Venous Catheterization Experiences With Ultrason Guided In Pediatric Burn Cases In Our New Burn Center

Yeni Yanık Merkezimizde Pediatrik Yanık Vakalarında Ultrason Eşliğinde Venous Kateterizasyon Deneyimlerimiz

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ABSTRACT

Objective: We aimed to convey our experience of opening CVC with US in children under 18 years of age who came to our clinic between 01.09.2018 and 15.12.20019.

Methods: In this study, 20 patients with a body burn surface of $\geq 15\%$, with electrical, chemical and inhalation burns, whose could not be achieved access vascular access despite at least 5 years of experienced assistant health personnel were included. Patients with thrombocytopenia and coagulopathy, whose catheter could not be opened with US, and who were not allowed to operate by their parents were excluded from the study.

Results: The patients included in the study were determined to be equal in terms of gender. The mean age values of the patients were calculated as 39.45 ± 39.10 months. The average burn percentage of patients was $27.25 \pm 8.95\%$. When the patients were examined for the cause of burns, 13 patients had hot water burns(65%), 1 patient had hot tea burns(5%), 4 patients had hot milk burns(20%) and 2 patients had flame burns(10%). When the patients were examined for CVC opening indication, 14 patients(70%) were tried by experienced medical staff, but it was observed that CVC was opened for 6 patients(30%) due to the prevention of hypovolemia.

Conclusion: Our study results showed that the CVC procedure opened with the help of US in the pediatric patient group should be the preferred method of choice for burn patients, since it has both less complication and higher chance of success.

Keywords: Central venous catheterization, ultrasonography, burn.

ÖZ

Amaç: 01.09.2018 ve 15.12.20019 tarihleri arasında kliniğimize gelen 18 yaş altı yoğun bakım takibi gereken çocuklarda USG eşliğinde CVP açma deneyimlerimizi aktarmayı amaçladık.

Yöntemler: Bu çalışmada vücut yanık yüzeyi $\geq 15\%$ olan, elektrik, kimyasal ve inhalasyon yanığı olan, en az 5 yıllık deneyimli yardımcı sağlık personeli çabasına rağmen damar yolu ulaşımı sağlanamayan 20 hasta dâhil edildi. Trombositopenisi ve koagulopatisi olan, USG ile katater açılmayan ve ebeveynleri tarafından işleme izin verilmeyen hastalar çalışma dışı bırakıldı.

Bulgular: Çalışmaya dâhil edilen hastalar cinsiyet açısından eşit tespit edildi. Hastaların ortalama yaş değerleri $39,45 \pm 39,10$ ay olarak hesaplandı. Hastaların ortalama yanık yüzdesi $27,25 \pm 8,95$ bulundu. Hastalar yanık nedeni açısından incelendiğinde 13 hastada sıcak su yanığı(%65), 1 hastada sıcak çay yanığı (%5),4 hastada sıcak süt yanığı(%20) ve 2 hastada alev yanığı (%10) olduğu saptandı. Hastalar CVP açma endikasyonu açısından incelendiğinde 14 hastaya(%70) deneyimli sağlık personeli tarafından denenmesine rağmen damar yolu bulunamadığı için, 6 hastaya (%30) hipovolemi önlenmesi nedeniyle CVP açıldığı gözlemlendi.

Sonuç: Çalışma sonuçlarımız gösterdi ki pediatrik hasta grubunda USG yardımıyla açılan CVP işlemi hem daha az komplikasyona hem de daha yüksek başarı şansına sahip olması nedeniyle yanık hastalarında öncelikli tercih edilen yöntem olmalıdır.

Anahtar Sözcükler: Santral venöz kateterizasyon, ultrasonografi, yanık.

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Introduction

Burns occurring in children are a health problem that must be examined in all aspects, as they cause severe physical and psychological trauma in patients, as well as high mortality and morbidity due to dehydration and metabolic events. The World Health Organization has determined that the number of injuries caused by burns is 6.6 million people each year, and the number of deaths caused by burns is 300,000.¹

When the patients are examined by age groups, childhood and newborn period constitute a high-risk group in terms of burns. Studies in the literature show that 50% of burn patients are from the patient group in these two periods.¹

When burn patients are examined in terms of the causes of burns, hot water and milk burns are frequently observed especially in childhood, while flame burns are observed more frequently in the adult group. These causes of burns are followed by electrical and chemical burns².

The most important indicators of mortality in burns observed in childhood and newborn period are the amount of burn surface, fluid electrolyte disturbances developing in patients, acute renal failure and infections. Therefore, effective fluid management, appropriate antibiotherapy and nutritional correctness are the most important parameters in preventing mortality.

Depending on the loss of fluid observed due to burns and the width of the burn area, vascular access problem in the pediatric patient group poses a serious problem for healthcare professionals. Therefore, opening an appropriately sized central venous catheter (CVC) in the early period was the primary preference in patients undergoing intensive care in most centers.

Although it has been shown in the literature that there are fewer complications and higher success rates after CVC opened with the use of ultrasonography, it has been determined that routine ultrasonography has not been used during CVC opening in many clinics.^{3,4}

In a study conducted in the USA, it was found that the rate of ultrasonography aiming at CVC in burn centers is less than 50%.⁵ Many factors have been found effective in low rates of ultrasonography use. The primary reason is that the ultrasonography device is still not available in most clinics, the duration of the procedure due to the use of US is extended, the fact that it causes the clinicians not to prefer the US, and the ability to use the US is not sufficient.

In this study, we would like to convey our experiences of opening CVC accompanied by US in children under 18 years of intensive care, who came to our clinic between 01.09.2018 and 15.12.20019.

Material ve Method

Our study was planned in our burn center with 13 clinical beds and 5 intensive care beds. The study started after the approval our hospital ethics committee with the date 15.05.2020 and

the number 478. During the study, approximately 715 patients with burns applied to the burn center of our hospital. Of these, 20 patients with a body burn surface of $\geq 15\%$, with electrical, chemical and inhalation burns, and whose vascular access could not be achieved despite the efforts of experienced medical personnel. Patients with thrombocytopenia and coagulopathy, whose catheter could not be opened with US, and who were not allowed to operate by their parents were excluded from the study.

In our burn center, routine US is used during patients opening CVC. Patients' images and data are recorded on our computers. Other data belonging to the patient were accessed through the electronic data recording system and anesthesia forms of our hospital. Demographic data of each patient, total body burn percentage, burn type and grade, burn zone, CVC opening reason, CVC shape opened, CVC size used, number of trials, complications observed during the procedure, urea and creatine values before and after CVC opening, hospitalization duration and mortality status were recorded.

The burn percentage was given in % as TBSA and the calculation was made using the "Lund-Browder Scale"⁶ (Figure 3). In the grading, the depth of the burn was evaluated and a classification was made between 1 and 4 degrees. First degree burns were defined as superficial burns, the depth of which did not exceed the epidermis. Second-degree burns are those with a depth exceeding the epidermis but not more than half the dermis. Third degree burns depth was defined as burns with dermis passing through the full layer and affected by reticular dermis. Fourth degree burns were defined as burns extending to the subcutaneous fascia, containing muscle or bone. Since first degree isolated burns were treated in an outpatient clinic in our hospital, they were not included in our data.

Figure 1: Pediatric patient developing scalding burn after pouring hot water

The length of hospital stay was evaluated in days and was recorded as the time between the day of hospital admission and the day of discharge.

While choosing the CVC region, the distance from the burn area was preferred as far as possible from the burn site to reduce the risk of infection. Before the procedure, 1mcg / kg fentanyl, 0.1mg / kg midazolam or 1-2mg / kg ketamine were given for sedation. During the procedure, patients were monitored for heart rate, rhythm, respiratory rate and peripheral oxygen saturation. After dressing sterile and taking the necessary medical barrier measures (mask, sterile gloves, disposable sterile gowns and goggles), the treatment area was cleaned with 10% povidone ioin (Poviodex). During the procedure, routine linear US probe (7.5 MHz) was used (Mindray DP-50). Technically, out of plane technique was preferred. Before the procedure, the venous structures in the appropriate CVC regions were evaluated with US and regions with an anatomical variation or thrombus were excluded. Arterial and vein localization was determined and the image was taken on the midline in the image of US. "Seldinger Technique" was preferred when inserting the catheter⁷ (picture 2,3). After the catheter was placed, the use of CVC was started after both the US and posterior-anterior chest x-ray were seen in the distal vena cava superior or right atrium entrance.

Statistics

Numerical data obtained in the study were expressed as arithmetic mean $\pm$ standard deviation, and categorical data were expressed as frequency (percent). Statistical analyzes were performed using SPSS 16.0 (Chi. Ill. USA) statistical package program. Compliance of numerical data to normal distribution was tested with Shapiro-Wilks and homogeneity with Levene

test. For statistical analysis, Chi-square, Student's-t independent, one-way analysis of variance (one-way ANOVA) post hoc Tukey-HSD tests were used. $P < 0.05$ value was accepted for statistical significance.

Results

When the patients included in the study were examined in terms of gender, 10 (50%) were female and 10 (50%) were male (Table 1).

The mean age values of the patients were calculated as 39.45 ± 39.10 months (minimum 10 months, maximum 154 months).

The average burn percentage of patients was 27.25 ± 8.95 (minimum 15%, maximum 45%).

When the patients were examined in terms of the degree of burns, it was found that 10 patients were followed due to 2nd degree burns (50%), 9 patients were followed for a 3rd degree burns (45%), and 1 patient was followed for a 4th degree burns (5%).

When the patients were examined for the cause of burns, 13 patients had hot water burns (65%), 1 patient had hot tea burns (5%), 4 patients had hot milk burns (20%) and 2 patients had flame burns (10%).

Figure 2: Pediatric patient developing scalding burn after pouring hot milk

Date: _____

Height: _____ Weight: _____

2° _____ + 3° _____ = _____ %

Percent surface area burned
(Berkow formula)

AREA	0-1 YEAR	1-4 YEARS	5-9 YEARS	10-14 YEARS	15 YEARS	ADULT	2°	3°
Head	19	17	13	11	9	7		
Neck	2	2	2	2	2	2		
Ant. Trunk	13	13	13	13	13	13		
Post. Trunk	13	13	13	13	13	13		
R. Buttock	2Qw	2Qw	2Qw	2Qw	2Qw	2Qw		
L. Buttock	2Qw	2Qw	2Qw	2Qw	2Qw	2Qw		
Genitalia	1	1	1	1	1	1		
R. U. Arm	4	4	4	4	4	4		
L. U. Arm	4	4	4	4	4	4		
R. L. Arm	3	3	3	3	3	3		
L. L. Arm	3	3	3	3	3	3		
R. Hand	2Qw	2Qw	2Qw	2Qw	2Qw	2Qw		
L. Hand	2Qw	2Qw	2Qw	2Qw	2Qw	2Qw		
R. Thigh	5Qw	6Qw	8	8Qw	9	9Qw		
L. Thigh	5Qw	6Qw	8	8Qw	9	9Qw		
R. Leg	5	5	5Qw	6	6Qw	7		
L. Leg	5	5	5Qw	6	6Qw	7		
R. Foot	3Qw	3Qw	3Qw	3Qw	3Qw	3Qw		
L. Foot	3Qw	3Qw	3Qw	3Qw	3Qw	3Qw		
TOTAL								

Figure 3: Lund-Browder Burn Scale (Since the scale is an international commonly used general scale, it has been taken from scientific publication sources.)*

* Lund, Charles C. The estimation of areas of burns. Surg Gynecol Obst. 1944; 79; 352-58.

Figure 4: Jugular central venous catheterization with US

Figure 5: Femoral central venous catheterization with US

When the patients were examined in terms of length of hospital stay, the average length of hospital stay was found to be 10.10 ± 3.93 days.

When the patients were examined in terms of CVC indication, since vascular access was not found, although 14 patients (70%) were tried by experienced medical personnel it was observed that 6 patients (30%) opened CVC due to hypovolemia (Table 2).

Figure 6: Baking bread in tandoor(Oven made in an underground hole to bake bread in Turkey)

Table 1. Demographic and burn related data

Charecteristics	Categories	n(%)
Gender	Female	10(%50)
	Male	10(%50)
Age(month)	39,45(±39,10)	
Burn type	Hot water	13(%65)
	Hot tea	1(%5)
	Hot milk	4(%20)
	Flame	2(%10)
Burn degree	1. degree	0(%0)
	2. degree	10(%50)
	3. degree	9(%45)
	4. degree	1(%5)
Total body burn percentage	%27,25(±8,95)	
Hospital stay (days)	10,10(±3,93)	

Table 2. Process evaluation

Charecteristics	Categories	n(%)
CVC indication	Hypovolemia	6(%30)
	No vascular access	14(%70)
CVC region	Femoral	10(%50)
	Internal jugular	10(%50)
CVC F	4 F	10(%50)
	5F	10(%50)
Processing time(min)	11,05±6,37	
Number of attempts	1,70±0,92	
Complication	Intraarterial puncture	2(%10)
Mortality		0(%0)

When the patients were examined in terms of CVC opening region, it was seen that femoral region was preferred in 10 patients (50%) and internal jugular region was preferred in 10 patients (50%).

When it was evaluated in terms of the diameter of CVC used, it was found that 10 patients (50%) opened 5 F CVC, and 10 patients (50%) opened 4 F CVC.

When the patients were examined in terms of the duration of the procedure, it was found that the average duration of the procedure was 11.05 ($\pm$ 6.37) (minimum 4, maximum 30) minutes.

When the patients were examined in terms of number of trials during CVC opening, it was seen that the average number of trials was 1.70 ($\pm$ 0.92) (minimum 1 maximum 4) times.

When the patients were examined in terms of complications during the procedure, complications were observed in 2 patients (10%). Both of the complications were intraarterial puncture and were effectively controlled after 5 minutes of compression.

None of the patients included in the study were ex.

When the patients were examined in terms of urea values (urea 1) before opening CVC, it was determined that the mean value was 27.6 ± 8.15 mg / dl, and when analyzed in terms of creatinine values (cre 1), the mean value was 33.30 ± 2.90 mg / dl.

When the patients were examined in terms of urea values (urea 2) after opening CVC and adequate fluid resuscitation, the mean value was found to be 12.15 ± 5.43 mg / dl, and when examined in terms of creatinine value, the mean value was 20.35 ± 3.41 mg / dl.

As a result of comparison of urea values before fluid resuscitation, the result was 15.45 ± 9.05 mg / dl (p : 0.000), and the comparison of creatinine values was 12.93 ± 15.58 mg / dl (p : 0.001) (Table 3).

No symptoms of acute kidney injury were observed in any patient included in the study.

Discussion

In this study, we aimed to present a retrospective evaluation of our CVC catheter opening experiences of patients under the age of 16 in our burn center intensive care unit and with a burn percentage of ≥ 15 and contribute to the literature on the subject.

Table 3- Urea / creatinine values analysis

	Mean $\pm$ Sd	Minimum	Maximum	P value
Urea 1- Urea 2	15,45 $\pm$ 9,05	11,21	19,68	0.000
Cre 1-Cre 2	12,93 $\pm$ 15,58	5,64	20,23	0.001

Choi et al., in their study with burn patients over the age of 18, found the ratio of male to female is 1,81 / 1, while Austin et al. found this rate as 1,11 / 1. In our study, we found this rate as 1/1. Compared to the studies, we associate this difference between gender distribution with the different age groups of the studies. We think that the frequency of burns increases in men as the age increases because most studies in the literature are conducted with adults and the frequency of working in risky jobs in males is higher than in females.^{8,9}

When we examined the literature, we found that the incidence of newborns and burns during childhood is higher than that of adults.^{10,11} In our study, we preferred the group of patients under 16 years of age with a higher risk of severe injury to the burn, as both the frequency of burns are more frequent than adults and the body surface area is larger than adults.

Burn width is defined as the percentage of burn area to total body area. The 9's rule, which is used very often in adults, is only suitable for children in adolescence. In our study, we chose the Lund Browder scale for calculating the percentage of burns. The reason we chose this scale is that it handles each age group individually due to the varying head and limb ratios that vary during growth and development, thus giving more accurate results in children.⁶

In previous studies, a positive correlation was found between mortality and total body burn surface. Mortality was found to be between 0.9% and 10.5%, depending on the percentage of burn. In a study conducted with patients with a burn percentage of 40% or more, mortality was found to be 60%.^{10,12} Our study results showed that 2 (10%) of our patients had 45% of total body burn, while the average burn area of patients was 27.25% ($\pm$ 8.95), but we did not have any exitus patients. Although this result is a great success for our clinic, we believe that it would be better to conduct a longer study with a larger patient group in order to obtain clearer results regarding mortality.

Yastı et al., in their study with children with burns, determined the average burn area percentage of the patients as $16.91 \pm 12.63\%$, and the average length of hospital stay as 12.41 ± 10.03 days.¹³ In their study Albayrak Y. et al. determined the average burn area percentage of the patients as $16.91 \pm 12.63\%$ and the average length of hospital stay as 12.1 ± 8.8 days.¹⁰ In our study, we found that the average length of hospital stay was 10.10 ($\pm$ 3.93) days. In our study, although we found the average burn area percentage of the patients to be 27.25% ($\pm$ 8.95%), we found that the length of hospital stay was relatively short, since the majority of patients were 2nd degree burn patients, the use of burn covers, such as skin equivalent, in our clinic at an early stage, and effective fluid resuscitation and early beginning of nutrition period.

In addition, in a study for the evaluation of hypovolemia and hypothermia in burn patients, two parameters were emphasized as a marker of mortality. These are the absence of vascular access after burns and associated hypovolemia.^{13,14} When we evaluate our study in terms of CVC indications, it is seen that the most

common two reasons for CVC opening in the early period are absence of vascular access and hypovolemia due to losses secondary to the burn site. We believe that the opening of the US -assisted early CVC contributes to the low mortality rate.

Burn depth is affected by age as well as factors such as temperature of hot agent, contact time, anatomical region, early intervention time.¹⁵ Due to the thinner skin tissue in childhood, the same factor can cause deeper burns. While burns caused by hot water in short term contact in adults often cause 1st degree burns, it causes 2nd and 3rd degree burns in children.¹⁵ In our study, although the majority of the patients (65%) had hot water burns, the fact that the burns observed in 95% of the patients were 2nd and 3rd degree burns also supports this data.

In studies that examined the causes of childhood burns, we realised that hot water burns and tandoor (Oven made in an underground hole to bake bread in Turkey) burns are the most common causes that lead to treatment of burns in children treated hospitalized in Turkey.^{10,16} (Figure 6) When our study was examined in terms of results, it was compatible with the literature and hot water burns (65%) in boiling style were observed most frequently.

Tolunay et al., in their study on US -assisted CVC in ICU children, the femoral region and jugular region selection rates were found to be 45.7% and 54.3%, respectively, and we found this rate as 1/1 in our study.¹⁷ In previous studies conducted on pediatric patients, it was concluded that the risk of infection was higher in the CVC procedure opened from the femoral region, but no relationship was found between infection development and region selection in the large-scale studies conducted by Reyes and his friends with 4512 patients.¹⁸ Also, in current CDCP (Centers for Disease Control and Prevention) guidelines it has been stated that no suggestions can be made for any region in reducing infection rates.¹⁹

It has been suggested that the maintenance of the infection risk should be done well and catheter should not be used >20 days. Since the patients in our study were a burn patient group, we aimed to stay away from the burn area as primary as possible in the selection of the region in order to reduce the infection rates. We believe that this proportional difference is related to the burn area diversity. In addition, we think that the fact that our hospitalization times are no > 20 days in any patient and that empirical antibiotherapy is initiated by the consultant infectious diseases specialist in the early period contributes to the absence of infection.

In a metaanalysis, the use of US and the CVC opening process with the landmark method were compared and as a result, the chance of success was higher and the complication rates were lower in the CVC operation opened with the help of US.²⁰ Although all of the patients in our study were under 16 years old and had burns, we were able to successfully attach CVC to all our patients with a low complication rate of 2% and an average procedure time of 11.05 ± 6.37 minutes. In our study, pneumothorax and hemothorax did not develop in any of our

patients. Intraarterial puncture occurred in two of our patients.

Studies have shown that acute kidney damage observed in risky patient groups is associated with increased mortality, morbidity, and length of hospital stay.²¹ In their study Kirsten et al. reported that depending on the age, burn percentage, sepsis and multiorgan dysfunction, acute kidney injury was observed in 1/4 and 1/3 of major burn patients.²²

In our study, we could not detect acute kidney damage in any of the patients, and we link this to many factors. The most important of these is that we open an appropriate CVC in the early period, calculate fluid losses and perform proper fluid replacement according to the Parkland method, start early nutritional support in accordance with the hypermetabolism that develops due to burns, and effectively fight infection with our empirical antibiotherapy. However, as in our study, the evaluation of acute kidney damage with serum creatinine value in patients with pediatric groups and patients with low muscle mass may cause false results. Another limitation is the fact that patients with different muscle mass, although their serum creatinine value is higher, may have the same glomerular filtration rates.²³ We believe that serum creatinine values measured as a result of hemodilution, which can develop secondary to fluid resuscitation, which is vital for burn patients, is another obstacle to our correct assessment of acute kidney damage. For this reason, although the changes in urea creatinine levels are statistically significant, we believe that it is necessary to contribute to the literature with large-scale studies in which more patients and more parameters are evaluated together in the evaluation of acute kidney damage.

As a result, our study results showed that the CVC procedure opened with the help of US in the pediatric patient group should be the preferred method of choice in burn patients, since it has both less complications and a higher chance of success.

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