

General characteristics of paint thinner burns: Single center experience

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ABSTRACT

BACKGROUND: The aim of the present study was to present characteristic features and risk factors of paint thinner burns in order to raise awareness and help prevent these injuries.

METHODS: Records of patients admitted to the burn unit due to paint thinner burns were retrospectively reviewed, and patients with comprehensive data available were included in the study. Total of 48 patients (3 female and 45 male) with mean age of 27.79 ± 11.49 years (range: 4–58 years) were included in the study.

RESULTS: Mean total hospitalization period was 30.25 ± 27.11 days (range: 3–110 days), and mean total burn surface area was $32.53 \pm 24.06\%$ (range: 3.0–90.0%). In 31 cases (64.6%), intensive care unit admission was required. Among all 48 patients, 9 (18.8%) died in hospital and remaining 38 were discharged after treatment. Primary cause of death was septicemia (n=7) or respiratory failure (n=6). Inhalation injury was present in 12 of the patients, 6 of whom died (50%). Statistically significant differences were found between expired and discharged patients when compared for presence of inhalation injury ($p=0.01$) and septicemia ($p=0.031$).

CONCLUSION: Ignition of paint thinner is an important cause of burn injuries that may result in very severe clinical picture. Patients require prompt and careful treatment. Clinicians should be aware that inhalation injury and sepsis are the 2 main factors affecting mortality rate in this group of patients. With increased awareness, preventive measures may be defined. Further studies are warranted to decrease mortality rate in this subgroup of burn patients.

Keywords: Inhalation injury; mortality; paint thinner burn.

INTRODUCTION

Unfortunately, especially in developing countries, paint thinner is an easily accessible, common household product, and for that reason, paint thinner-associated accidents, including burns, are not rare.^[1] Paint thinner is highly inflammable liquid that should be handled carefully.^[2] It is also toxic for almost

all systems of the body, including the central nervous system, the lungs, the heart, the liver and the kidneys.^[3]

Although data in the literature about paint thinner burns are limited, it has been associated with high total burn surface area percentage (%TBSA), and with resulting high mortality and morbidity rates. Furthermore, concomitant inhalation injury may also worsen clinical picture of the victims.^[4] The aim of the present study was to present the characteristic features and risk factors related to paint thinner burns in order to help prevent them.

MATERIALS AND METHODS

After receiving approval from the Kocaeli University School of Medicine ethics committee, this study was conducted at Kocaeli Derince Training and Research Hospital between January 2012 and December 2015. Patient records of those

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admitted to burn unit due to paint thinner burns were retrospectively reviewed and patients with comprehensive data were included in the study. During this period, total of 630 major burn patients were admitted and hospitalized in burn center, and among those, 48 (7.6%) were paint thinner burns. After initial assessment, intravenous fluid resuscitation was initiated in all cases with monitoring of urine output. Surgical interventions, including debridement, escharotomy, fasciotomy, and flap coverage, were performed as needed. Erythrocyte or fresh frozen plasma was transfused when required. Demographic details; routine laboratory data, including complete blood count, renal and liver function tests, and C-reactive protein (CRP) and serum electrolyte levels; intensive care unit (ICU) requirements; total hospitalization period; and presence of blood culture positivity were recorded.

Rule of Nines was used to calculate %TBSA. Most affected region and depth of burn were also recorded for each patient using burn grading scale: Grade 1, superficial thickness of skin is involved; Grade 2, full thickness of skin is destroyed; Grade 3, skin, subcutaneous tissue, fat, and muscle

are destroyed; Grade 4, skin, subcutaneous tissue, and bone are destroyed.

Statistical Analysis

Statistical analysis of the results was conducted using SPSS software (version 21; IBM Corp., Armonk, NY, USA). Results were presented as mean±SD for continuous variables and as number and proportion (percentage) for categorical variables. Descriptive statistics were used for analyses. P value of less than 0.05 was considered statistically significant.

RESULTS

Total of 48 patients (3 female and 45 male) with mean age of 27.79±11.49 years (range: 16–58 years) were included in the study. Burn took place at home in 14 cases, at work in 25 cases, and in another location in 9 cases. The patients arrived at the hospital by ambulance (n=36), with their own vehicle (n=7), or by air ambulance (n=5). For 25 patients (1 female, 24 male), paint thinner burn was due to work-related accident, and in remaining 23 cases (2 female, 21 male) it was

Table 1. The general characteristics of the study participants

	Paint thinner burns (n=48)		
	n	%	Mean±SD
Age (years)			27.79±11.49
Gender			
Male	45		
Female	3		
Total body surface area burned (%)			32.53±24.06
Burn degree			
2 nd degree	37	77.1	
3 rd degree	11	22.9	
Burn area (most affected)			
Hairy skin	3	6.3	
Extremity	18	37.5	
Body	14	29.2	
Head and neck	11	22.9	
Genital-gluteal region	2	4.2	
Operation requirement	38	79.2	
Mean number of debridement procedures			6.04±8.12
Hospitalization time (days)			30.25±27.11
Intensive care unit requirement	31	64.6	
Intensive care unit hospitalization time (days)			25.48±27.77
Mean erythrocyte transfusion requirement			2.05±3.49
Mean fresh frozen plasma requirement			4.47±8.45
Mean albumin requirement			1.00±2.43
Dialysis requirement	5	10.4	

SD: Standard deviation.

related to inhalant addiction. In 4 cases, burn was result of suicide attempt.

Of all the patients, 27 were directly hospitalized in ICU; in another 4 cases, during follow-up at hospital, ICU hospitalization was required. General characteristics of patients are summarized in Table 1. Mean hospitalization period in ICU was 25.48 ± 27.77 days (range: 7–110 days). Mean total hospitalization period was 30.25 ± 27.11 days (range: 3–110 days), and mean %TBSA was $32.53 \pm 24.06\%$ (range: 3.0–90.0%). Total of 20 patients had %TBSA of greater than 30% and 29 patients had %TBSA of greater than 20%. In 5 cases (10.4%), hemodialysis was required due to acute renal failure. Of those 5 cases, 3 patients died and 2 were discharged. In comparison of patients who expired and those who were discharged, hemodialysis requirement did not yield statistically significant difference ($p=0.10$).

In all, 9 (18.8%) patients in the group expired and remaining 38 were discharged after treatment. Principal cause of death was septicemia ($n=7$) or respiratory failure ($n=6$). Septicemia was statistically significantly more common in expired group ($p=0.031$). When odds ratio (OR) was calculated, presence of septicemia increased mortality ratio 2.19 times (1.21–3.95). In comparison of expired and discharged patients regarding presence of respiratory failure requiring mechanic ventilation, respiratory failure was also statistically significantly more common in expired group ($p=0.001$). OR calculation

indicated that respiratory failure increased mortality ratio 9 times (2.44–33.24).

Inhalation injury was present in 12 of the patients, and 6 of those died (50%). In 6 of the patients with inhalation injury, burn was due to work-related accident, while in remaining 6 cases, burn was related to inhalant addiction. Among 36 patients without inhalation injury, 3 patients died (8.3%). In comparison of expired and discharged patients regarding presence of inhalation injury, it was statistically significantly more common in expired group ($p=0.01$). Presence of inhalation injury increased the mortality ratio 3.22 times (1.38–7.53).

Study participant laboratory data at admission are summarized in Table 2. Interestingly, at admission, 41 (85.4%) patients had CRP level higher than normal value, and 44 (91.7%) had the white blood cell and neutrophil count above normal values. In 39 (81.3%) of the patients, antibiotherapy was required, and blood cultures were positive in 34 (70.8%) cases. In 7 of the 9 expired patients, blood cultures were positive and all those who died were receiving antibiotherapy.

DISCUSSION

The present study is retrospective assessment of patients with paint thinner burns conducted to determine general characteristics and outcomes. To the best of our knowledge, this is the largest study in the current literature evaluating paint thinner burns. We determined that the victims of paint thinner burns were generally young males, %TBSA was high ($32.53 \pm 24.06\%$), along with requirement for operation (79.2%) and ICU (64.6%) care. Total mortality ratio determined in this group was 18.8%, and main cause of death was septicemia or respiratory failure.

Even though paint thinner burns are not rare, data about such burns in the current literature is limited. Queiroz et al.^[5] investigated 293 patients admitted to ICU of burn center between 2010 and 2012 and reported that 3.4% ($n=10$) of cases were due to paint thinner burn. We have reported prevalence of paint thinner burn of 7.6% in this study. Kulahci et al.^[6] investigated demographic features of 9 male patients who were the victims of paint thinner burn and reported that mean %TBSA was as high as 67.7% with mortality rate of 33.3%. Benbrahim et al.^[7] examined demographic features of 17 patients admitted with paint thinner flame burns. Mean age of the patients was 32 years and nearly all of them (16/17) were male. Mean %TBSA was 23% in that study. Haberal et al.^[8] retrospectively evaluated epidemiology of 28 paint thinner burn injuries (25 male, 3 female) from period of 8 years and reported that mean age of the patients was 27.88 ± 14.74 years and mean %TBSA was $48.82 \pm 27.39\%$. They stated that %TBSA was significantly larger in cases of paint thinner burn when compared with other sources of flame burn, and as in our study, the most commonly affected site was the extremities. In that study, overall mortality rate was reported as

Table 2. Laboratory data of study participants at admission to the hospital

	Paint thinner burns (n=48)
	Mean±SD
Creatinine (mg/dL)	0.83±0.30
Urea (mg/dL)	27.68±9.84
Glucose (mg/dL)	138.36±90.88
Total protein (mg/dL)	5.32±1.62
Albumin (mg/dL)	3.07±0.98
Uric acid (mg/dL)	4.46±1.37
Aspartate amino transferase (IU/l)	53.57±96.67
Alanine aminotransferase (IU/l)	36.85±86.07
Potassium (mEq/L)	4.33±0.76
Sodium (mEq/L)	136.45±2.87
C-reactive protein	80.08±101.85
Hemoglobin (g/dL)	11.75±4.28
Mean platelet volume (fL)	8.45±1.24
Neutrophil (%)	70.12±19.04
Platelet count	266.76±143.82
WBC ($10^3/\mu\text{L}$)	21.78±11.19

SD: Standard deviation; WBC: White blood cell count count.

39.3% and main cause of death was sepsis. Ozgenel et al.^[9] reported demographic data of 32 patients (30 males, 2 females) with paint thinner burns and indicated that mean age of patients was 25.9±11 years and mean %TBSA was 33.6±24%. Mortality ratio was 15.6% in that study. In the present study, mean age of patients (27.79±11.49 years) and male predominance were similar to other results. Also consistent with these studies, mean %TBSA was greater than 30% and mortality rate was greater than 15%.

In this study, main cause of death was septicemia or respiratory failure. Inhalation injury was determined to be statistically significantly more common in the expired group and presence of inhalation injury was associated with more than 3 times greater mortality. Recently, inhalation injury was determined to be independently associated with mortality in adults with %TBSA of 20% or greater.^[10] Similarly, Chen et al.^[11] also reported that inhalation injuries significantly reduced survival rate in patients with mild or moderate burns (burn index<50%). Aguayo-Becerra et al.^[12] reported that mortality was higher for burns caused by inhalation injury and burns associated with infection. However, de Campos et al.^[13] and Moore et al.^[14] did not determine significant association between inhalation injury and hospital mortality in severe adult burn patients admitted to burn ICU.

In our study, we determined that respiratory failure requiring mechanical ventilation increased mortality rate about 9 times. Similarly, Rosanova et al. also determined that mechanical ventilation was an independent variable related to mortality in children with burns.^[15] Queiroz et al. also reported that mechanical ventilation requirement was associated with significantly increased mortality rate in burn victims.^[5] These results were also compatible with our findings. In the present study, septicemia was one of the most common causes of mortality, and increased mortality by more than double. In parallel with our results, Krishnan et al.^[16] reported that multi-organ failure was primary cause of death, with sepsis being primary trigger in acute burn patients. Elkafssaoui et al.^[17] also reported association of sepsis with increased mortality. Multi-organ failure triggered by sepsis-associated inflammatory cytokines may play a role in this association.^[18] In a recent review, Stewart et al.^[19] did not recommend systemic antibiotic prophylaxis for burns in low- and middle-income countries; however, further studies about prophylactic antibiotic treatment, especially for patients with large paint thinner burns accompanied by inhalation injury, are warranted.

In a retrospective study, Coban et al. investigated 411 burn patients and reported mortality rate of 5.6% (n=23). Among that study group, only 6 patients (1.4%) with acute renal failure responded to hemofiltration. They also determined most common cause of mortality to be septicemia or effects of inhalation injury.^[20] Saracoglu et al. recently reported that main cause of death was multiple organ failure or infection in patients with electrical burns. However, they reported that

renal injury requiring hemofiltration was associated with an almost 12-fold increased risk for mortality.^[21] In our study, we did not determine a significant difference between expired or discharged groups regarding presence of hemodialysis requirement.

There are some limitations to this study that should be mentioned. Although this is one of the largest studies in the literature about paint thinner burns, the number of patients is still low. Secondly, blood culture results and microorganisms found were not recorded in this study, which may be the topic of another study to define an appropriate prophylaxis protocol.

Conclusion

Paint thinner ignition is an important cause of burn injuries that may cause very severe clinical picture in patients that requires prompt and careful treatment. Clinicians should be aware that presence of inhalation injury or sepsis were the 2 main factors affecting mortality rate in this group of patients. With increased awareness, preventive measures can be defined. Further studies are warranted in order to decrease mortality rate in this subgroup of burn patients.

Conflict of interest: None declared.

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ORJİNAL ÇALIŞMA - ÖZET

Tiner yanıklarının genel özellikleri: Tek merkezli bir çalışma

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AMAÇ: Bu çalışmanın amacı tinere bağlı yanıkları önlemek için bu yanıkların karakteristik özelliklerini incelemek ve risk faktörlerine olan farkındalığı artırmaktır.

GEREÇ VE YÖNTEM: Tiner yanığı nedeniyle yanık ünitesine kabul edilen hastalar geriye dönük olarak tarandı, hastaların klinik kayıtları kapsamlı bir şekilde incelendi. Ortalama yaşları 27.79 ± 11.49 (dağılım, 16–58 yaş) olan toplam 48 hasta (3 kadın, 45 erkek) çalışmaya alındı.

BULGULAR: Ortalama hastanede kalış süresi 30.25 ± 27.11 (dağılım, 3–110) gündü, ortalama toplam yanık yüzey alanı 32.53 ± 24.06 (dağılım, %3.0–90.0). Toplam 31 hastada yoğun bakım ünitesi ihtiyacı oldu. Tiner yanığı olan hastaların dokuzu kaybedildi (%18.8), geriye kalan 38 hasta tedavileri sonrasında taburcu edildi. Ana ölüm nedeni septisemi ($n=7$) ve respiratuvar yetersizlik ($n=6$). Hastaların 12'sinde inhalasyon yanığı eşlik ediyordu, bunlardan altısı kaybedilmişti (%50). Septisemi ($p=0.031$) ve inhalasyon hasarı ($p=0.01$) varlığı açısından karşılaştırıldığında, kaybedilen veya taburcu edilen hastalar arasındaki farklar anlamlı idi.

TARTIŞMA: Tinerle temas, hızlı ve dikkatli tedaviler gerektiren çok ciddi klinik tablolara neden olabilen önemli bir yanık nedenidir. Klinisyenlerin bunun bilincinde olması, bu hasta grubunda inhalasyon yanığı ve sepsisin mortalitenin iki önemli nedeni olduğunu bilmelidir. Artan bilinçle önleyici tedbirler tanımlanabilir. Bu hasta grubunda mortalitenin azaltılması için daha fazla çalışma yapılmasına ihtiyaç vardır.

Anahtar sözcükler: İnhalasyon hasarı; mortalite; tiner yanıkları.

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