E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.01.568

Research Article

Public Health Based Study on Association of Drug Exposure and Self-Medication Practices with Changes in Liver Cirrhosis: A Cross-Sectional Study

Aqsa Jamali[1], Alishba siddiqui[2], Waqas Manzoor[3], Muhammad ilyas[4], Nousheen Gul[5], Abdullah Memon[6], Zaroob Najam[7], Noor nabi mahesar[8],Misha Fatima[9], Sonia Khan[10*]

[1]District Manager in SIEHs 1122, Shahed Benzaira Abad.
[2,6,7]MBBS final year, Al Tibri medical college and Hospital.
[3]Assistant Professor, Dept of Gastroenterology, Al-Tibri Medical College and Hospital.
[4,8]Fourth Year Mbbs, Al Tibri Medical college and Hospital.
[5]House officer, Al tibri medical college and hospital.
[9]Second year student, Karachi.
[10*]Associate professor, Islam medical & Dental college.

Corresponding Author: Sonia Khan
Email: drsonia.azeeem@gmail.com
Received: 14.03.26, Revised: 09.04.26, Accepted: 12.05.26

Background: Liver cirrhosis is a chronic, progressive liver condition marked by fibrosis and irreversible structural damage that can lead to significant morbidity and mortality. The use of non-prescribed medications, over-the-counter drugs, and herbal products can contribute to drug-induced liver injury and may worsen hepatic damage. This study aimed to examine the relationship between medication use, self-medication practices, and morphological changes in patients with liver cirrhosis.

Methodology: A cross-sectional clinical study was conducted among 250 patients with confirmed liver cirrhosis attending a tertiary care hospital. Data regarding demographic characteristics, medication history, self-medication practices, and clinical findings were collected using a structured questionnaire. Radiological assessment was performed using abdominal ultrasonography to evaluate liver morphology, portal hypertension, splenomegaly, ascites, and regenerative nodules. Statistical analysis was conducted using SPSS version 22.0, with p-values <0.05 considered statistically significant.

Results: Among the participants, 68.4% reported self-medication practices. The most commonly used medications were NSAIDs, analgesics, antibiotics, and herbal remedies. Radiological findings revealed surface nodularity (82.8%), splenomegaly (65.2%), portal hypertension (62.0%), ascites (58.4%).

Conclusion: Self-medication and prolonged exposure to potentially hepatotoxic drugs are significantly associated with adverse morphological changes in liver cirrhosis. The findings emphasize the importance of rational drug use, patient education, and regular medical supervision to prevent disease progression and improve clinical outcomes in cirrhotic patients.

Keywords: L Iver Cirrhosis, Self-Medication, Drug Exposure, Hepatotoxicity, Morphological Changes, Liver Fibrosis, Portal Hypertension.

INTRODUCTION

Liver cirrhosis is a chronic, progressive, and irreversible disease characterized by diffuse hepatic fibrosis, regenerative nodule formation, and distortion of normal liver architecture. It represents the final common pathway of various chronic liver diseases and remains a major cause of morbidity and mortality worldwide [1-3]. According to the World Health Organization, liver diseases account for more than two million deaths annually, with cirrhosis contributing significantly to global healthcare burdens [4]. The disease develops gradually following persistent hepatic injury caused by chronic viral hepatitis, excessive alcohol consumption, non-alcoholic fatty liver disease (NAFLD), autoimmune hepatitis, metabolic disorders and exposure to hepatotoxic agents [5,6].

The progression of cirrhosis results in profound structural and functional changes within the liver. Morphological alterations such as surface nodularity, hepatic atrophy, regenerative nodules, portal hypertension, splenomegaly and ascites are common manifestations that can be detected through radiological imaging [7-9]. Ultrasonography, computed tomography (CT), and magnetic

resonance imaging (MRI) are valuable diagnostic tools for assessing disease severity, monitoring progression, and identifying complications [10]. These radiological findings provide objective evidence of hepatic damage and are closely associated with clinical outcomes.

Drug-induced liver injury (DILI) has emerged as an increasingly important contributor to chronic liver disease progression. The liver serves as the primary organ responsible for drug metabolism and detoxification, making it particularly susceptible to toxic injury. Numerous prescription medications, over-the-counter drugs, herbal remedies, and dietary supplements have been implicated in hepatic toxicity [11,12]. Repeated exposure to potentially hepatotoxic substances may accelerate fibrosis progression and worsen underlying liver disease.

Self-medication has become increasingly common worldwide due to easy availability of medications, financial constraints, limited healthcare access and widespread misinformation through social media and informal networks [13]. Although self-medication may provide temporary relief of symptoms, inappropriate use of medications can lead to serious health consequences including adverse drug reactions, antimicrobial resistance, organ toxicity, and delayed diagnosis of underlying diseases.

Patients with liver cirrhosis are particularly vulnerable to the harmful effects of self-medication. Impaired hepatic function alters drug metabolism, reduces clearance, and increases susceptibility to toxic metabolites. Even medications considered safe in healthy individuals may precipitate hepatic decompensation among cirrhotic patients [14-16]. Commonly self-administered drugs such as non-steroidal anti-inflammatory drugs (NSAIDs), analgesics, antibiotics and herbal products have been associated with hepatotoxicity, gastrointestinal bleeding, renal dysfunction, and worsening portal hypertension.

Several studies have highlighted the increasing prevalence of self-medication among patients with chronic diseases. Research conducted in developing countries reported self-medication rates ranging from 40% to 80%, with analgesics, antibiotics, and herbal remedies being the most frequently used substances. Previous investigations have also demonstrated associations between inappropriate medication use and deterioration of liver function, increased hospitalization rates, and poorer clinical outcomes among patients with chronic liver disease. [17] However, limited studies have specifically examined the relationship between self-medication practices and radiologically detectable morphological changes in cirrhotic patients. Understanding patterns of drug exposure and their influence on liver morphology is essential for developing preventive strategies and improving disease management. Identification of modifiable behavioral factors such as self-medication may provide opportunities for early intervention and patient education.

Therefore, the present study aimed to assess drug exposure and self-medication practices among patients with liver cirrhosis and evaluate their association with clinical severity and morphological liver changes identified through radiological imaging.

METHODOLOGY

A cross-sectional clinical study was conducted over a period of one year following approval from the ethical review committee of Jinnah Postgraduate Medical Centre among patients diagnosed with liver cirrhosis attending the Department of Gastroenterology and Hepatology. The study population comprised adult patients aged 18 years and above with cirrhosis confirmed by clinical, laboratory and radiological findings.

Data was collected through structured interviews and clinical evaluation after obtaining informed consent. Demographic information recorded included age, gender, educational status, occupation, socioeconomic status, and residence. Drug exposure over the preceding 12 months was assessed in detail, covering prescription medications, over-the-counter drugs, herbal and traditional remedies, analgesics, antibiotics and NSAIDs along with the duration and frequency of use. Self-medication practices were also explored by asking participants about the frequency of self-medication, sources of drug information, reasons for self-medicating, awareness of drug side effects and any prior consultation with healthcare professionals.

Clinical assessment included the duration and etiology of liver disease, Child-Pugh classification and the presence of complications such as ascites, portal hypertension, hepatic encephalopathy and variceal bleeding. Radiological assessment involved review of abdominal ultrasonography

and available CT findings, with morphological liver changes evaluated for liver size, surface nodularity, hepatic atrophy, regenerative nodules, splenomegaly, ascites, portal vein diameter and evidence of portal hypertension.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) from JPMC. Written informed consent was obtained from all participants prior to enrollment. Confidentiality and anonymity of participant information were strictly maintained throughout the study.

Statistical Analysis

Data was entered and analyzed using SPSS version 22.0**.** Descriptive statistics were used to summarize demographic characteristics, clinical findings, self-medication practices, and drug exposure patterns. Continuous variables were presented as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

Chi-square tests were used to determine associations between self-medication practices and categorical morphological changes observed in cirrhotic patients. Multivariate logistic regression analysis was performed to identify independent predictors of advanced morphological liver changes after adjusting for potential confounders including age, gender, duration of liver disease, alcohol consumption, and comorbid conditions. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 250 patients with clinically and radiologically confirmed liver cirrhosis were included in the study. The mean age of participants was 52.6 ± 11.4 years, with the majority being males (61.2%) and belonging to lower socioeconomic backgrounds (57.6%). Most participants had limited formal education, and a substantial proportion resided in urban and peri-urban areas

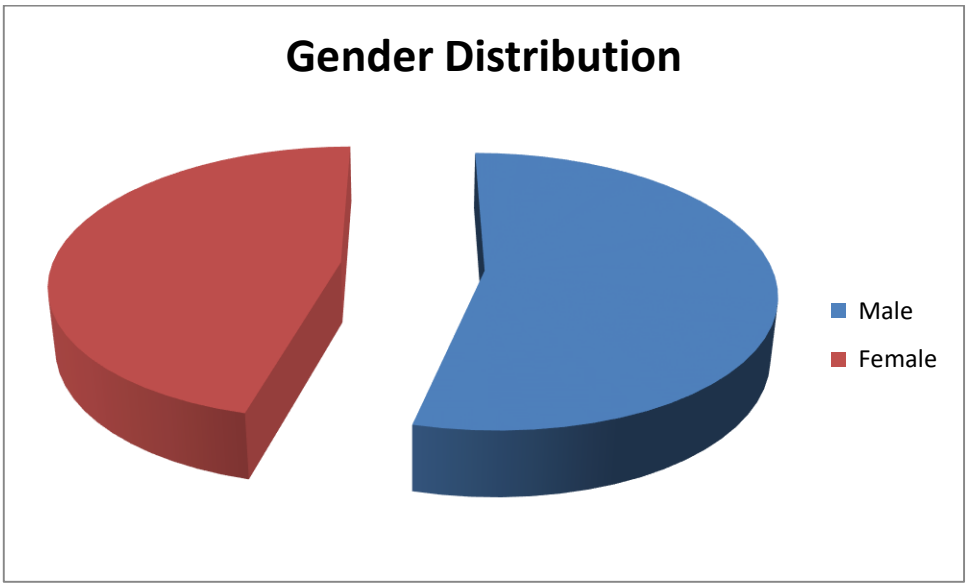

Figure 1 Showed the Gender Distribution of Participants

Where access to over-the-counter medications and traditional remedies was readily available. The duration of self-medication was positively associated with disease severity. Patients reporting medication use for more than six months demonstrated significantly greater rates of liver-related complications compared with those using medications occasionally or under physician supervision.

Table 1. Demographic Characteristics of Study Participants (n=250)

Variable	Frequency (%)
Age <40 years	38 (15.2)
40–59 years	142 (56.8)
≥60 years	70 (28.0)
Low Socioeconomic Status	144 (57.6)

Middle Socioeconomic Status	78 (31.2)
High Socioeconomic Status	28 (11.2)

The study included 250 patients with liver cirrhosis. Most participants belonged to the 40–59-year age group (56.8%), while males constituted nearly two-thirds of the study population (61.2%). A majority resided in urban settings and belonged to lower socioeconomic groups, indicating increased vulnerability to unsupervised medication use and limited healthcare access.

Table 2. Patterns of Drug Exposure among Cirrhotic Patients

Drug Category	**Frequency (%)**
NSAIDs	122 (48.8)
Analgesics	110 (44.0)
Antibiotics	89 (35.6)
Herbal Medicines	73 (29.2)
Vitamin Supplements	66 (26.4)
Traditional Remedies	54 (21.6)
Antacids	49 (19.6)
Steroids	18 (7.2)

NSAIDs represented the most commonly used medication category (48.8%), followed by analgesics (44.0%) and antibiotics (35.6%). Nearly one-third of participants reported using herbal medicines, highlighting the widespread use of alternative therapies among cirrhotic patients despite limited evidence regarding their safety. Self-medication was highly prevalent, reported by 68.4% of participants. Most patients lacked awareness regarding potential medication-related liver injury. Informal sources of information, including family members and social media, were frequently utilized, whereas professional medical consultation was comparatively limited.

Chronic viral hepatitis was identified as the leading cause of cirrhosis (46.8%), followed by NAFLD and alcohol-related liver disease. Splenomegaly and ascites were the most common clinical manifestations, reflecting advanced portal hypertension and hepatic dysfunction.

Patients practicing self-medication demonstrated significantly higher rates of advanced morphological abnormalities. Hepatic atrophy, portal hypertension, regenerative nodules, and splenomegaly were substantially more common among self-medicating individuals, suggesting a possible role of inappropriate drug exposure in disease progression. Abdominal ultrasonography and radiological assessment demonstrated substantial structural liver abnormalities among cirrhotic patients.

Table 3 Showed the Common Morphological Findings of Participants

Morphological Finding	Frequency (%)
Surface nodularity	82.8
Splenomegaly	65.2
Portal hypertension	62.0
Ascites	58.4
Hepatic atrophy	41.6
Regenerative nodules	37.2
Enlarged portal vein diameter	54.8

Patients with frequent self-medication practices exhibited a significantly higher prevalence of advanced morphological abnormalities compared with patients who did not self-medicate.

Hepatic atrophy was observed in 52.6% of self-medicating patients compared to 26.6% among non-self-medicating individuals ($p = 0.002$). Similarly, portal hypertension was significantly more prevalent among self-medication users (70.2% vs. 45.5%; $p = 0.001$).

Table 4. Child-Pugh Classification of Study Participants

Child-Pugh Class	Frequency (%)
Class A	78 (31.2)
Class B	109 (43.6)
Class C	63 (25.2)

Long-term NSAID exposure demonstrated a statistically significant association with hepatic atrophy, portal hypertension, and worsening Child-Pugh scores. Similarly, repeated antibiotic use without prescription was associated with increased rates of ascites and hepatic decompensation. Multivariate logistic regression analysis identified several independent predictors of advanced morphological changes.

Table 5. Multivariate Logistic Regression Analysis for Advanced Morphological Changes

Predictor	Odds Ratio (OR)	95% CI	p-value
Frequent self-medication	2.41	1.42–4.08	0.001
NSAID use	2.18	1.31–3.64	0.003
Herbal medicine use	1.96	1.11–3.45	0.019
Duration of cirrhosis >5 years	2.85	1.64–4.92	<0.001
Child-Pugh Class C	3.24	1.82–5.76	<0.001

After adjustment for age, gender, socioeconomic status, and underlying liver disease etiology, self-medication remained a significant independent predictor of adverse liver morphology.

These findings suggested that inappropriate medication exposure contributes significantly to progression of structural liver damage among cirrhotic patients.

DISCUSSION

The present study investigated the association between drug exposure, self-medication practices, and morphological changes in patients with liver cirrhosis. The findings demonstrated a high prevalence of self-medication among cirrhotic patients and revealed significant associations between unsupervised medication use and advanced structural liver abnormalities [18].

The prevalence of self-medication in the current study (**68.4%**) is consistent with previous studies conducted in developing countries where over-the-counter drug accessibility remains largely unrestricted. Many studies reported that self-medication prevalence ranging from 45–75% among patients with chronic illnesses[19,20]. Similar findings have been reported in Asian and Middle Eastern populations where healthcare access barriers and economic limitations encourage self-directed medication use.

The widespread use of NSAIDs observed in the present study is particularly concerning. NSAIDs are recognized contributors to hepatic decompensation because they inhibit prostaglandin synthesis, impair renal perfusion, and exacerbate portal hypertension [21-23]. Our finding that NSAID users had significantly higher rates of hepatic atrophy and portal hypertension aligns with studies conducted by researchers such as Vicente Arroyo, who demonstrated increased morbidity among cirrhotic patients exposed to NSAIDs.

Our findings are consistent with studies reporting widespread self-medication among patients with chronic diseases. A study reported that limited awareness regarding medication-related risks contributes substantially to inappropriate drug consumption and adverse health outcomes [24, 25].

The high prevalence of NSAID use observed in the present study is concerning because these medications are known to impair renal function, worsen portal hypertension and increase bleeding risks in cirrhotic patients. Previous investigations have demonstrated that NSAID exposure is associated with accelerated hepatic decompensation and poorer clinical outcomes [26].

The significant association between herbal medicine use and morphological liver deterioration observed in our study is supported by growing evidence linking herbal and traditional remedies to hepatotoxicity. Several herbal compounds contain potentially toxic alkaloids and contaminants capable of inducing chronic hepatic inflammation and fibrosis progression [27].

The observed increase in hepatic atrophy, portal hypertension and splenomegaly among

self-medicating individuals suggested that repeated exposure to hepatotoxic substances contribute to worsening structural liver damage. Similar findings have been reported in studies investigating drug-induced liver injury among patients with chronic liver disease.

The results also emphasize the need for improved patient education regarding medication safety. Many participants lacked awareness of the potential consequences of unsupervised drug use, highlighting deficiencies in healthcare counseling and public health awareness programs.

The strengths of this study include comprehensive clinical and radiological assessment of liver morphology and evaluation of multiple forms of drug exposure. However, several limitations should be acknowledged. Future prospective studies are recommended to establish temporal relationships between drug exposure and progression of cirrhotic changes.

The significant association between herbal medicine use and worsening liver morphology observed in our study is supported by numerous reports on herb-induced liver injury. Previous investigations have shown that many traditional and herbal preparations contain hepatotoxic compounds, heavy metals, pesticides, or undeclared pharmaceutical substances capable of inducing chronic hepatic inflammation. Studies have repeatedly demonstrated a relationship between herbal medication use and progression of liver fibrosis [28].

Our study also demonstrated that self-medication was associated with increased frequencies of regenerative nodules and hepatic atrophy. These findings are biologically plausible because repeated exposure to hepatotoxic substances can induce chronic oxidative stress, mitochondrial dysfunction, and inflammatory responses that accelerate fibrosis progression [29]. Experimental studies have shown that oxidative injury promotes an activation of hepatic stellate cells, leading to excessive collagen deposition and structural distortion of hepatic architecture.

The association between antibiotic misuse and worsening liver outcomes observed in the present study has also been reported previously. Several antibiotics, particularly when used repeatedly without monitoring, are known to cause idiosyncratic drug-induced liver injury. Research by the Drug-Induced Liver Injury Network has identified antibiotics as one of the leading causes of drug-induced liver injury worldwide. Such injury may further compromise hepatic reserve in patients with pre-existing cirrhosis.

The radiological findings observed in our study are comparable to those reported in previous imaging studies of cirrhosis. Surface nodularity, splenomegaly, portal vein enlargement, and regenerative nodules are well-established indicators of advanced chronic liver disease [30]. The significantly greater prevalence of these findings among self-medicating patients suggests that medication-related hepatotoxicity may contribute to accelerated disease progression.

Our multivariate analysis identified frequent self-medication as an independent predictor of advanced liver morphological changes even after controlling for confounding variables. This finding highlights the importance of behavioral and healthcare-related factors in the progression of chronic liver disease. Similar conclusions were reported by several international studies investigating medication adherence and disease progression among patients with chronic hepatic disorders.

From a public health perspective, these findings have important implications. Many patients with chronic liver disease remain unaware of the dangers associated with unsupervised medication use. Lack of patient education, easy access to medications, and inadequate regulation of herbal products may increase the risk of avoidable liver injury. Educational interventions targeting patients with chronic liver disease may substantially reduce harmful drug exposure and improve clinical outcomes.

The strengths of the present study include comprehensive assessment of medication exposure, clinical evaluation, and radiological characterization of liver morphology. The inclusion of multiple drug categories allowed a detailed analysis of various self-medication patterns.

The cross-sectional design precludes establishing causality between self-medication and liver damage. Self-reported medication histories may introduce recall bias, and some participants may have underreported drug use. Additionally, dosage and cumulative exposure could not be precisely quantified for all medications.

Despite these limitations, the study provides valuable evidence suggesting that self-medication and inappropriate drug exposure

may contribute significantly to structural liver deterioration in cirrhotic patients. Future longitudinal studies are needed to establish temporal relationships and further clarify the mechanisms through which medication misuse influences cirrhosis progression.

CONCLUSION

The study concluded that a significant association between self-medication practices, exposure to potentially hepatotoxic medications and adverse morphological changes in patients with liver cirrhosis. Frequent use of NSAIDs, antibiotics and herbal preparations was associated with increased rates of hepatic atrophy, portal hypertension, splenomegaly and other indicators of advanced liver disease. These findings highlighted the importance of patient education, medication monitoring and stricter regulation of over-the-counter drug use among individuals with chronic liver disease. Targeted public health interventions and clinician-led counseling may help reduce preventable liver damage and improve outcomes among cirrhotic patients.

REFRENCES

1. Yuan L, Kaplowitz N. Mechanisms of drug-induced liver injury. Clin Liver Dis. 2023;17:507-518.
2. Iorga A, Dara L, Kaplowitz N. Drug-induced liver injury: cascade of events leading to cell death, apoptosis or necrosis. Int J Mol Sci. 2017;18:1018.
3. Noureddin N, Kaplowitz N. Overview of mechanisms of drug-induced liver injury (DILI) and key challenges in DILI research. In: Will Y, Chen M, editors. Drug-induced liver toxicity. Methods in pharmacology and toxicology. Humana Press; 2018. p. 3-18.
4. Light DS, Aleo MD, Kenna JG. Interpretation, integration, and implementation of in vitro assay data: the predictive toxicity challenge. In: Chen M, Will Y, editors. Drug-induced liver toxicity. Methods in pharmacology and toxicology. Humana Press; 2018. p. 345-364.
5. Dara L, Liu ZX, Kaplowitz N. Mechanisms of adaptation and progression in idiosyncratic drug induced liver injury, clinical implications. Liver Int. 2016;36:158-165.
6. Dara L, Liu ZX, Kaplowitz N. Pathogenesis of idiosyncratic drug induced liver injury. In: Muriel P, editor. Liver pathophysiology. Elsevier; 2017. p. 87-100.
7. Kaplowitz N. Acetaminophen hepatotoxicity: what do we know, what don't we know, and what do we do next? Hepatology. 2021;40:23-26.
8. Larson AM, Polson J, Fontana RJ, Davern TJ, Lalani E, Hynan LS, et al. Acetaminophen-induced acute liver failure: results of a United States multicenter, prospective study. Hepatology. 2005;42:1364-1372.
9. Win S, Than TA, Min RWM, Aghajan M, Kaplowitz N. c-Jun N-terminal kinase mediates mouse liver injury through a novel Sab (SH3BP5)-dependent pathway leading to inactivation of intramitochondrial Src. Hepatology. 2016;63:1987-2003.
10. Saito C, Lemasters JJ, Jaeschke H. c-Jun N-terminal kinase modulates oxidant stress and peroxynitrite formation independent of inducible nitric oxide synthase in acetaminophen hepatotoxicity. Toxicol Appl Pharmacol. 2020;246:8-17.
11. Ramachandran A, Jaeschke H. Acetaminophen toxicity: novel insights into mechanisms and future perspectives. Gene Expr. 2018;18:19-30.
12. Centre for Evidence-Based Medicine. Levels of evidence 2019. Available from: https://www.cebm.net/2009/06/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/
13. European Association for the Study of the Liver. Clinical Practice Guidelines of the European Association for the Study of the Liver – advancing methodology but preserving practicability. J Hepatol. 2018;70:5-7.
14. Andrade RJ, Lucena MI, Fernández MC, Pelaez G, Pachkoria K, García-Ruiz E, et al. Drug-induced liver injury: an analysis of 461 incidences submitted to the Spanish registry over a 10-year period. Gastroenterology. 2015;129:512-521.
15. Björnsson ES, Bergmann OM, Björnsson HK, Kvaran RB, Olafsson S. Incidence, presentation, and outcomes in patients with drug-induced liver injury in the general population of Iceland. Gastroenterology. 2013;144:1419-1425.
16. Chalasani N, Bonkovsky HL, Fontana RJ, Lee W, Stolz A, Talwalkar J, et al. Features and outcomes of 899 patients with drug-induced liver injury: the DILIN

prospective study. Gastroenterology. 2015;148:1340-1352.
17. Ostapowicz G, Fontana RJ, Schiødt FV, Larson A, Davern TJ, Han SHB, et al. Results of a prospective study of acute liver failure at 17 tertiary care centers in the United States. Ann Intern Med. 2022;137:947-954.
18. Reuben A, Koch DG, Lee WM, Acute Liver Failure Study Group. Drug-induced acute liver failure: results of a U.S. multicenter, prospective study. Hepatology. 2020;52:2065-2076.
19. Wei G, Bergquist A, Broomé U, Lindgren S, Wallerstedt S, Almer S, et al. Acute liver failure in Sweden: etiology and outcome. J Intern Med. 2017;262:393-401.
20. Björnsson E, Jerlstad P, Bergqvist A, Olsson R. Fulminant drug-induced hepatic failure leading to death or liver transplantation in Sweden. Scand J Gastroenterol. 2019;40:1095-1101.
21. Ohmori S, Shiraki K, Inoue H, Okano H, Yamanaka T, Deguchi M, et al. Clinical characteristics and prognostic indicators of drug-induced fulminant hepatic failure. Hepatogastroenterology. 2023;50:1531-1534.
22. Wai CT, Tan BH, Chan CL, Sutedja DS, Lee YM, Khor C, et al. Drug-induced liver injury at an Asian center: a prospective study. Liver Int. 2017;27:465-474.
23. Andrade R, Medina-Caliz I, Gonzalez-Jimenez A, Garcia-Cortes M, Lucena MI. Hepatic damage by natural remedies. Semin Liver Dis. 2018;38:021-040.
24. Ekor M. The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. Front Pharmacol. 2019;4:177.
25. Calitz C, du Plessis L, Gouws C, Steyn D, Steenekamp J, Muller C, et al. Herbal hepatotoxicity: current status, examples, and challenges. Expert Opin Drug Metab Toxicol. 2015;11:1551-1565.
26. Navarro VJ, Khan I, Björnsson E, Seeff LB, Serrano J, Hoofnagle JH. Liver injury from herbal and dietary supplements. Hepatology. 2017;65:363-373.
27. Navarro VJ, Lucena MI. Hepatotoxicity induced by herbal and dietary supplements. Semin Liver Dis. 2019;34:172-193.
28. Teschke R, Eickhoff A. Herbal hepatotoxicity in traditional and modern medicine: actual key issues and new encouraging steps. Front Pharmacol. 2018;6:72.
29. Larrey D, Faure S. Herbal medicine hepatotoxicity: a new step with development of specific biomarkers. J Hepatol. 2021;54:599-601.
30. García-Cortés M, Robles-Díaz M, Ortega-Alonso A, Medina-Caliz I, Andrade R. Hepatotoxicity by dietary supplements: a tabular listing and clinical characteristics. Int J Mol Sci. 2017;17:537.