

# Risk of burns in pressure cooker usage: a comprehensive analysis of explosive injuries

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## ABSTRACT

**BACKGROUND:** Despite the widespread use of pressure cookers for quick and efficient cooking, literature has insufficiently highlighted the potential dangers resulting from inappropriate handling. This study aims to provide a comprehensive overview of 32 patients who presented with pressure cooker burns, emphasizing the serious risks associated with their misuse.

**METHODS:** Retrospective data were collected from patients admitted to Bağcılar Training and Research Hospital Burn Center between 2017 and 2020 with pressure cooker burns in Türkiye. Data encompassed patient characteristics, burn causes, locations, severities, treatments, and clinical outcomes.

**RESULTS:** The study included 32 patients (29 female/3 male) with a mean age of 42.3 (8-83). Patients were categorized based on burn areas, revealing associated injuries such as ocular (34.3%) and ear injuries (6.25%). The average hospital stay was 10.5 days [2-37]. While five pressure cookers exploded due to product-related issues, 26 explosions resulted from user errors (15.6%/81.2%). Importantly, no mortality was observed among the patients.

**CONCLUSION:** While pressure cookers facilitate rapid food preparation, this study underscores the severe risks arising from product or usage errors. This study emphasizes the need for more effective usage instructions and increased awareness about pressure cookers to prevent burn risks. We anticipate that educational programs focused on safe pressure cooker use could significantly reduce the incidence of serious injuries.

**Keywords:** Burn; explosive burn; pressure cooker.

## INTRODUCTION

The pressure cooker, a marvel of culinary convenience, harnesses steam power to expedite meal preparation. Operating on the principle of elevating the boiling point of liquids within, it promises quick and efficient cooking. The functionality of pressure cookers is primarily rooted in the interplay between pressure and the boiling point of water. Operating at elevated temperatures and in a sealed environment, pressure cookers significantly reduce food preparation time.<sup>[1]</sup> These cookers, equipped with a valve set to a specific boiling point, function

under pressure. The valve, adjustable based on desired cooking intensity, serves as a safety mechanism against explosion, preventing the pot from rupturing by releasing steam through the whistle when pressure builds up.<sup>[2]</sup>

Delving into the historical context of pressure cookers, approximately 300 years ago, in 1679, French physicist Denis Papin, assisted by Irish physicist Robert Boyle, conducted an experiment using a robust iron pot.<sup>[3]</sup> By tightly sealing the pot's lid and applying weight to prevent steam pressure, Papin's pot was born. This innovation allowed meals to be cooked significantly faster than in traditional pots. In contrast to normal

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**Table 1.** Demographics of included patients

Total Patients Number	Female/Male	Mean Age	Education (Primary/High School/Secondary/University)	Percentage of Burn	Degree of Burn (1°-2°/ 2°-3°/ 2°)	Length of Stay
32	29/3	42.3 years	22/3/6/1	14% [5-25]	1/3/28	10.5 days [2-37]

pots where water boils at a constant 100 degrees Celsius, a pressure cooker's sealed environment causes the temperature to rise to 125°C (257°F).<sup>[4]</sup> This heightened temperature accelerates the penetration of heat into food, ensuring swift cooking without compromising the integrity of vitamins and minerals. As a result, meats can be boiled in as little as half an hour, and dry vegetables in just twenty minutes.

By managing steam pressure, these kitchen devices ensure controlled cooking, releasing excess pressure in a regulated manner. While pressure cookers offer a swift and simple culinary solution, the potential dangers associated with their misuse remain inadequately understood. Despite their widespread use in Türkiye, only a limited number of burn cases have been reported in the literature, emphasizing the need for comprehensive research and awareness.<sup>[5,6]</sup> In this study, we present a detailed analysis of 32 patients who suffered burns due to pressure cooker incidents over a 3-year period, shedding light on both manufacturer-related defects and user errors.

## MATERIALS AND METHODS

This study draws upon data collected retrospectively from patients admitted to the Burn Center of Bağcılar Training and Research Hospital during the years 2017–2020. Ethical approval was obtained from the local data and ethics committee, and the study encompassed a total of 1,808 patients. The focus of our investigation was on 32 patients who suffered second- and third-degree burns, predominantly affecting areas such as legs, arms, chest, shoulders, neck, and face, as a result of contact with steam produced by pressure cookers. Daily dressing of burn areas and the initiation of antibiotic therapy were standard procedures in the management of these cases.

Comprehensive data, including patient demographics, burn mechanism, site and severity of the burn, treatment modalities, and clinical outcomes, were meticulously extracted from clinical records for detailed analysis.

This study seeks to provide a thorough understanding of the demographics and clinical characteristics of patients who experienced burns due to pressure cooker incidents. The collected data will serve as a foundation for evaluating the patterns and outcomes of these incidents, shedding light on both manufacturer-related defects and user errors. While our study thoroughly presents the findings, it is crucial to acknowledge the absence of statistical analysis, which stems

from several considerations. The modest sample size of 32 patients may limit the statistical robustness, leading to potential errors. Additionally, the diverse nature of injuries and contributing factors makes standardized statistical approaches less applicable.

## RESULTS

The study cohort comprised 32 patients (Female/Male: 29/3) with a mean age of 42.3 years (range 8–83 years). In terms of educational status, 22 were primary school graduates (68.7%), 3 had completed high school, 6 had secondary education, and 1 was a university graduate (Table 1).

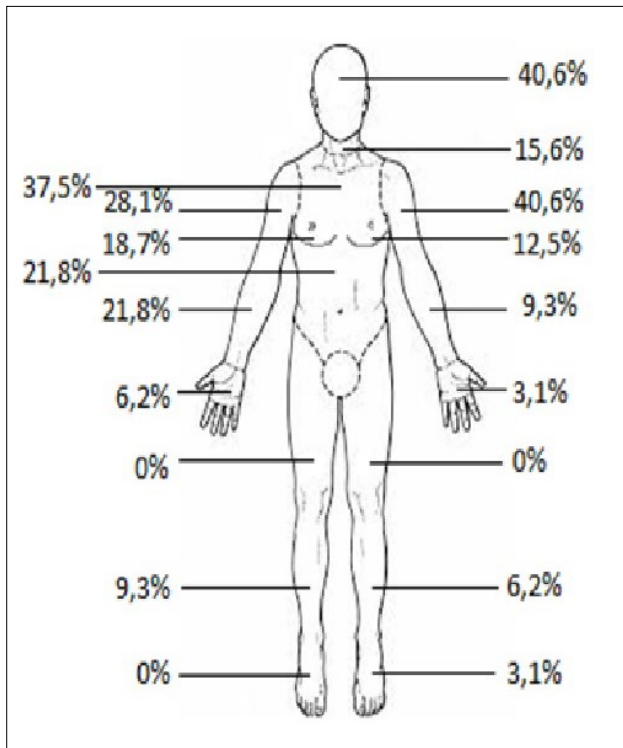
Upon examining burn areas, we observed a distribution across right/left arm, right/left forearm, right/left hand, upper/lower body, right/left breast, right/left thigh, right/left foot, face, and neck (Table 2, Fig. 1).

Regarding the degree of burn, 1 patient had a first-/second-degree burn, 3 had second-/third-degree burns, and 28 patients had second-degree burns (87.5%). The mean percentage of total body surface area burned was 14% (range: 5–25%). Three patients required intensive care hospitalization, and specific antibiotics were administered to three patients (9.37%). Thirty-one patients underwent debridement, with only one patient requiring grafting. The average length of hospital stay was 10.5 days (range: 2–37 days). Ocular injuries were associated with 11 cases (34.3%), and auricular injuries were associated with two cases (6.25%) (Table 3, Fig. 2).

The explosion of five pressure cookers resulted from product defects, while 26 explosions were attributed to user error

**Table 2.** Percentages of burns of included patients

Burn Area	Percentage
Face	40.6%
Neck	15.6%
Right/Left Arm	28.1/40.6%
Right/Left Forearm	21.8/9.3%
Right/Left Hand	6.2/3.1%
Upper/Lower Body	37.5/21.8%
Right/Left Breast	18.7/12.5%
Right/Left Thigh	9.3/6.2%
Right/Left Foot	0/3.1%



**Figure 1.** The percentages of included patients with commonly affected areas from the exploding pressure cooker.



**Figure 2.** A photograph of a patient with a pressure cooker burn causing eye-related damage

(15.6%/81.2%). Notably, there were no reported mortalities among the patients involved in the study.

The treatment algorithm in our study involved evaluating patients in the emergency department based on the degree and percentage of burns. Intensive care hospitalization was recommended for cases of explosive pressure cooker burns to monitor inhalation burns and prevent respiratory complications. For patients with facial and neck burns, a multidisciplinary approach was adopted, involving consultations with relevant specialists to address cosmetic and organ-related concerns. None of the patients experienced permanent damage to the eyes or ears. Empirical treatment was initiated, ensuring the hydration of all patients requiring routine hospitalization. Specific antibiotics were reserved for patients in need of intensive care. While 31 patients undergoing routine burn dressings required debridement, only one patient necessitated grafting due to the depth of the burn.

### DISCUSSION

The advantages of pressure cookers include the preservation of dish flavors, as steamed dishes are less exposed to water, and the rapid cooking process due to higher temperatures. Additionally, pressure cooking eliminates contact with oxygen, maintaining food quality.<sup>[3]</sup>

However, cautious use of pressure cookers is crucial to prevent accidents. Key considerations include ensuring that pressure cookers, as explosive vessels, bear the CE mark. Users should avoid overfilling the pot, maintaining the material and water levels below half of the pot's capacity. Adequate water must be added to prevent pot cracking during cooking. After turning off the pressure switch, users should adhere to specified cooking times and refrain from attempting to open the pot lid without reducing pressure, facilitating a safer release by placing the pot in water or under running tap water.

Pressure cookers, initially crafted from cast iron, evolved into variations made of earth, copper, aluminum, enamel, and glass. Maintenance guidelines dictate bicarbonate-based first use for aluminum pressure cookers, while stainless steel variants can be efficiently cleaned with soap and hot water. The gasket, a crucial sealing component, should be replaced annually, and it is recommended that pressure cookers older than five years be replaced.<sup>[7]</sup>

Despite their efficiency, pressure cookers can pose hazards if not used properly, leading to severe burns.<sup>[8]</sup> Common reasons for pressure cooker explosions include overfilling, which hampers steam release, and premature lid opening. Attempt-

**Table 3.** Results of burn caused by household pressure cookers

Intensive Care Unit Need	Special Antibiotic Usage	Debridement Need	Graft Need	Ocular Injury	Auricular Injury	Product Error Defect/User	Mortality
3	3	31	1	11	2	5/26 (15.6-81.2%)	0

ing to open the lid immediately after cooking without proper deaeration and cooling increases the risk of explosion.<sup>[9]</sup> Our study highlighted cases where patients suffered organ injuries, emphasizing the importance of caution and recommending consulting relevant specialists to mitigate associated problems.

While serious burn injuries from pressure cooker explosions are relatively scarce in PubMed-indexed literature, managing such cases poses complexity in burn care coordination.<sup>[1,2,4]</sup> Burns are classified based on skin layer involvement: "first-degree" burns affect the upper epidermis, "second-degree" burns involve the dermis, often causing blisters, and "third-degree" burns extend to all skin layers and underlying tissues. In our study, most patients suffered pure second-degree burns, requiring careful attention to an estimated Total Body Surface Area (TBSA) to guide referrals for optimal healing.<sup>[10]</sup>

Injury reports related to domestic pressure cooker burns are predominantly limited to case studies. Our study, with the largest case sample in medical literature, identified the commonality of injuries resulting from premature lid opening. A notable observation was that over half of the patients had only completed primary education. Proper lid removal procedures, such as allowing pressure to release naturally, using a manual pressure regulator, or employing cold water discharge, should be emphasized in user instructions, especially to those with lower education levels.

Reports of unintentional explosions involving household pressure cookers are rare, but associated burns seem to be on the rise.<sup>[4,11,12]</sup> To mitigate burn risks, providing effective usage instructions and educating users, particularly those with limited education, can enhance awareness and safety. This study aims to contribute to raising awareness of pressure cooker dangers.

The discourse surrounding our findings is fundamentally rooted in technical considerations, yet a conspicuous gap exists in the examination of a comprehensive treatment algorithm pertaining to uninstructed use. This omission raises critical concerns, urging a meticulous exploration of the nuanced intricacies associated with therapeutic interventions lacking clear guidelines. The absence of a well-defined treatment algorithm for instances of uninstructed use poses a significant challenge, as it hinders the establishment of standardized, evidence-based approaches for optimal patient outcomes. It is imperative to recognize that the effectiveness and safety of medical treatments are inherently intertwined with the structured application of treatment algorithms. Without a robust algorithm, the risk of variability in clinical decisions increases, potentially leading to suboptimal outcomes and compromised patient safety. Addressing this deficiency in our discussion necessitates a deeper analysis of the existing gaps in treatment protocols and serves as a catalyst for future research endeavors aimed at formulating comprehensive, standardized treatment algorithms, particularly in scenarios where clear

instructions may be lacking.

Nevertheless, the study has limitations, including a small patient population and a retrospective design, which prevent drawing conclusive insights or conducting statistical analyses. Extended follow-ups and larger series are warranted for more comprehensive results. Despite the comprehensive insights provided in this study, certain limitations should be acknowledged. Firstly, the study primarily relies on a retrospective analysis of cases, potentially leading to selection bias. Additionally, the sample size, while noted as the largest in medical literature for pressure cooker burns, may still be limited in capturing the full spectrum of incidents. The retrospective nature also poses challenges in obtaining real-time data on user behavior and specific circumstances leading to accidents. Furthermore, the study does not delve into the psychological aspects influencing user behavior, which could play a significant role in safety practices. Future research could benefit from prospective studies, larger sample sizes, and a more in-depth exploration of user psychology to enhance the understanding of pressure cooker-related incidents.

## CONCLUSION

Our study represents the first with the largest case sample of pressure cooker explosions documented in medical literature, addressing the associated risks and injury patterns. Given the widespread use of pressure cookers as household appliances, it is imperative for emergency physicians to be cognizant of the rare but significant dangers they present. Evaluating injuries resulting from pressure cooker explosions necessitates a comprehensive trauma assessment, emphasizing the examination of areas at risk and evaluating the patient's physical proximity to the stove at the time of the incident.

**Ethics Committee Approval:** This study was approved by the Bagcilar Training and Research Hospital Ethics Committee (Date: 15.01.2021, Decision No: 2021.01.1.10.184.r1.010).

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**Authorship Contributions:** Concept: S.M., O.O.; Design: Me.T., H.F.G., T.V.A.; Supervision: T.V.A., N.A.H.; Resource: Mu.T.; Materials: Me.T., O.O.; Data collection and/or processing: H.F.G., N.A.H.; Analysis and/or interpretation: S.M.; Literature search: T.V.A., Mu.T.; Writing: T.V.A.; Critical review: S.M., T.V.A.

**Conflict of Interest:** None declared.

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## ORİJİNAL ÇALIŞMA - ÖZ

### Düdüklü tencere kullanımında yanık tehlikesi: Patlayıcı yaralanmaların detaylı incelemesi

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**AMAÇ:** Hızlı ve etkili yemek pişirmek için yaygın olarak kullanılan düdüklü tencerelerin, uygun olmayan kullanımdan kaynaklanan potansiyel tehlikeleri literatür yeterince vurgulamamıştır. Bu çalışma, düdüklü tencere yanıkları nedeniyle tedavi arayan 32 hastayı kapsayarak, düdüklü tencerelerin yanlış kullanımından kaynaklanan ciddi risklere vurgu yapmayı amaçlamaktadır.

**GEREÇ VE YÖNTEM:** Bağcılar Eğitim ve Araştırma Hastanesi Yanık Merkezi'ne 2017 ile 2020 yılları arasında düdüklü tencere yanığı ile başvuran hastalardan retrospektif veriler toplandı. Veriler, hasta özellikleri, yanma nedenleri, yerleri, ciddiyetleri, tedavileri ve klinik sonuçları içermektedir.

**BULGULAR:** Çalışma, 32 hastayı (29 kadın/3 erkek) içermekte olup, ortalama yaşları 42.3 (8-83) idi. Hastalar, yanık bölgelerine göre kategorize edildi ve ilişkili yaralanmalar, özellikle oküler (%34.3) ve kulak yaralanmalarını (%6.25) içermekteydi. Ortalama hastanede kalış süresi 10,5 gün [2-37] idi. Ürünle ilgili sorunlardan kaynaklanan 5 düdüklü tencere patlaması yaşanırken, 26 patlama kullanıcı hatalarından kaynaklandı (%15.6 / %81.2). Hastalar arasında mortalite gözlenmedi.

**SONUÇ:** Düdüklü tencereler, hızlı yemek pişirmeyi kolaylaştırırken, bu çalışma ürün veya kullanım hatalarından kaynaklanan ciddi riskleri vurgulamaktadır. Bu çalışma, daha etkili kullanım talimatlarına ve düdüklü tencerelerle ilgili farkındalığın artırılmasına ihtiyacı vurgulamaktadır. Güvenli düdüklü tencere kullanımına odaklanan eğitim programlarının, ciddi yaralanmaların insidansını önemli ölçüde azaltabileceğini öngörmekteyiz.

**Anahtar sözcükler:** Düdüklü tencere; patlayıcı yanık; yanık.

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