ORİJİNAL MAKALE / ORIGINAL ARTICLE

Sağlık Bilimlerinde Değer / Sağlık Bil Değer
Value in Health Sciences / Value Health Sci
ISSN: 2792-0542 sabd@duzce.edu.tr 2023; 13(3): 337-345
doi: https://dx.doi.org/10.33631/sabd.1292429

# Characteristics of Patients Presenting to the Emergency Department with Mushroom Poisoning and the Role of Laboratory Parameters in Determining Prognosis

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**ABSTRACT**

**Aim:** In this study it is aimed to investigate the general characteristics of the patients of mushroom poisoning in the emergency department and to determine the possible prognostic factors.

**Material and Methods:** This study was conducted by retrospectively examining the records of patients who applied to the emergency department of a university hospital in Samsun, Turkey, with mushroom poisoning in 6 years. Patients were grouped using models that predict mortality and the severity of poisoning. Model for end stage liver diseases (MELD) scoring and poisoning severity score (PSS) were used for this purpose. All data obtained from this study were analyzed using the Statistical Package for Social Sciences (SPSS) for Windows 15.0 package program.

**Results:** Liver failure developed in 16 of 471 patients who applied with mushroom poisoning. The median symptom onset time was 2 hours in 455 patients who did not develop liver failure, and the median symptom onset time was 9.5 hours in 16 patients who developed liver failure. When the patients were classified according to PSS, 91.1% of patients applied with PSS 1, while 2.1% of them applied with severe symptoms. 93.6% of the patients were with a mild MELD score.

**Conclusion:** The most common clinical finding is nausea and vomiting. The appearance of symptoms within 2 hours is an indicator of a good prognosis. According to the MELD score, the severity of the disease increases as the BUN value increases. At the same time, high BUN and amylase levels mean a life-threatening poisoning according to PSS.

**Keywords:** Mushroom; poisoning; emergency department: laboratory parameters.

## Mantar Zehirlenmesiyle Acil Servise Başvuran Hastaların Karakteristik Özellikleri ve Laboratuvar Parametrelerinin Prognoz Tayininde Rolü

**ÖZ**

**Amaç:** Bu çalışmada acil servise mantar yeme sonrası gelişen zehirlenme tablosu ile başvuran hastaların genel karakteristiklerinin araştırılması ve olası prognostic faktörlerin belirlenmesi amaçlanmıştır.

**Gereç ve Yöntemler:** Bu çalışma Samsun, Türkiye'deki bir üniversite hastanesi acil servisine 6 yıl içerisinde mantar zehirlenmesi ile başvuran 18 yaş ve üzerindeki hastaların kayıtlarının geriye dönük olarak incelenmesi ile yapıldı. Çalışmada mortalite öngördürücü ve zehirlenme ciddiyetini gösteren modeller kullanılarak hastalar gruplandırıldı. Son dönem karaciğer hastalığı için model (MELD) skorlaması ve zehirlenme şiddet skoru (PSS) bu amaçla kullanıldı. Bu çalışmaya ait elde edilen tüm veriler Statistical Package for Social Sciences (SPSS) for Windows 15.0 paket programı kullanılarak analiz edildi.

**Bulgular:** Mantar zehirlenmesi ile acil servise başvuran 471 hastadan 16 tanesinde karaciğer yetmezliği geliştiği saptandı. Karaciğer yetmezliği gelişmeyen 455 hastada semptom başlangıç süresinin ortalama 2 saat olduğu, karaciğer yetmezliği gelişen 16 hastada ise semptom başlangıç süresinin ortalama 9,5 saat olduğu saptandı. Mantar zehirlenmeli hastalar PSS'sine göre sınıflandırıldığında, hastalarımızın %91,1'i PSS 1 olarak acil servise başvurmuş iken, %2,1'i ise şiddetli semptomlarla acil servise başvurmuştu. Mantar zehirlenmesiyle gelen hastaların %93,6'sı MELD skoru hafif olan hastalardı.

**Sonuç:** Mantar intoksikasyonu olgularında en sık klinik bulgu bulantı ve kusmadır. Mantar intoksikasyonu hastalarında semptomların 2 saat içerisinde ortaya çıkması iyi prognoz göstergesidir. MELD skoruna göre Bun değeri yükseldikçe hastalık ciddiyeti de artmaktadır. Aynı zamanda BUN ve amilaz değeri yüksekliği PSS'ye göre hayatı tehdit edici bir

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Geliş Tarihi / Received: 04.05.2023, Kabul Tarihi / Accepted: 18.07.2023

zehirlenme açısından hekimi uyarıcı roldedir.
**Anahtar Kelimeler:** Mantar; zehirlenme; acil servis; laboratuvar parametreleri.

## INTRODUCTION

Ingestion of some mushrooms can cause severe poisoning and death. Poisoning develops due to amateur collectors' inability to distinguish poisonous mushrooms from non-poisonous ones. A study in the United States of America (USA) observed that a severe clinical condition developed in 8.6% of patients poisoned with mushrooms (1). 133.700 cases of mushroom poisoning have been reported in the USA between 1999-2016. Poisonings usually occur as a result of accidental ingestion of poisonous species. Mushroom poisoning accounts for 0.2% of applications to the national poison data system (2).

Mushrooms may vary according to the type of toxin they contain, and it is not easy to classify mushrooms. Distinguishing whether it is poisonous by its appearance carries risks. Clinical classification will be beneficial compared to the taxonomic classification. In many cases, patient management can be planned, and prognosis can be predicted by considering the geographical region where the fungus grows, the initial symptoms the patient shows, and the organ systems involved. Mushroom poisonings can be classified as early and delayed. Early toxicity occurs within 2 hours of ingestion, while delayed toxicity ranges from 6 hours to 20 days. In early toxicity, the clinic is usually benign. The clinic is more severe in late toxicity and may result in organ failure and death (3).

Predicting the prognosis earlier in mushroom poisoning will help manage the case. Patients predicted to develop liver failure with early signs can be referred to hospitals where liver transplantation can be performed quickly. A donor search can be started for patients who are predicted to need liver transplantation. Unnecessary referrals can be avoided in poisonings that are expected to be benign with early signs. Therefore, in our study, we aimed to determine the admission characteristics of patients who applied to the emergency department (ED) with mushroom poisoning and to reveal whether complete blood count (CBC) and biochemical parameters could be helpful as prognostic factors.

## MATERIAL AND METHODS

### Study design and setting

This study retrospectively examined the records of patients aged 18 years and over who presented to the ED of a university hospital in Samsun, Turkey, between January 1, 2010, and December 31, 2015, with symptoms of poisoning after eating mushrooms. Approval was obtained from the local Ethics Committee for the study (Date: August 11, 2016, approval ID: B.30.2.ODM.0.20.08/432). The patients' data included in the study were obtained using the hospital information system. Age, gender, vital signs, date of ingestion of the mushroom, state of consciousness at the time of admission, place of residence, complaint at admission, electrocardiogram findings, time from ingestion to the onset of symptoms, comorbidities, laboratory results, the treatment methods applied, the services in which the cases were hospitalized (emergency service observation unit, intensive care unit, referral to another health center) and the last status of the patients (death, recovery, transplantation) was scanned from their files. The obtained data were recorded in the study form.

**Inclusion criteria for the study:** To admit during the specified study period, to be 18 years of age or older, have a history of eating mushrooms, and of having applied to the ED with complaints that developed after eating mushrooms.

**Exclusion criteria**: Intoxication cases other than mushrooms, patients who used drugs with mushrooms, patients who consumed alcohol with mushrooms, patients who were referred from another hospital, and patients with missing file information.

### Participant selection and measurements

In the study, patients were grouped using models that predict mortality and the severity of poisoning. The Model for End-Stage Liver Disease (MELD) score is a scoring system developed to predict mortality in patients with end-stage liver failure. MELD score is calculated using serum creatinine level, total bilirubin level, and INR values. MELD score = [3.8 × loge(bilirubin in mg/dL)] + [11.2 × loge(INR)] + [9.6 × loge(creatinine in mg/dL)] + [6.4 × (etiology: 0 if cholestatic or alcoholic, one otherwise)] (4). The MELD score was calculated for each of the cases using laboratory parameters. The patients were divided into three groups according to their MELD scores: mild (MELD score between 1-10), moderate (MELD score between 11-20), and severe (MELD score ≥21).

The poisoning severity score (PSS) is a classification based on clinical findings developed to reveal the severity of poisoning. The categorization is as follows: Asymptomatic patients PSS 0; those with mild self-limiting symptoms PSS I; those with pronounced or prolonged symptoms PSS II; those with severe or life-threatening symptoms PSS III; dead patients are classified as PSS IV. (5) PSS was calculated for each case by evaluating the symptoms and physical examination findings. PSS 0 was not used in the study, as there were no patient admissions without symptoms. In addition, PSS IV was not used because no patients applied with cardiac arrest due to mushroom poisoning. For this reason, analyzes were performed on three groups (PSS I, PSS II, and PSS III) according to the PSS scoring calculated in the study.

An increase in the INR value above the normal range and an increase in the indirect bilirubin level were accepted as indicators for the development of liver failure (6).

### Statistical Analysis

All data from this study were analyzed using the Statistical Package for Social Sciences (SPSS) for Windows 15.0 computer program. Frequency (n) and percentage (%) values were given for categorical variables. The Kolmogorov-Smirnov test did conformity of data to normal distribution. The median (min-max) was used as the descriptive statistics for the variables that did not fit the normal distribution. The Mann-Whitney U test, Kruskal-Wallis analysis of variance, and Bonferroni corrected Mann-Whitney U test was used to compare the groups. The statistical significance level was accepted as $p<0.05$ for the Mann-Whitney U test and Kruskal-Wallis analysis of variance and $p<0.016$ for the Mann-Whitney U test with Bonferroni correction.

## RESULTS

In 6 years (2010-2015), 471 mushroom poisoning patients admitted to the ED were included in the study. The median age of all cases was 46 (interquartile range, 28) years, and 59% were female.

The most frequent admission (n=116, 24.6%) was in October, while the least number of admissions (n=3, 0.6%) was in February. When we examine the complaints of patients applying to the ED, nausea (90.9%) and vomiting (82.6%) were the most common, followed by abdominal pain and diarrhea with decreasing frequency (Table 1).

**Table 1.** Complaints of patients admitted to emergency department with mushroom poisoning

| Complaints | n (%) |
|---|---|
| Nausea | 428 (90.9) |
| Vomiting | 389 (82.6) |
| Abdominal Pain | 113 (23.9) |
| Diarrhea | 93 (19.7) |
| Vertigo | 85 (18.0) |
| Headache | 26 (5.5) |
| Palpitation | 14 (2.9) |
| Loss of Balance | 9 (1.9) |
| Seizure | 3 (0.6) |
| Urinary incontinence | 1 (0.2) |
| Gaita incontinence | 1 (0.2) |

When we evaluate the state of consciousness of the patients at the time of admission, the Glasgow Coma Score (GCS) of 466 patients (98.9%) was 15 points, the GCS of 2 patients (0.4%) was 13 points, the GCS of 2 patients (0.4%) was 10 points, and GCS of 1 patient (0.2%) was 9 points.

We encountered liver failure in 16 (3.4%) of 471 patients admitted to the ED with mushroom poisoning, and hepatic encephalopathy developed in 2 (12.5%) of these 16 patients. Patients who developed liver failure were referred to another hospital for liver transplantation. Five (1.1%) of the mushroom poisoning cases died.

When we examined the patients in terms of the time from the ingestion of the mushroom to the appearance of symptoms, It was found that the symptom onset time [median (min-max)] in 455 patients who did not develop liver failure was 2 (0-48) hours, and in 16 patients who developed liver failure was 9.5 (2-24) hours. It was seen that the length of symptom onset time is a significant indicator of poor prognosis ($p<0.001$).

When treatments were examined used in this study, it was noticed that activated charcoal was administered at a rate of 67.7%, gastric lavage was performed at a rate of 42.7%, N-Acetyl Cysteine was administered at a rate of 22.1%, Penicillin G was administered at a rate of 11.9%, and Silibilin therapy was administered at a rate of 5.9%. In addition, It was detected that hemodialysis was applied as a treatment method in 5 patients (1.1%).

When the patients with mushroom poisoning were classified according to PSS, 91.1% of our patients applied to the ED with PSS I, while 2.1% visited the ED with PSS 3. In four of our patients included in the study, the MELD score could not be calculated because the necessary laboratory parameters needed to be checked. 93.6% of the patients presenting with mushroom poisoning had a mild MELD score (Table 2).

**Table 2.** Grouping of mushroom poisoning patients according to PSS and MELD scores

| Poisoning Severity Score (PSS) | n (%) |
|---|---|
| 0 (No Symptom at Application) | 0 (0) |
| 1 (Mild clinical symptoms) | 429 (91.1) |
| 2 (Medium clinical symptoms) | 32 (6.8) |
| 3 (Severe clinical symptoms) | 10 (2.1) |
| 4 (Dead patients at application) | 0 (0.0) |
| Model for End Stage Liver Disease (MELD) Score | |
| 1-10 points | 437 (93.6) |
| 11-20 points | 22 (4.7) |
| 21 and above points | 8 (1.7) |

When the blood test results of patients with and without liver failure were compared, hemoglobin, total bilirubin, direct bilirubin, AST, ALT, PT, aPTT, INR, BUN, and creatinine median values were significantly higher in patients with hepatic failure (all p values $<0.05$) (Table 3). After the patients were divided into three groups according to their MELD scores, when these groups were compared with each other in terms of laboratory parameters, it was observed that there was a statistically significant difference in lymphocyte count, total bilirubin, direct bilirubin, AST, ALT, PT, aPTT, INR, BUN, creatine (all p values $<0.016$). According to this, Total bilirubin, direct bilirubin, creatin, INR, and PT median values were significantly lower in the group with a low MELD score, while the lymphocyte count was higher. aPTT median value was significantly higher in the group with a high MELD score than in the other groups. As the BUN value increased, there was a significant difference between all groups (Table 4).

It was determined a statistically significant difference between PSS groups in laboratory parameters such as lymphocyte count, total bilirubin, direct bilirubin, AST, ALT, PT, INR, BUN, creatine, and amylase ($p<0.016$). The difference that created this significance was due to the following: Total bilirubin, direct bilirubin, AST, and ALT median values were significantly lower in the PSS I group than in the other groups. BUN and amylase median values were considerably higher in PSS III than in the other groups (Table 5).

**Table 3.** Comparison of hemogram and biochemistry parameters in mushroom poisoning patients with and without liver failure [Median (min-max)]

| Parameters | Liver Failure | | p Value |
|---|---|---|---|
| | No | Yes | |
| **White Blood Cell Counts (thousand/uL)** | 9.160 (1930.0-25980.0) | 11.060 (6270.0-15520.0) | 0.213 |
| **Hemoglobin (g/dL)** | 13.3 (7.3-18.6) | 13.8 (10.0-20.2) | **0.035** |
| **Plathelets (thousand/uL)** | 225500 (55000.0-546000.0) | 254000 (28000.0-390000.0) | 0.294 |
| **Lymphocyte Counts (thousand/uL)** | 1340 (120.0-21200.0) | 970 (340.0-3080.0) | 0.060 |
| **Notrophyl Counts (thousand/uL)** | 6800 (13.0-24000.0) | 8860 (4040.0-14430.0) | 0.109 |
| **Monocyte Counts (thousand/uL)** | 380 (0.0-2300.0) | 410 (200.0-940.0) | 0.650 |
| **Mean Platelet Volume (MPV) (fL)** | 7.4 (5.4-16.3) | 7.4 (5.8-10.4) | 0.810 |
| **Red Blood Cell Distribution Width (RDW) (%)** | 13.9 (11.8-23.2) | 14.4 (13.2-16.3) | 0.210 |
| **Total Bilirubin (mg/dL)** | 0.5 (0.1-6.9) | 1.2 (0.2-11.8) | **0.001** |
| **Direct Bilirubin (mg/dL)** | 0.1 (0.0-4.6) | 0.4 (0.1-6.9) | **0.001** |
| **Aspartat Amino Transferaz (AST) (U/L)** | 20.4 (11.0-5214.0) | 415.2 (22.0-1814.0) | **0.001** |
| **Alanin Amino Transferaz (ALT) (U/L)** | 17.4 (5.0-5277.0) | 290.6 (10.0-2279.0) | **0.001** |
| **Protrombin Time (PT) (Second)** | 11.7 (9.4-19.9) | 13.1 (10.1-72.2) | **0.001** |
| **Activated Partial Thromboplastin Time aPTT (Second)** | 23.7 (12.2-190.0) | 25.3 (19.2-190.0) | **0.038** |
| **INR** | 1.0 (0.8-1.7) | 1.2 (0.9-6.8) | **0.001** |
| **BUN (mg/dL)** | 13.8 (5.0-57.0) | 21,3 (7.0-49.0) | **0.001** |
| **Creatinin (mg/dL)** | 0.7 (0.3-12.4) | 1.1 (0.5-2.9) | **0.001** |
| **Amilaz (U/L)** | 29.3 (1.0-2410.0) | 64.2 (14.0-113.0) | 0.096 |

Parameters in the table are shown as median (min-max). Bold characters represent statistically significant values ($p<0.05$).

**Table 4.** Comparison of mushroom intoxicated patients according to MELD scores in terms of laboratory parameters

| Parameters | MELD Score 1-10 | MELD Score 11-20 | MELD Score ≥21 | p value |
|---|---|---|---|---|
| **White Blood Cell Counts (thousand/uL)** | 9160 (1930.0-25980.0) | 9520 (4830.0-22240) | 9360 (5200-15520) | 0.811 |
| **Hemoglobin (g/dL)** | 13.3 (7.3-18.9) | 13.8 (9.9-18.6) | 13.3 (10.0-20.2) | 0.369 |
| **Plathelets (thousand/uL)** | 226000 (55000-546000) | 220000 (138000-321000) | 243500 (28000-390000) | 0.501 |
| **Lymphocyte Counts (thousand/uL)** | 1370 (120 -21200)a | 870 (350.0-1870.0)b | 850 (340.0-3080.0)ab | **0.001** |
| **Notrophyl Counts (thousand/uL)** | 6755 (12.9-24000.0) | 8560 (3360.0-19840.0) | 8330 (4040 - 14430) | 0.278 |
| **Monocyte Counts (thousand/uL)** | 380 (0.0-2300.0) | 390 (100.0-1200.0) | 485 (200.0-940.0) | 0.753 |
| **Mean Platelet Volume (MPV) (fL)** | 7.4 (5.4-16.3) | 6.9 (5.9-8.8) | 8.2 (6.1-10.4) | 0.285 |
| **Red Blood Cell Distribution Width** | 13.9 (11.8-23.2) | 14.3 (12.7-16.4) | 14.2 (12.6-16.3) | 0.218 |
| **Total Bilirubin (mg/dL)** | 0.5 (0.1-2.4)a | 0.8 (0.1-6.9)b | 1.6 (0.4-11.8)b | **0.001** |
| **Direct Bilirubin (mg/dL)** | 0.1 (0-1.2)a | 0.3 (0.0-4.6)b | 0.5 (0.0-6.9)b | **0.001** |
| **Aspartatamino Transferaz (AST) (U/L)** | 20.4 (12.0-4355.7)a | 37.2 (10.5-5214.0)b | 525.1 (15-2478.0)b | **0.001** |
| **Alaninamino Transferaz (ALT) (U/L)** | 17.4 (5.0 – 4088.2)a | 22.9 (6.7 – 5277.0)b | 288.4 (12.3 –2278.6)b | **0.001** |
| **Protrombin Time (PT) (Second)** | 11,7 (9.4-15.9)a | 12.5 (9.8-17.9)b | 20.3 (11.8-72.2)b | **0.001** |
| **Activated Partial Thromboplastin Time aPTT (Second)** | 23.6 (12.2-190.0)a | 24.1 (20.2-31.4)a | 37.3 (25.1-190.0)b | **0.001** |
| **INR** | 1.0 (0.8-1.4)a | 1.1 (0.8-1.5)b | 1.8 (1.1-6.8)b | **0.001** |
| **BUN (mg/dL)** | 13,7 (4.6-42.2)a | 19.6 (5.8-43.5)b | 43.1 (21.3-57.0)c | **0.001** |
| **Creatinin (mg/dL)** | 0.7 (0.3-12.4)a | 1.3 (0.3-2.1)b | 2.3 (0.8-6.6)b | **0.001** |
| **Amilaz (U/L)** | 29 (0.9-2409.6)a | 31,88 (14.0-217.0)ab | 691 (42.0-86.5)a | 0.036 |

Parameters in the table are shown as median (min-max). It is used to show similarities between the letters a, b, c. The groups with the same letters are statistically similar. Bold characters represent statistically significant values (p <0.016)**.** MELD: Model for End Stage Liver Disease

**Tablo 5.** Comparisons of patients according to PSS scores in terms of laboratory parameters

| Parameters | PSS I | PSS II | PSS III | p Value |
|---|---|---|---|---|
| **White Blood Cell Counts (thousand/uL)** | 9145.0 (1930-25980) | 9445.0 (3650-15420) | 11080.0 (7190-15520) | 0.427 |
| **Hemoglobin (g/dL)** | 13.3 (7.3-18.6) | 13.8 (8.5-18.9) | 13.8 (10-20.2) | 0.167 |
| **Plathelets (thousand/uL)** | 225000.0 (55000-546000) | 240000.0 (84000-347000) | 247500.0 (28000.0-390000.0) | 0.556 |
| **Lymphocyte Counts (thousand/uL)** | 1400.0 (120.0-21200.0)a | 855.0 (340.0-3640.0)b | 1115.0 (400.0-3080.0)ab | **0.001** |
| **Notrophyl Counts (thousand/uL)** | 6770.0 (130.0-24000.0) | 7510.0 (13.0-13590.0) | 9325.0 (4040-14430) | 0.328 |
| **Monocyte Counts (thousand/uL)** | 380.0 (0.0-2300.0) | 390.0 (150.0-1200.0) | 395.0 (90.0-940.0) | 0.832 |
| **Mean Platelet Volume (fL)** | 7.4 (5.4-16.3) | 7.8 (5.9-9.8) | 6.7 (5.8-10.4) | 0.239 |
| **Red Blood Cell Distribution Width** | 13.9 (11.9-23.2) | 13.9 (11.8-18.1) | 14.5 (13.2-16.3) | 0.424 |
| **Total Bilirubin (mg/dL)** | 0.4 (0.1-2.4)a | 0.8 (0.2–6.9)b | 0.9 (0.2-11.8)b | **0.001** |
| **Direct Bilirubin (mg/dL)** | 0.1 (0.0-0.6)a | 0.2 (0.0-4.6)b | 0.3 (0.1-6.9)b | **0.001** |
| **Aspartatamino Transferaz (AST) (U/L)** | 20.0 (11.0-133.0)a | 239.9 (15.0-5214.0)b | 448.3 (22.0-4356.0)b | **0.001** |
| **Alaninamino Transferaz (ALT) (U/L)** | 17.0 (5.0-188)a | 195.0 (7.0-5277)b | 290.6 (10.0-4088.0)b | **0.001** |
| **Protrombin Time (PT) (Second)** | 11.7 (9.4-16.5)a | 12 (10.3-28.1)ab | 14.4 (10.1-72.2)b | **0.001** |
| **Activated Partial Thromboplastin Time aPTT (Second)** | 23.7 (12.2–190.0) | 24.4 (19.1-47.3) | 24.3 (19.2-190.0) | 0.124 |
| **INR** | 1.0 (0.8–1.5)a | 1.1 (0.9-2.8)ab | 1.3 (0.9-6.8)b | **0.001** |
| **BUN (mg/dL)** | 13.7 (5.0-44.0)a | 16.7 (5.0-57.0)a | 21.3 (16.0-49.0)b | **0.001** |
| **Creatinin (mg/dL)** | 0.7 (0.3-12.4)a | 0.8 (0.4-6..6)ab | 1.3 (0.6-2.9)b | **0.001** |
| **Amilaz (U/L)** | 29.2 (1.0-2410.0)a | 28.7 (14.0-920.0)a | 78.3 (27.0-113.0)b | **0.008** |

Parameters in the table are shown as median (min-max). It is used to show similarities between the letters a, b, c. The groups with the same letters are statistically similar. Bold characters represent statistically significant values.($p<0.016$). PSS: Poisoning severity score

Considering the processes of 471 mushroom poisoning patients who were admitted to the ED, 195 (41.4%) of them were discharged after a few hours of observation in the ED, 263 (55.8%) patients were hospitalized in the ED, followed and treated for a little longer, 4 (0.9%) patients were admitted to the intensive care unit (ICU). Seven patients (1.5%) were referred to another health institution for liver transplantation. Two (0.4%) patients died while being treated in the ED. Three patients who were transferred to another hospital for liver transplantation died before transplantation could be performed, while four patients were discharged after successful liver transplantation.

## DISCUSSION

Mushroom poisoning is a public health problem that we still cannot prevent worldwide; many people die yearly due to mushroom poisoning. The most effective protection method is not eating mushrooms other than cultivated ones. Our study showed that mushroom poisonings presented symptoms such as nausea and vomiting at a very high rate. We observed that more than 95% of patients recovered with mild-moderate signs. The appearance of symptoms within 2 hours after eating mushrooms indicates a good prognosis. It was found that that laboratory parameters that are abnormal or tend to go outside the reference values could be guided in terms of prognosis.

Yardan et al. conducted 317 cases of mushroom intoxication and reported that 67.5% of the cases were women (7). In a study conducted by Hocaoğlu et al., 799 mushroom poisoning cases were examined, and it was reported that 57.9% were women (8). In the analysis of Erdur et al. on 154 mushroom poisoning cases, the ratio of females to males was equal (9). In a study conducted in Ireland by Cassidy et al. in 70 cases of mushroom intoxication, it was shown that 71.4% of the patients were male (10). In another study conducted in Iran by Badsar et al. in 102 cases of mushroom poisoning, it was reported that 53.9% of the patients were female (11). Although the frequency of cases exposed to mushroom poisoning in the literature varies according to the countries regarding gender, the female gender is a little more prominent. In our study, the female gender predominated with a rate of 59% in mushroom poisoning.

It is known that the causes of poisoning in poisoning cases admitted to the ED vary according to the season. For example, food poisoning is more common in summer, carbon monoxide in winter, and insecticide in summer and autumn (12). In different studies conducted in our country and abroad, it has been reported that mushroom poisoning is most common in autumn (October and November) (8,9). Our study determined that poisonings with mushrooms were most common in autumn and October. Because the Black Sea region of Turkey consists of forest areas and hazelnut orchards, we think mushroom poisoning is more common in autumn. After heavy rainfall, mushrooms overgrow in hazelnut orchards and forest areas because people consume these mushrooms as food. This situation is compatible with the general literature.

A study evaluating of 307 mushroom poisoning patients in Turkey reported that the most common complaints at admission to the ED were nausea, vomiting, and abdominal pain, respectively (13). Yardan et al., on the other hand, reported that the most common complaints at presentation to the ED were nausea, vomiting, and diarrhea, respectively (7). In Iran, Badsar et al. reported that the most common complaints in mushroom poisoning cases who applied to the emergency service were nausea, with a rate of 83.5%, vomiting, with 86.4%, and diarrhea, with a rate of 16.1% (11). When we examined the patients' complaints during admission in our study, we observed that the most common symptom was nausea (90.7%), followed by vomiting (82.4%). The results of our study were similar to other studies in the literature. The most common toxin in all fungal species is those that irritate the gastrointestinal tract. Even non-toxic mushrooms have an irritating effect on the gastrointestinal tract in most people. Nausea, vomiting, and diarrhea are the most common complaints in cases of mushroom poisoning due to their irritant effects on the gastrointestinal tract (14).

Many studies in the literature report that the long symptom onset time in cases of mushroom poisoning is associated with poor prognosis (15). Badsar et al. reported that in 87% of the cases, symptoms were seen within the first 6 hours after the mushroom was eaten (11). Similar results were also found in different studies conducted in our country (7,9). Various studies have reported that the average time of admission to the ED in cases with mushroom intoxication may extend up to 13 hours. In a study in the USA, in which 18 patients developed an acute liver injury or acute liver failure after eating mushrooms and were subsequently hospitalized and treated in the ICU, it was reported that the symptom onset time could extend up to an average of 4 days (8,16,17). In our study, we examined patients from mushroom ingestion to the appearance of symptoms. While the median symptom onset time was 2 hours in 455 patients who did not develop hepatic failure, it was 9.5 hours in those who developed liver failure. The early symptoms that appear after eating mushrooms indicate mild poisoning. It was concluded that the late onset of symptoms is associated with poor prognosis.

When the literature was searched regarding the level of consciousness at admission in patients with mushroom poisoning, it could not find any study on this subject. In our research, the GCS was 15 points in 99% of our cases at the time of admission. In our study, more than 90% of the patients presented with mild symptoms, and only 2% were in the severe symptom group. If it was to make an inference here, it was seen that only a tiny part of mushroom poisoning can lead to severe and life-threatening clinical outcomes.

After a detailed anamnesis and physical examination, several laboratory parameters are examined to determine the severity of the clinical picture, organ dysfunction, and prognosis in patients who apply to the ED due to mushroom intoxication. Erdur et al. examined AST, ALT, Bilirubin, INR, electrolytes, and complete blood count parameters in 154 patients with mushroom intoxication and found that 73.4% of the patients did not have laboratory abnormalities, and 13.6% had elevated liver function tests (9). Badsar et al. looked at the laboratory parameters of the blood taken from patients with mushroom intoxication at the time of admission to the hospital. They observed that leukocytosis was found in 28.4% of the patients and reported that the platelet value was below 100,000 in all patients. Again, this study stated

that 5.9% of the patients had elevated plasma AST levels, and 9.8% had elevated plasma ALT values (11). Our investigation revealed that plasma levels of total and direct bilirubin, AST, ALT, INR, BUN, and creatine were elevated in patients with hepatic failure. In addition to evaluating the patient's clinic, it should not be ignored that elevation in liver and kidney function tests plays a warning role in poor prognosis.

The MELD score is used as an indicator to determine the need for transplantation in patients who follow up with hepatic failure. The higher the MELD score, the higher the mortality probability of the patients (4). The MELD score successfully predicts mortality in liver diseases of many different etiologies (18). In our study, patients with a MELD score of 1-10 (n=437, 93.6%) Group I, patients with a MELD score of 11-20 (n=22, 4.7%) Group II, and patients with a MELD score of 21 and above (n =8, 1.7% were grouped as Group III. In our study, patients with low MELD scores had lower AST, ALT, total bilirubin, direct bilirubin, and creatinine values than the other groups, while they had significantly higher lymphocyte values. In addition, the apTT duration was significantly longer in the severe group. Level of this value had a significant difference between all groups.

In PSS, patients are divided into groups according to the severity of their clinical findings. (5) In our study, total bilirubin, direct bilirubin, ALT, and AST were significantly lower in the PSS I group, while lymphocytes were higher. BUN and amylase were significantly higher in the PSS III group than in the other groups. Therefore, amylase and bun values should be monitored in patients presenting with anamnesis of mushroom poisoning. If these values are high, it should be suspected that the patient may progress to a life-threatening poisoning (PSS III group). Even with average values of bun and amylase elevation, values close to the upper limit may indicate poor prognosis in patients with mushroom poisoning.

The diagnosis of mushroom poisoning is mainly made in light of the patient's anamnesis and clinical findings, and the treatment is used in light of these data (19). However, today's diagnosis and treatment protocols still need to be clarified. In their study, Erdur et al. reported that gastric lavage was used 66.9%, activated charcoal 68.8%, Metoclopramide 85.7%, and H2 receptor blockers were used 75.3% of patients in the treatment with mushroom poisoning (9). Badsar et al. reported that the most common treatments for mushroom poisoning patients were activated charcoal, gastric lavage (52%), and anti-biotherapy (84.3%) (11). In a study conducted by Enjalbert et al. in North America and Europe, 2108 patients with signs of poisoning due to Amanita Phalloides were evaluated. The cases were investigated in terms of appropriate treatment methods and drug applications. It has been reported that its effect is minimal when penicillin G is used as monotherapy or in combination with other treatments. Thioctic acid or steroids do not affect the treatment, and detailed studies are needed to understand the effectiveness of Silibilin and N-Acetyl Cysteine treatments (20). When the treatments were examined used in this study, It was seen that activated charcoal was administered at a rate of 67.7%, gastric lavage was performed at a rate of 42.7%, N-Acetyl Cysteine was applied at a rate of 22.1%, Penicillin G at a rate of 11.9%, and Silibilin therapy at a rate of 5.9%. In addition, It was found that hemodialysis was applied as a treatment method in 5 patients (1.1%). While the treatments used in mushroom poisonings showed slight differences according to the centers, It was seen that the data in our study were similar to the literature.

Ünlüoğlu et al. reported that the mortality rate was 2.8% in their study of 143 mushroom poisoning patients (21). Eren et al. evaluated 294 mushroom poisoning cases in their study and reported that the mortality rate was 1% (22). Hocaoğlu et al. reported in their research that the mortality rate in patients with mushroom poisoning was 1.2% (8). Karvellas et al. said that liver failure developed after eating mushrooms, and the mortality rate was 34% in patients treated in the ICU (16). When we look at our mortality rate among 16 patients who developed liver failure, It was found that our mortality rate was 31.3%. For this reason, increasing the effectiveness of preventive health services should be targeted in the first place. In hospitals, the worsening of the patient's clinical condition and the high level of laboratory parameters or their tendency to increase should play a role in warning the physician regarding severe poisoning.

Our study had some limitations. The first is that it is retrospective, and the second is that it is single-centered. Third, statistical threshold determination analysis was not performed on the laboratory parameters studied. Finally, the results cannot be generalized since only mushroom poisonings in a particular region were studied.

## CONCLUSION

The most common clinical finding in cases of mushroom intoxication is nausea and vomiting. The appearance of symptoms within 2 hours is an indicator of a good prognosis in patients with mushroom intoxication. According to the MELD score, the severity of the disease increases as the BUN value rises. At the same time, high BUN and amylase levels act as a warning to the physician in terms of a life-threatening poisoning, according to PSS.

**Authors's Contributions:** Idea/Concept: E.Ş., A.B.; Design: E.Ş., A.B.; Data Collection and/or Processing: E.Ş., A.B.; Analysis and/or Interpretation: E.Ş., A.B., M.C.D.; Literature Review: E.Ş., A.B., M.C.D.; Writing the Article: E.Ş., A.B., M.C.D.; Critical Review: E.Ş., A.B., M.C.D.

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