DOI:10.34084/bshr.1337030 e-ISSN 2587-1641

Journal of Biotechnology and Strategic Health Research

Araştırma Makalesi /Research Article

http://dergipark.org.tr/tr/pub/bshr

Perfusion Index Use and Clinical Follow-ups in the Pediatric Intensive Care Unit

Çocuk Yoğun Bakım Ünitesi'nde Perfüzyon İndeksi Kullanımı ve Klinik İzlemleri

Mehmet Nur Talay[1], Özhan Orhan[2]

[1] Artuklu University, Faculty of Medicine, Department of Child Health and Diseases, Mardin, Türkiye

[2]Artuklu University, Faculty of Medicine, Department of Child Health and Diseases, Mardin, Türkiye

ORCID ID: Mehmet Nur Talay: https://orcid.org/0000-0002-7361-3823, Özhan Orhan: https://orcid.org/0000-0002-3042-6972

***Sorumlu Yazar / Corresponding Author:** Özhan Orhan, **e-posta / e-mail:** ozhan.orhan@hotmail.com.tr

Geliş Tarihi / Received : 03-08-2023 **Kabul Tarihi / Accepted:** 24-12-2023 **Yayın Tarihi / Online Published:** 31-12-2023

Talay M.N., Orhan Ö. Perfusion index use and clinical follow-ups in the pediatric intensive care unit,
J Biotechnol and Strategic Health Res. 2023;7(4):249-257

Abstract

Aim Non-invasive measurement are used as standard methods in the hemodynamic follow-up of patients in the Pediatric Intensive Care Unit (PICU). The aim of this study is to investigate the feasibility of use of the perfusion index (PI), a non-invasive marker, in critically ill patients followed up in the PICU, to compare it with other vital signs and to analyze its utility in predicting mortality.

Material and Method Critically ill patients aged 1 month to 18 years with circulatory disorder, who were followed up in the intensive care unit between 01.June.2018 and 31.December.2019, were included in the study. PI, vital signs and mortality scores were compared within the first 6 hours after the patients were admitted to the intensive care unit.

Results When the values at the time of admission were examined, it was observed that the PI values were low, the capillary refill time was long, and the lactate levels were high in patients in the dehydration-acute gastroenteritis and metabolic disease groups. The patients were grouped as those with or without signs of dehydration. A correlation analysis between 0th hour PI and capillary refill time, systolic blood pressure and lactate levels in the patient group with signs of dehydration found; a moderately strong (r=-0.53/0.11/-0.36, respectively) negative and significant ($p<0.05$) relationship. In the first 6-hour follow-up of patients who died after being admitted to the intensive care unit; the PI, systolic blood pressure and mean diastolic blood pressure values were found to be lower (0.54/84.86/45.81, respectively) compared to the discharged patients. When a ROC analysis was performed for the PI values at the time of admission of patients with signs of dehydration and death, it was found that a cutt-off value of 0.57 of PI could predict mortality with a sensitivity of 70% and a specificity of 67.9%.

Conclusion In critically ill patients followed up in the pediatric intensive care unit, PI measurement, which can be easily made and is a standard feature in many bedside monitors and pulse oximetry devices, can be used in the early detection of hemodynamic status, clinical follow-up, shock findings, and mortality estimatio, together when used with other vital signs.

Keywords Mortality, pediatric intensive care, perfusion index, vital signs

Özet

Amaç *Çocuk Yoğun Bakım Ünite'sinde (ÇYBÜ) invaziv olmayan ölçümler, hastaların hemodinamik izlemlerinde standart yöntemler olarak kullanılmaktadır. Bu çalışmanın amacı, ÇYBÜ'sinde takip edilen kritik hastalarda non-invaziv bir belirteç olan perfüzyon indeksinin (PI) kullanılabilirliğini araştırmak, diğer vital bulgularla karşılaştırmak ve mortaliteyi öngörmede kullanılabilirliğini analiz etmektir.*

Gereç ve Yöntem *01.Haziran.2018 – 31.Aralık.2019 tarihleri arasında yoğun bakımda izlenen 1 ay-18 yaş arası dolaşım bozukluğu olan kritik hasta çalışmaya dahil edildi. Hastaların yoğun bakıma alındıktan sonraki ilk 6 saat içinde PI, vital bulguları ve mortalite skorları karşılaştırıldı.*

Bulgular *0. saat değerleri incelendiğinde dehidratasyon-akut gastroenterit ve metabolik hastalık grubunda olanların PI değerleri düşük, kapiller dolum zamanı uzun ve laktat düzeyleri yüksek izlendi. Hastalar dehidratasyon bulgusu olan ve olmayan şeklinde gruplandırıldı. Dehidratasyon bulgusu olan hasta grubunda 0.saat PI ile Kapiller dolum zamanı, sistolik kan basıncı ve laktat düzeyleri arasında korelasyon analizinde; orta düzeyde (sırasıyla r=-0,53/0,11/-0,36) negatif yönde ve anlamlı ($p<0,05$) ilişki bulundu. Yoğun bakıma yatırıldıktan sonra ölen hastaların ilk 6 saatlik takibinde; taburcu edilen hastalara göre PI, sistolik kan basıncı ve diyastolik kan basıncı ortalama değerleri daha düşük (sırasıyla 0.54/84,86/45,81) bulundu. Dehidratasyon bulgusu olan ve eksitus olan hastaların sıfırıncı saat PI değerleri için ROC analizi yapıldığında 0,57 Cutt off değerinde %70 sensitivite, %67,9 spesifite ile PI'nin mortaliteyi öngörebileceği saptandı.*

Sonuç *Çocuk yoğun bakım ünitesinde takip edilen kritik hastalarda, kolayca ölçülebilen ve pek çok hasta başı monitör ve pulse oksimetre cihazında standart olarak bulunan pahalı olmayan PI ölçümü, diğer vital bulgularla birlikte hastaların hemodinamik durumu, klinik izlemleri ve şok bulgularının erken tespitinde ve mortalite tahmininde kullanılabilir.*

Anahtar Kelimeler *Mortalite, çocuk yoğun bakım, perfüzyon indeksi, vital bulgular*

INTRODUCTION

Non-invasive measurements are currently used as standard methods in the hemodynamic follow-up of patients in intensive care units. The perfusion index (PI) measures changes in peripheral perfusion by attaching a pulse oximeter to the finger. PI is a relative assessment of pulse strength. It is expressed as the ratio of the pulsatile component, which reaches the sensor in the probe with the infrared light signal and is reflected by the arterial blood, to the non-pulsatile component reflected by the venous blood and tissues. It is a measurement derived independently of oxygen saturation.[1-2] PI is an indicator of changes in microcirculation. It is a method frequently used by clinicians and anesthesiologists to predict circulatory disorders. However, it should be noted that these changes may affect local vasoconstriction.[3-4]

PI also reflects changes in peripheral blood flow, and values below 1.24 can be a marker for assessing the seriousness of a patient's status.[5] Vasomotor tone, which plays a role in the etiopathogenesis of various shock types and determines pulse pressure, is directly related to PI. The type and etiology of shock is affected by many factors such as peripheral body temperature, measurement site, patient age, use of vasoactive agents, and cardiac output.[6]

There are no clear data on normal or pathological values of PI by age in children. Studies on subjects mostly include newborn patients.[7-8] Sivaprasath et al stated that the pathological value of PI in children is below 1.15 under the age of 3, below 1.25 between the ages of 3 and 10, and below 1.55 between the ages of 10 and 12. While its non-invasive nature, ease of use and easy accessibility provide advantages, the low temperature in the measured extremity and the variability between the measurement regions limit the use of this method.[9] The aim of this study is to investigate the usability of PI, a non-invasive marker, in patients followed in the Pediatric Intensive Care Unit (PICU), compare it with other vital signs, and analyze its effectiveness and feasibility of use in predicting mortality.

MATERIALS and METHODS

In the study, 191 critically ill patients (severe dehydration, metabolic acidosis, cardiac arrest, cardiovascular surgery, postoperative follow-up, diabetic ketoacidosis, respiratory failure, or those followed on mechanical ventilation) aged between 1 month and 18 years, who were hospitalized and treated in the tertiary PICU between 01.01.2018 and 31.12.2019, were included. By performing hemodynamic monitoring immediately after hospitalization, vital signs (body temperature, pulse rate, systolic blood pressure [SBP], diastolic blood pressure [DBP], respiratory rate, oxygen saturation (sPO2), and laboratory parameters in the first 6 hours, as well as consciousness levels, Glasgow Coma Scale (GCS) score, Pediatric mortality risk score III (PRISM III) were prospectively determined. Demographic properties of the patients, PRISM III score, reason for hospitalization, history of surgery, underlying disease, mechanical ventilator monitoring, transfusion, perfusion index values, hourly vital signs from 0th hour (at admission) to 6th hour, lactate measurements and turnover/discharged information were recorded.

The perfusion index of the patients was measured using a radical-7 pulse oximeter (Masimo Radical -Masimo Corporation, Irvine, California, USA) device using Masimo signal subtraction technology and a pulse oximetry probe attached to it. The pulse oximeter was placed on the index finger of the patients. All tests were performed by the same investigator and PI data and all other data were recorded. In order to reduce the effects of motion artifact, PI readings were taken after 8-10 seconds of regular waves were shown to the patients.

Statistical analysis

The written permission was obtained from the parents of all patients. Frequency and mean criteria were used for descriptive data. Student's t test was used to compare normally distributed variables, Mann-Whitney U test for nonparametric variables and $\chi 2$ test for categorical variables, and Pearson or Spearman tests for correlation analyses. ROC

analysis was used for sensitivity and specificity.

This study was approved by Diyarbakır Gazi Yaşargil Training and Research Hospital Good Clinical Practices Ethics Committee with the date 05/10/2018 and number 155.

RESULTS

Of the 191 patients included in the study, 113 (59.1%) were male and 78 (40.9%) were female. The median age was calculated as 14 (2-211) months. the median Glasgow Coma Scale and PRISM III scores at admission were 12 and 19, respectively. The median length of hospitalization of the patients in the PICU was 93 (6-1763) hours. Ninety-one (47.6%) patients were followed on mechanical ventilation; the median duration of mechanical ventilation was 36 (2-888) hours. A total of 62 patients were followed up with high-flow nasal cannula oxygen therapy (HNCOT) from baseline or after weaning from mechanical ventilation. The median duration of stay in HNCOT was 36 hours. Vasoactive inotropic therapy was needed in 66 patients (34.5%) and the median vasotropic inotropic score (VIS) calculated as 15 (Table 1).

Patients were divided into two groups as those having diseases with signs of dehydration (sepsis, septic shock, acute gastroenteritis, metabolic acidosis, metabolic disease, diabetic ketoacidosis, cardiac diseases, renal diseases) and those having diseases without signs of dehydration (pneumonia, post operative surgery patients, intoxication, central nervous system diseases and others). Patients diagnosed with dehydration-acute gastroenteritis and met-

Table 1. Demographic data of the patients

		Patients with signs of dehydration		Patients without signs of dehydration	
		Mean±Std. Deviation	Median (IQR)	Mean±Std. Deviation	Median (IQR)
Age, (months)		40.89±54.06	14(2-211)	40.94±51.83	21 (2-200)
Vasoactive inotrope score		16.26±6.51	17(5-33)	12.22±5.94	12 (5-27)
Glasgow coma score		11.10±3.54	12(3-15)	11.90±2.66	12 (3-15)
PRISM III score		21.76±9.61	19(9-59)	29.16±7.75	17 (9-55)
Length of stay on mechanical ventilator, (hours)		106.88±176.72	36(2-888)	78.33±125.71	18 (5-600)
Time to receive high flow nasal cannula oxygen therapy (hours)		41.81±19.49	36(12-114)	37.21±33.79	24 (4-208)
Intensive care hospital stay (hours)		166.94±244.52	93(6-1763)	112.83±102.16	84 (12-600)
		n (%)		n (%)	
Gender	Male	61 (62.2)		52 (55.9)	
	Female	37 (37.8)		41 (44.1)	
Inotrope	Yes	39 (39.8)		27 (29)	
	No	59 (60.2)		66 (71)	
High flow Nasal cannula oxygen therapy	Yes	31 (31.6)		32 (34.4)	
	No	67 (68.4)		61 (65.6)	
Mechanical ventilator follow-up	Yes	43 (43.9)		48 (51.6)	
	No	55 (56.1)		45 (48.4)	
Intravenous Saline (SF)	Yes	67 (68.4)		0 (0.0)	
	No	31 (31.6)		93 (100)	
Exitus	Yes	20 (20.4)		5 (5.4)	
	No	78 (79.6)		88 (94.6)	

abolic disease had lower PI values, longer capillary refill time and higher lactate levels at 0th hour compared to patients with other diagnoses. A total of 25 patients, 20 of whom were in the group with signs of dehydration, died (Table 2).

While the 0th hour PI value was positively correlated with dehydration, it was negatively correlated with capillary refill time. Likewise, while 0th hour capillary refill time and lactate levels were positively correlated with the patients who died; There was a negative correlation between PI, systolic-diastolic blood pressures, and sPO2 values (Table 3).

In the first 6-hour follow-up of the patients, both PI and capillary refill time values improved with interventions (Figure 1).

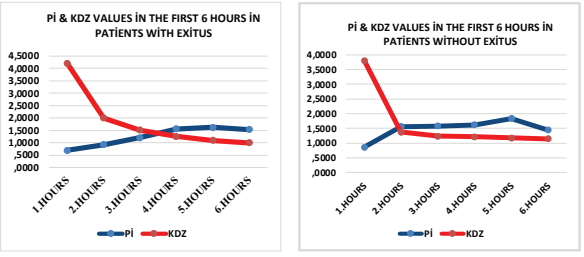

Figure 1. Perfusion index and capillary refill time changes in the first 6 hours of patients

In 67 of 98 patients with dehydration, 0.9% NaCl (SF) was loaded at a dose of 10 or 20 ml/kg. A significant improvement was observed in the PI, capillary refill time, SBP, DBP, pulse rate, sPO2, respiratory rate, and lactate levels measured at 0th hour and the values measured at the first hour (physiological saline solution) ($p<0.05$). In patients without signs of dehydration, no loading was performed; however, a significant improvement was observed in capillary refill time, SBP, pulse rate and lactate values ($p<0.05$). Surviving patients had a significant improvement in capillary refill time, SBP, sPO2, respiratory rate, and lactate level. When all patient groups were analysed, a significant improvement was observed in capillary refill time, SBP, respiratory rate, and lactate level ($p<0.05$) (Table 4).

When a ROC analysis was performed for 0th hour PI values of deceased patients with signs of dehydration, it was found that a cut-off value of 0.57 of PI predicted mortality with a sensitivity of 70% and a specificity of 67.9% (Figure 2).

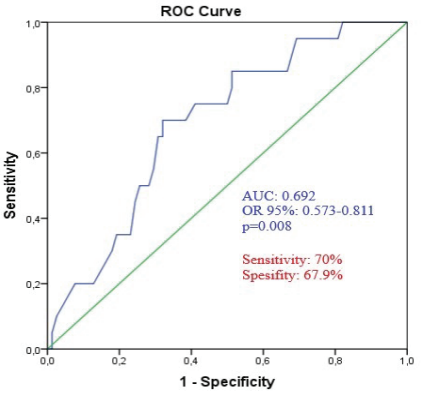

Figure 2. ROC analysis in deceased patients with signs of dehydration

Risk faktörü	AUC (95%)	Cutt off	P	Sensitivity(%) Duyarlılık	spesifity(%) Özgüllük
Exitus olanlar	0.69 (0.57-0.81)	0.69	0.008	70.0	28.2

Table 2. Vital signs with PI at 0 hour (first admission)

	PI Median (Min-Max)	Capillary refill time (sec) Median (Min-Max)	Pulse/ min Median (Min-Max	sPO2 Median (Min-Max)	Systolic Blood Pressure (mmHg) Median (Min-Max)	GCS Median (Min-Max)	PRISM III Score Median (Min-Max)	VIS score Median (Min-Max)	Length of stay on MV (hours) Median (Min-Max)	Intensive Care hospital stay (hour) Median (Min-Max)	Lactate Median (Min-Max)
All patients (n=191)	1.02 (0.09-7.60)	2 (1-5)	138 (52-216)	97 (34-100)	102 (38-201)	12 (3-15)	18 (9-59)	15 (5-33)	36 (2-888)	86 (6-1763)	2,56 (0,74-23,96)
Sepsis+ Septic shock (n=13)	1.40 (0.46-3.6)	2 (1-5)	136 (102-190)	99 (51-100)	120 (70-149)	11 (3-15)	19 (13-36)	17 (12-25)	44 (2-708)	184 (52-708)	2,95 (1,40-9,12)
Dehydration +AGE (n=26)	0.73 (0.10-2.50)	2,5 (1-5)	164 (64-216)	97 (80-100)	90 (44-151)	12 (3-15)	21 (10-48)	15 (5-25)	28 (4-560)	88 (12-1763)	2,25 (0,74-14,10)
Metabolic Disease (n=15)	0.6 (0.10-1.30)	4 (1-5)	135 (88-192)	98 (34-100)	88 (38-121)	10 (3-15)	23 (15-53)	20 (20-33)	33 (14-186)	72 (8-576)	4,86 (1,86-23,96)
Pneumonia+ Respiratory Failure (n=33)	098 (0.20-5.10)	3 (1-5)	147 (92-200)	94 (36-100)	105 (62-137)	12 (3-15)	19 (9-59)	12 (7-20)	48 (5-400)	84 (7-644)	3,06 (1,20-15,42)
Diabetic ketoacidosis (n=12)	1.45 (0.27-3.90)	2,5 (1-5)	122,5 (83-173)	100 (92-100)	105 (65-144)	15 (12-15)	15 (11-18)	17 (17-17)		30 (6-96)	2 (1,09-7,21)
Renal Diseases (n=10)	1.75 (0.18-2.10)	1 (1-3)	130 (80-164)	99 (80-100)	121 (74-201)	15 (8-15)	15 (11-20)	-	-	136 (46-1104)	1,97 (1,67-3,27)
Cardiac Diseases (n11)	0.6 (0.19-3.6)	2,00 (1- 5)	155 (113-193)	94 (86-100)	91 (85-138)	10 (8-12)	21 (16-44)	12 (5-20)	50 (4-192)	132 (8-380	2,42 (1,73-8,40)
Post Operative Surgery patients. (n=28)	1.2 (0.18-7.10)	1,5 (1-5)	132 (98-179)	98 (38-100)	98 (53-144)	12 (5-15)	18 (11-49)	10 (5-25)	8 (6-120)	91 (24-265)	2,46 (0,74-6,28)
Others (n=43)	1.10 (0.29-7.6)	1 (1-5)	138 (52-214)	96 (83-100)	110 (70-146)	12 (3-15)	17 (10-47)	12 (5-27)	71 (6-600)	84 (12-600)	2,66 (0,83-9,83)

Abbreviations: PI: Perfusion Index GCS: Glasgow Coma Scale. Prism III Score: Pediatric mortality risk.
VIS score: Vasoactive Inotrope score MV: Mechanical ventilator. AGE: Acute gastroenteritis. SpO2: Oxygen saturation

Table 3. Correlation analysis between zero hour patient groups

	Patients with signs of dehydration (n=98) and without dehydration (n=93)		Deceased (n=25) and surviving (n=166) patients	
	Spearman correlation	**p**	**Spearman correlation**	**p**
Perfusion Index	0.53	0.000[c]	-0.29	0.000[c]
Capillary refill time (sec)	-0.36	0.000[c]	0.375	0.000[c]
Systolic BP (mmHg)	0.11	0.143[c]	-0.204	0.005[c]
Diastolic BP (mmHg)	0.04	0.603[c]	-2.55	0.000[c]
Pulse (min)	-0.34	0.639[c]	0.68	0.347[c]
sPO2	-0.53	0.468[c]	-0.221	0.002[c]
Lactate	-0.36	0.624[c]	0.196	0.007[c]

In the first 6-hour follow-up of the patients, both PI and capillary refill time values improved with interventions (Figure 1).

Table 4. Comparison of 0[th] hour values and first hour values in the patient groups

		Perfusion Index		Capillary refill time (sec)		Systolic BP (mmHg)		Diastolic BP (mmHg)		Pulse(min)		sPO2		Respiratory rate		Lactate	
		Median (IQR)	P*	Median (IQR)	P*	Median (IQR)	P*	Median (IQR)	P*	Median (IQR)	P*	Median (IQR)	P*	Median (IQR)	P*	Median (IQR)	P*
Patients with signs of dehydration	Zero hour	0.64 (0.20-1.08)	<0,001	3,0 (1-5)	<0,001	99,0 (38-163)	<0,001	57 (17-89)	<0,001	141 (64-216)	0,03	98,0 (52-100)	0,06	34 (16-67)	<0,001	2,63 (0,7-26,2)	<0,001
	1st hour(SF)	0.8 (0.4-4.2)		1 (1-5)		78 (45-152)		43 (15-97)		138 (42-217)		98 (66-100)		32 (22-64)		2,1 (0,2-21,3)	
Patients without signs of dehydration. (n=93)	Zero hour	1.2 (0.3-7.6)	0,72	2 (1-5)	<0,001	107 (53-146)	0,01	58 (26-97)	0,21	138 (53-204)	<0,001	97 (63-100)	0,21	32 (18-55)	0,07	2,7 (0,7-16,1)	<0,001
	1st hour(SF)	1.4 (0.2-9.3)		1 (1-3)		102 (54-139)		56 (24-96)		130 (63-213)		98 (72-100)		30 (19-63)		1,8 (0,7-8,7)	
Deceased patients (n=25)	Zero hour	0.53 (0.29-1.1)	<0,001	5 (1-5)	<0,001	88 (38-138)	<0,001	47 (17-86)	<0,001	146 (63-193)	<0,001	92 (77-100)	0,13	34 (20-48)	<0,001	4,05 (1,1-26,3)	<0,001
	1st hour(SF)	0.52 (0.2-3.1)		2 (1-3)		76 (45-110)		40 (15-67)		140 (42-196)		96 (79-100)		35 (20-52)		2,9 (0,1-21,3)	
Surviving patients (n=166)	Zero hour	0.9 (0.2-7.6)	0,19	2 (1-5)	<0,001	105 (53-171)	0,01	59 (32-92)	0,15	138 (52-216)	0,38	98 (35-100)	0,04	32 (24-71)	0,04	2,55 (0,7-18,4)	0,01
	1st hour(SF)	1.3 (0.2-9.3)		1 (1-5)		91 (54-162)		51 24 (94)		135 (63-217)		98 (36-105)		30 (22-59)		1,82 (0,5-9,7)	

*Wilcoxon analizi uygulanmıştır. (p< 0,05 anlamlılık değeri)
BP: Blood Pressure SpO2: Oxygen saturation SF:%0.9 NaCl saline

DISCUSSION

In our study, we studied non-invasive PI measurement in patients with circulatory disorders admitted to the PICU during clinical follow-up, along with capillary refill time and other vital signs. We sought to answer the question whether it would aid in the early detection of circulatory disorders and mortality prediction in pediatric patients hospitalized in the PICU. We found that the PI value of the patients at first admission predicted mortality with a sensitivity of 70% and a specificity of 67.9%. In a literature review we could not find any clear data for normal and/or pathological values of PI in the pediatric age group. We have seen that in current studies, attempts are made to establish normal values of PI mostly in the neonatal age group.[7-9].

In our study, the mean PI value at 0th hor was low in the dehydration-acute gastroenteritis and metabolic disease groups. A low 0th hour PI value and high capillary refill time and lactate levels were considered significant. We found that PI was negatively correlated with other vital signs, especially capillary refill time.

A correlation analysis between 0th hour PI and capillary refill time, PRISM III score, and lactate levels in the patient group with signs of dehydration revealed a moderately strong, negative, significant ($p<0.05$) relationship. The PI value was lower in the SF-loaded group. In addition, a moderately negative and significant ($p<0.05$) relationship was found between the PI value and the capillary refill time in the SF-loaded and non-SF-loaded groups. We think that the mean PI value was 0.54 in the deceased patients and 1.51 in the surviving group, and that the low PI value in the patients was due to peripheral perfusion disorder, circulatory failure, and increased vascular smooth muscle tone. In a study conducted in newborns, lactate and PI were evaluated, and it was found that high lactate (4 mg/dL) and low PI values (<0.5) increased the incidence of early retinopathy and bronchopulmonary dysplasia.[10-11]

Choudhary et al. showed that PI is associated with low blood pressure and is useful in the evaluation of hemodynamic response.[12] In our study, a correlation was found between PI and capillary refill time. In addition, since PI can be measured in patients who have not developed hypotension yet, it may be useful in the evaluation of hemodynamic response and before the development of hypotension, which is a late finding of shock.

Sivaprasath et al. reported that PI is an easy, non-invasive and practical tool to predict shock in their study of 100 pediatric patients9. In a study by Van Genderen et al. in 25 healthy volunteers in adults, they monitored cardiac output, heart rate, mean blood pressure, and PI with pulse oximetry to detect changes in peripheral perfusion index during hypovolemia. In conclusion, they found that PI can be useful in detecting hypovolemia and shock long before cardiovascular deterioration occurs.[13] Capillary refill time is a useful and rapid measurement in determining the hypotension that occurs in patients and its potential consequences, particularly by determining the intravascular volume status. In our study, capillary refill time and PI show negatively correlation with perfusion status in patients who needed fluids.

In a multicenter study by Hua Wei et al., it was argued that the PI value was greater than 1.4 in adult healthy individuals and that the PI value 8 hours after resuscitation was associated with mortality within 30 days after resuscitation.[14] In a study by He et al. in adults, peripheral PI variability was demonstrated in patients with postoperative septic shock compared to the control group, and they reported sensitivity and specificity values of 65% and 92.3%, respectively, for a cut-off value of ≤0.2 for PI.[15] De Felice et al. in their study in newborns, found the AUC, sensitivity and specificity values for mortality to be 97%, 95.5% and 93.7%, respectively, for a cut-off value of 1.24 of PI.[16] In another study, the authors reported that PI may be associated with severe illness in newborns. They reported an AUC value of 0.831for a cut-off value of 0.86 of 24-hour

PI in the 60-day mortality estimate; they also reported a sensitivity of 77.78% and a specificity of 78.79%. In the same study, using the Kaplan-Meier analysis and the cut-off value, they showed that mortality was higher in patients with low PI.[17] In our study, it was determined that PI could predict mortality with an AUC of 69.2%, a sensitivity of 70%, and a specificity of 67.9% for 0.57 cut-off value in the ROC analysis performed for 0th hour PI values in patients with signs of dehydration and death. Our findings revealed different results in terms of the cut-off value in our ROC analysis to evaluate the PI value and mortality, and the results were less variable than the studies in the literature. In addition, it was observed that there was no significant PI value according to age. The PI values of the whole study population and those without signs of dehydration were 1.41±1.32 and 1.63±1.55, respectively.

CONCLUSION

In patients admitted to the PICU, the easily measurable and inexpensive PI measurement, along with other vital signs, may be useful in predicting the mortality of the patients. It is clear that further studies are needed in certain patient groups and/or more homogeneous patient groups in order to recognize dehydration and to determine its relationship with vital signs.

Limitations of the Study

Being a retrospective study and including data from a single center, are the limitations of the study. The study was conducted in a hospital in Diyarbakır province and cannot be generalized to the whole population. There are very few studies paediatric patients in terms of perfusion index. Epidemiological studies with more extensive data on this subject should be conducted.

Acknowledgements

We thank all patients who participated in the study.

Ethical Approval

The study was approved by the Diyarbakır Gazi Yaşargil Training and Research Hospital Good Clinical Practices Ethics Committee with the date 05/10/2018 and number 155. Written permission was obtained from the institution where the research was conducted. The study was carried out in accordance with the Declaration of Helsinki.

Peer-review

Externally and internally peer-reviewed.

Authorship Contributions

Concept: M.N.T., Ö.O., Design: M.N.T., Ö.O., Data Collection or Processing: M.N.T., Ö.O., Analysis or Interpretation: M.N.T., Ö.O., Literature Search: M.N.T., Ö.O., Writing: M.N.T., Ö.O.

Conflict of Interest

There is no conflict of interest in the study.

Funding

No financial support was received for this study.

References

1. Daviaud F, Grimaldi D, Dechartres A, et al. Performance analysis of OFDM modulation on indoor broadband PLC channels. Published online 2011. doi:10.1186/s13613-015-0058-8
2. Lima A, Bakker J, Lima A, Bakker · J. Noninvasive monitoring of peripheral perfusion. Intensive Care Med. 2005;31:1316-1326. doi:10.1007/s00134-005-2790-2
3. Piasek CZ, Van Bel F, Sola A. Perfusion index in newborn infants: a noninvasive tool for neonatal monitoring. doi:10.1111/apa.12574
4. Lima AP, Beelen P, Bakker J. Use of a peripheral perfusion index derived from the pulse oximetry signal as a noninvasive indicator of perfusion. Crit Care Med. 2002;30(6):1210-1213. doi:10.1097/00003246-200206000-00006
5. Van Genderen ME, Van Bommel J, Lima A. Monitoring peripheral perfusion in critically ill patients at the bedside. Curr Opin Crit Care. 2012;18(3):273-279. doi:10.1097/MCC.0B013E3283533924
6. Nishimura T, Nakae A, Shibata M, Mashimo T, Fujino Y. Age-related and sex-related changes in perfusion index in response to noxious electrical stimulation in healthy subjects. J Pain Res. 2014;7:91-97. doi:10.2147/JPR.S57140
7. Mowafi HA, Ismail SA, Shafi MA, Al-Ghamdi AA. The efficacy of perfusion index as an indicator for intravascular injection of epinephrine-containing epidural test dose in propofol-anesthetized adults. Anesth Analg. 2009;108(2):549-553. doi:10.1213/ANE.0B013E31818FC35B
8. Hu X jing, Ding J xiang, Wang Y, et al. Peripheral perfusion index percentiles for healthy newborns by gestational age and sex in China. Sci Rep. 2020;10(1). doi:10.1038/S41598-020-60741-9
9. Sivaprasath P, Mookka Gounder R, Mythili B. Prediction of Shock by Peripheral Perfusion Index. Indian J Pediatr. 2019;86(10):903-908. doi:10.1007/S12098-019-02993-6
10. Alakaya M, Arslanköylü AE. Evaluation of perfusion index in pediatric trauma patients. Ulus Travma Acil Cerrahi Derg. 2022 May;28(5):593-598 doi: 10.14744/tjtes.2021.68145
11. Bazaraa H, Roby S, Salah E, Algebaly H. Assessment of Tissue Perfusion Using the Peripheral Perfusion Index and Lactate Clearance in Shock in Pediatric Patients. Shock. 2021 Dec 1;56(6):933-938.
12. Choudhary VK, Rastogi B, Singh VP, Ghalot S, Dabass V, Ashraf S. Comparison of hemodynamic responses along with perfusion index to tracheal intubation with Macintosh and McCoy laryngoscopes. Int J Res Med Sci. 2018;6(5):1673-1681. doi:10.18203/2320-6012.IJRMS20181757
13. Van Genderen ME, Bartels SA, Lima A, et al. Peripheral perfusion index as an early predictor for central hypovolemia in awake healthy volunteers. Anesth Analg. 2013;116(2):351-356. doi:10.1213/ANE.0B013E318274E151
14. Hua W, Niu C, Xuan Y, et al. Peripheral perfusion index in well newborns at 6 to 72 h of life at different altitudes: a multi-center study in China. Eur J Pediatr. 2023;182(2):907-915. doi:10.1007/S00431-022-04725-Z
15. He H, Long Y, Liu D, Wang X, Zhou X. Clinical classification of tissue perfusion based on the central venous oxygen saturation and the peripheral perfusion index. Crit Care. 2015;19(1). doi:10.1186/S13054-015-1057-8
16. De Felice C, Latini G, Vacca P, Kopotic RJ. The pulse oximeter perfusion index as a predictor for high illness severity in neonates. Eur J Pediatr. 2002;161(10):561-562. doi:10.1007/S00431-002-1042-5
17. Er MC, Kaya C, Ustun YB, Sahinoglu AH. Predictive value of perfusion index for mortality in mechanically ventilated patients. Aging Male. 2020;23(5):1251-1258. doi:10.1080/13685538.2020.176081