edema (46%±16 vs. 38%±17). In spite of decreasing of IVCi with severity of edema scale these measures were not different significantly between groups (Table 1).

These IVCi measures were compared between no edema condition with both mild edema and significant edema which showed there is a reverse relation between edema presence and IVCi but these differences were not significant, there is not any differences between no edema condition with mild edema (P=0.3) and significant edema (P =0.9) .

Delta ratio decreased with significant edematous state 2.6 mm in compared to mild 3.7mm and no edema 3.8 mm in average but this relation was not significant (P>0.05) among three groups of non edema, mild to moderate edema and severe edema (Table1).

Table 1. Inferior vena cava index (IVCi) and delta ratio in patients with different edematous conditions

Indices	Edema(n)		
[Mean±SD(Min,Max)]	No(3)	Mild(13)	Significant(11)
IVCi[44±16 (0,71)]	46±16(0,71)	42±16(19,68)	38±17(20,55)
DELTA[3.7±1.6 (0,8)]	3.7±1.6(0,8)	3.8±1.6(2,7)	2.6±2(1,5)

Discussion

The accuracy of body fluid status assessment plays a vital role in the diagnostic and therapeutic processes of acute and chronic disorders, influencing on their further treatment and final recovery. There are different methods of evaluating body hydration status, but none of them is optimal and all of them have some limitations.[4]

The benefits of IVC indices are so diverse it has been used in dehydrated patients or shocked condition with respect that ultrasound is easy to perform, quick and precise. There are many optimistic reports pointing to the usefulness of sonographic IVC diameter assessment in monitoring body water condition in patients undergoing hemodialysis[5-7] or patients with nephrotic syndrome.[8]

Cheriex *et al*. proposed the optimal values of IVC diameter ranging between 8 and 11.5 mm per square meter of BSA on the basis of measurements from the examined group of adult patients under hemodialysis.[9] According to Chang *et al*., there is a significant reduction of cardiovascular, gastrointestinal, and neurologic complications if the body dry weight of hemodialysis patients if it was determined and monitored with the sonographic method by measuring vessels diameters like as IVC.[10] Simultaneously, some indicates to serious problems as limitations for the usefulness of IVC diameter assessment. It seems that both the equipment quality and appropriately trained staff can play role although lack of IVC diameter reference values for the pediatric group because of measurement of IVC diameter is difficult to measure in pediatric group is another problem in children has not been considered seriously.

In this study we try to find these measures as standard reference in pediatric group beside to measure these parameters in edematous conditions for the first time in Tabriz Madani heart center.

It seems that estimation of edema evaluated by physical examination as objective finding may be misleading in mild or moderate form with respect to routine standards which used clinically lead to false results especially if we have not the baseline weight of patients or there is not baseline information about patient history .

Although in other studies IVCi less than 40% indicate to overhydration[11] our study show that in children with clinically severe edema this value was 38% and in mild or moderate group it was 42 % this data show limitation of this method for detecting subclinical, mild or moderate edema in children because of there is narrow differences of IVCi from mild to severe edema (42% vs. 38%).

In this study, which performed in patients under age 6 years our results, showed that IVC diameters solely both in inspiration or expiration phases will not different with age significantly and we should try for other standards like as IVC diameter to body surface area in other studies.

This study shows although IVCi is a convenient parameter for evaluation of IVC diameter changes in contrast to measuring IVC diameter solely but it is not a sensitive technique in volume overload condition in spite of decreasing of IVCi and delta ratio in edematous conditions this means that in edematous condition IVCi or delta ratio cannot be helpful for edema severity discrimination in pediatric population significantly. Researcher should try to find another more standard measure instead of IVC values in pediatric group for volume estimation.

Conclusion

IVC diameters are not change with increasing age significantly and IVCi is a rough means for estimating of edema severity in pediatric population although IVCi less than 42% is suggestive for edema but there are a large overlap findings of IVCi among mild, moderate and severe edema that make difficult using this measure.

Conflict of interests: The authors declare no conflicts of interest.

References

1. McCullough PA, Nowak RM, McCord J, Hollander JE, Herrmann HC, Steg PG, et al. B-type natriuretic peptide and clinical judgment in emergency diagnosis of heart failure: analysis from Breathing Not Properly (BNP) Multinational Study. **Circulation** 2002;106:416-22.

2. Feissel M, Michard F, Faller JP, Teboul JL. The respiratory variation in inferior vena cava diameter as a guide to fluid therapy. **Intensive Care Med** 2004;30:1834-7.

3. Barbier C, Loubieres Y, Schmit C, Hayon J, Ricome JL, Jardin F, et al. Respiratory changes in inferior vena cava diameter are helpful in predicting fluid responsiveness in ventilated septic patients. **Intensive Care Med** 2004;30:1740-6.

4. Ishibe S, Peixoto A. Methods of assessment of volume status and inter compartmental fluid shifts in hemodialysis patients: implications in clinical practice. **Semin Dial** 2004;17:37-43.

5. Chang ST, Chen CC, Chen CL, Cheng HW, Chung CM, Yang TY. Changes of the cardiac architectures and functions for chronic hemodialysis patients with dry weight determined by echocardiography. **Blood Purif** 2004;22:351-9.

6. Sonmez F, Mir S, Ozyurek AR, Cura A. The adjustment of postdialysis dry weight based on non-invasive measurements in children. **Nephrol Dial Transplant** 1996;11:1564-7.

7. Krause I, Birk E, Davidovits M, Cleper R, Blieden L, Pinhas L, et al. Inferior vena cava diameter: a useful method for estimation of fluid status in children on haemodialysis. **Nephrol Dial Transplant** 2001;16:1203-6.

8. Donmez O, Mir S, Ozyurek R, Cura A, Kabasakal C. Inferior vena cava indices determine volume load in minimal lesion nephrotic syndrome. **Pediatr Nephrol** 2001;16:251-5.

9. Cheriex EC, Leunissen KM, Janssen JH, Mooy JM, van Hooff JP. Echography of the inferior vena cava is a simple and reliable tool for estimation of 'dry weight' in haemodialysis patients. **Nephrol Dial Transplant** 1989;4:563-8.

10. Chang ST, Chen CL, Chen CC, Hung KC. Clinical events occurrence and the changes of quality of life in chronic haemodialysis patients with dry weight determined by echocardiographic method. **Int J Clin Pract** 2004;58:1101-7.

11. Mandelbaum A, Ritz E.Vena cava diameter measurement for estimation of dry weight in haemodialysis patients .**Nephrol Dial Transplant** 1996;11:24-27.