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# Hazardous alcohol consumption and perioperative complications in a cardiac surgery patient. A retrospective study

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## Abstract

**Background:** We investigated the prevalence and effects of hazardous alcohol consumption on perioperative complications in cardiac surgery patients. Preoperative hazardous alcohol consumption has been associated with an increased risk of postoperative complications in noncardiac patient populations.

**Methods:** We retrospectively collected data from the Finnish Intensive Care Consortium database and electronic patient records on all cardiac surgery patients treated in the intensive care units (ICUs) of Helsinki University Hospital ($n = 919$) during 2017. Data on preoperative alcohol consumption were routinely collected using the alcohol use disorder identification test consumption (AUDIT-C) questionnaire. We analyzed perioperative data and outcomes for any associations with hazardous alcohol consumption. Outcome measures were length of stay in the ICU, re-admissions to ICU, bleeding and infectious complications, and incidence of postoperative arrhythmias.

**Results:** AUDIT-C scores were available for 758 (82.5%) patients, of whom 107 (14.1%) fulfilled the criteria for hazardous alcohol consumption (AUDIT-C score of 5/12 or higher for women and 6/12 or higher for men). Patients with hazardous alcohol consumption were younger, median age 59 (IQR 52.0–67.0) vs. 69.0 (IQR 63.0–74.0), $p < .001$, and more often men 93.5% vs. 71.9%, $p < .001$ than other patients and had an increased risk for ICU re-admissions [adjusted OR (aOR) 4.37 (95% CI, 1.60–11.95)] and severe postoperative infections aOR 3.26 (95% CI, 1.42–7.54).

**Conclusion:** Cardiac surgery patients with a history of hazardous alcohol consumption are younger than other patients and are predominantly men. Hazardous alcohol consumption is associated with an increased risk of severe postoperative infections and ICU re-admissions.

KEYWORDS
AUDIT-C, cardiac surgery, hazardous alcohol use, intensive care unit, perioperative complications

**Editorial Comment**

In this retrospective study on a cardiac surgery cohort, patients who responded to a standardized screening questionnaire regarding hazardous alcohol consumption were at higher odds for readmission and severe infections. These findings support the relevance of screening for harmful alcohol use for patients undergoing elective surgery. This also raises a question of whether a positive screening result should be followed by further assessment and a potential delay in surgery to mitigate the risk of adverse outcomes.

## 1 | INTRODUCTION

Alcohol use is among the most common factors responsible for morbidity and even mortality in most parts of the world.[1,2] Previous studies have shown that chronic hazardous alcohol consumption and irregular heavy alcohol consumption have detrimental effects on the cardiovascular system,[3] but light or moderate alcohol consumption has also been suggested to have cardioprotective effects.[3–6] Because hazardous alcohol consumption is associated with the burden of cardiovascular diseases,[3–5,7] a high prevalence of hazardous alcohol consumption among cardiac surgery patients could be expected.

In noncardiac surgery patient populations, preoperative hazardous alcohol consumption is associated with an increased risk of postoperative complications, such as infections, wound complications, pulmonary complications, prolonged hospital stays, and a higher number of admissions to the intensive care unit (ICU).[8] High alcohol consumption (over 60 g/day) was associated with an increased risk of postoperative mortality in one study.[8] Earlier studies have shown that excessive alcohol use reduces immune competence,[9] is associated with an increased risk for infections,[8,10] and has detrimental effects on the wound-healing process.[10] Hazardous alcohol consumption impairs blood coagulation,[6] which might increase the risk of postoperative bleeding. However, in a meta-analysis, no increased risk of intraoperative bleeding complications was observed.[8]

To date, data on the association between hazardous alcohol consumption and perioperative complications in cardiac surgery patients are scarce. Therefore, the aim of this study was to analyze the prevalence of preoperative hazardous alcohol consumption and its association with intraoperative and postoperative complications in cardiac surgery patients.

## 2 | PATIENTS AND METHODS

This retrospective study comprised cardiac surgery patients admitted to postoperative care in the ICUs of Helsinki University Hospital between January 1 and December 31, 2017. The study population included all cardiac surgery patients, except heart transplant and left ventricular assist device patients (LVAD). We obtained data from electronic patient records (Uranus, 8.4.6.16, CGI, Canada; PICIS Care Suite, 8.6, USA), laboratory records (Weblab, 2022.4.0.3), and the National Intensive Care quality database (Intensium, TietoEvry, Helsinki, Finland).[11] The study protocol was approved by the Institutional Review Board of Helsinki University Hospital, and ethical approval was waived due to the retrospective design of the study.

We extracted the following data: age, gender, preoperative New York heart association classification (NYHA), the European system for cardiac operative risk evaluation (EuroScore) II and preoperative and postoperative ejection fraction, admission type (emergency vs. elective), and type of operation (coronary artery bypass [CAGB], valvular, aortic, or other type of surgery). We recorded information of preoperative alcohol use from the alcohol use disorders identification test- consumption (AUDIT-C) (see Data S1) questionnaires the patients had filled out as a routine part of the preoperative assessment. We defined hazardous alcohol consumption as five or more points (of 12) for women and six or more points for men.

We extracted the following data concerning the perioperative period: preoperative laboratory variables (hemoglobin [Hb], mean corpuscular volume [MCV], platelet count [PLT], creatinine, thromboplastin time (TT, Owren method), and international normalized ratio [INR]), volume of bleeding during surgery, and the amount of blood products (red blood cells [RBC], platelets, and fresh frozen plasma [FFP]) administered. We classified RBC transfusions according to the Bleeding Academic Research Consortium classification.[12] Postoperative data from intensive care included the simplified acute physiology score II (SAPS II),[13] Sequential organ failure assessment score (SOFA) from the first 24 h of ICU admission,[14] the therapeutic intervention scoring system (TISS),[15] length of stay (LOS) in the ICU (first admission), and vasoactive and inotropic treatment in the ICU. We also extracted the laboratory results of the first postoperative day (Hb, PLT, TT, INR, troponin I [TnI], and creatine kinase-MB [CK-MB]). We collected the following data on postoperative complications: re-admissions to the ICU, re-operations, postoperative antimicrobial treatment, and its indications. We classified the following infections as severe: sepsis, mediastinitis, endocarditis, pneumonia necessitating ICU treatment, and sternal osteitis. We registered all recordings of arrhythmia during hospitalization (atrial fibrillation [AF] or flutter [AFL] [including paroxysmal and chronic], ventricular tachycardia [VT] or ventricular fibrillation [VF], and transfusions after surgery, as well as ICU, hospital, and one-year mortality. We compared the variables between patients with and without preoperative hazardous alcohol consumption.

We did not perform an a priori power calculation. We present continuous variables are presented as medians and interquartile ranges (IQR), and use the nonparametric Mann–Whitney U test for comparing non-normally distributed data. We present categorical data as absolute numbers and percentages and use the chi-square or

Fisher's exact test for comparisons. We performed multivariable logistic regression analyses for assessing hazardous alcohol consumption as an independent risk factor for ICU readmissions (model 1) and severe postoperative infections (model 2). We chose the covariates based on the level of significance ($p < .2$) in the univariable models. Of the variables representing severity of acute condition, we chose only one, due to the limited number of outcomes of interest. In model 1, we used age and hazardous alcohol consumption as covariates. In Model 2, we used SAPS II, admission type (elective/emergency) and hazardous alcohol use. We considered a $p$-value <.05 statistically significant. For the statistical analyses, we used IBM SPSS Statistics for Windows, Version 27.0. (IBM Corp., Armonk, NY, USA).

## 3 | RESULTS

During the 1-year period, there were 919 postoperative ICU admissions. A flowchart of the patients evaluated and included in the final analyses is shown in Figure 1. Of the patients not included in the analyses due to missing AUDIT-C scores, 26% ($n = 42$) were male, their median age was 66 (IQR 62–75) years, and 81% ($n = 130$) had emergency admissions. Table 1 presents the characteristics of the patients included in the final analyses. The prevalence of hazardous alcohol consumption was $n = 107$ (14%). Figure S1 presents the AUDIT-C score distribution among the study population. Table S1 shows preoperative laboratory results. Types of operation were CAGB (coronary artery bypass grafting) $n = 489$ (64.5%), valvular 229 (30.2%), aortic aneurysm or dissection $n = 31$ (4.1%), or other $n = 9$ (1.2%).

### 3.1 | Operative data

Intraoperative information is shown in Table 2. There was no association between hazardous alcohol consumption and intraoperative transfusions of platelets or FFP, vasopressors, and inotropes (Table 2), but patients without hazardous alcohol consumption received more RBC transfusions.

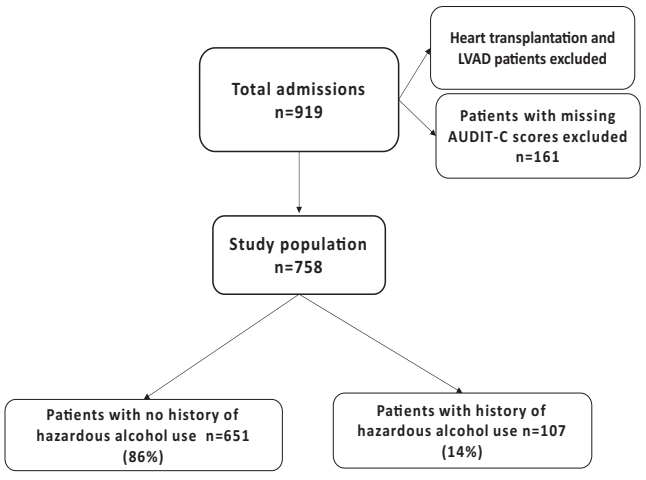


**FIGURE 1** Hazardous alcohol consumption was defined as five or more points (of 12) for women and six or more points for men. AUDIT-C, alcohol use disorders identification test consumption; LVAD, left ventricular assist device patients.

### 3.2 | Postoperative data

We found no difference in the frequency of reoperations between groups: $n = 25$ (3.8%) in the nonhazardous alcohol group and $n = 1$ (0.9%) in the hazardous alcohol group, $p = .126$. However, hazardous alcohol use was associated with more ICU readmissions (Table 3). The reasons for readmissions are shown in Table S2. Table 4 shows the frequency of postoperative arrhythmias. Hazardous alcohol consumption was not associated with increased arrhythmias such as VT or VF. AF or AFL were common arrhythmias after cardiac surgery, occurring in 50% of patients. We found no difference between groups in laboratory test results of the first postoperative day (Table S1), nor in the left ventricle ejection fraction preoperatively or postoperatively between groups (Table 4). Table S3 also shows data on vasoactive medication and inotropes in the ICU. During hospital care, there was no association between blood transfusions and hazardous alcohol consumption (Table S3).

### 3.3 | Antimicrobial treatment and infections

Postoperatively, 33.5% ($n = 218$) of patients without and 38.3% ($n = 41$) with hazardous alcohol consumption received antimicrobial treatment ($p = .198$). Table 5 shows indications for antimicrobial treatment; a more detailed description of infection types is presented in Table S4. Severe infections occurred more often in patients with a history of hazardous alcohol consumption in multivariable analysis (Table 6), adjusting for SAPS II score, admission type and hazardous alcohol use, hazardous alcohol consumption was independently associated with an increased risk for severe infection OR 3.26 (95% CI 1.42–7.54) ($p = .005$*).

### 3.4 | Mortality

ICU, hospital, and one-year mortality rates were low in cardiac surgery patients. Only one patient in the nonhazardous alcohol consumption group died during ICU treatment. Hospital mortality was 0.9% ($n = 6$) and 0 (0%) in the nonhazardous and hazardous alcohol consumption groups, respectively ($p = .319$). One-year mortality was 2.3% ($n = 15$) and 0.9% ($n = 1$) in the nonhazardous and hazardous alcohol consumption groups, respectively ($p = .361$).

## 4 | DISCUSSION

In this retrospective study, we investigated the frequency of preoperative hazardous alcohol consumption and its association with

**TABLE 1** Study population characteristics according to alcohol consumption defined as non-hazardous (AUDIT-C score <5 in women and <6 in men) and hazardous (AUDIT-C score ≥5 in women and ≥6 in men).

| | Non-hazardous alcohol consumption ($n = 651$) | Hazardous alcohol consumption ($n = 107$) | *p*-value |
|---|---|---|---|
| Age, years [IQR] | 69.0 [63.0–74.0] | 59.0 [52.0–67.0] | <.001* |
| Male gender, *n* (%) | 468 (71.9) | 100 (93.5) | <.001* |
| Emergency admission, *n* (%) | 86 (13.2) | 11 (10.3) | .400 |
| NYHA score, median [IQR] | 3.0 [2.0–3.0] | 3.0 [2.0–3.0] | .703 |
| EuroScore, median [IQR] | 5.0 [3.0–8.0] | 4.0 [2.0–6.5] | .013* |
| SAPS II, median [IQR] | 24.0 [20.0–29.0] | 20.0 [15.0–26.0] | .001* |
| SOFA 24, median [IQR] | 6.0 [5.0–7.0] | 6.0 [5.0–7.0] | .410 |
| TISS total, median [IQR] | 81 [72.0–108] | 76.0 [70–90] | .046* |
| ICU LOS, days, median [IQR] | 0.98 [0.9–1.9] | 0.97 [0.9–1.2] | .808 |

*Note*: Continuous variables were expressed as medians and interquartile ranges (IQR). Categorical data are presented as absolute numbers (*n*) and percentages. *p*-value <.05 statistically significant.
Abbreviations: AUDIT-C, alcohol use disorders identification test consumption; EuroScore, European system for cardiac operative risk evaluation; ICU LOS, intensive care unit length of stay; NYHA, New York heart association classification; SAPS II, simplified acute physiology score II; SOFA 24, sequential organ failure assessment score from first 24 h in ICU; TISS, the therapeutic intervention scoring system (i.e., the sum of TISS scores during the ICU treatment).

**TABLE 2** Comparison of intraoperative use of fluids, blood loss, transfusions, and vasoactive and inotropic medication between patients with nonhazardous (AUDIT-C score <5 in women and <6 in men) and hazardous (AUDIT-C score ≥5 in women and ≥6 in men) alcohol consumption.

| | Nonhazardous alcohol consumption ($n = 651$) | Hazardous alcohol consumption ($n = 107$) | *p*-value |
|---|---|---|---|
| Intraoperative fluids administered (mL), median (IQR)[a] | 2801 [2092–3646] | 2699 [1942–3469] | .216 |
| Intraoperative blood loss (mL), median (IQR)[b] | 400 [300–500] | 400 [300–500] | .413 |
| Intraoperative transfusions | | | |
| FFP, *n* (%) | 96 (14.8%) | 12 (11.2%) | .333 |
| RBCs, *n* (%) | 285 (43.8%) | 29 (27.1%) | .001* |
| Platelets, *n* (%) | 159 (24.4%) | 21 (11.7%) | .327 |
| Patients receiving intraoperative vasoactive medication *n* (%) | 524 (80.5%) | 82 (76.6%) | .356 |
| Patients receiving intraoperative inotropic medication *n* (%) | 161 (24.7%) | 22 (20.6%) | .350 |

*Note*: Continuous variables were expressed as medians and interquartile ranges (IQR). Categorical data are presented as percentages and absolute numbers (*n*). *p*-value <.05 statistically significant.
Abbreviations: AUDIT-C, alcohol use disorders identification test consumption; FFP, fresh frozen plasma; RBCs, red blood cell concentrates.
[a]Data missing of $n = 1$ (0.2%)/$n = 0$ patients.
[b]Data missing of $n = 19$ (3%)/$n = 2$ (2%) patients.

intraoperative and postoperative complications in cardiac surgery patients. As determined by using preoperatively obtained AUDIT-C questionnaire data, the prevalence of hazardous alcohol consumption was 14.2% ($n = 107$). The main findings of our study were that hazardous alcohol consumption was independently associated with an increased frequency of severe postoperative infections and ICU re-admissions. We found no difference in ICU LOS, need for transfusions, fluids, vasopressors or inotropes, laboratory test results, postoperative or preoperative ejection fraction, or postoperative arrhythmias.

In a previous study, alcohol consumption was not associated with an increased risk of postoperative complications among patients undergoing CAGB surgery, nor were any protective effects of moderate alcohol use (according to alcohol consumption as ≥3 portions/week) found.[16] On the contrary, heavy drinking (>21 units/week) was associated with increased all-cause mortality after CAGB in another study.[17] In our study population, mortality was too low to detect any association with hazardous alcohol consumption. Of note, EuroScore, SAPS2, and TISS scores were lower in patients with hazardous alcohol consumption.

In our study, the prevalence of hazardous alcohol consumption among cardiac surgery patients was in agreement with the previously reported prevalence of 13% in the Finnish general population

**TABLE 3** Univariable and multivariable analysis of association of hazardous alcohol use with ICU readmissions.

| All | ICU readmission | No ICU readmission | | ICU readmission | |
|---|---|---|---|---|---|
| *n* = 758 | *N* = 25 | *N* = 733 | *p* | ExpB (95% CI) | *p*-value |
| Sex, *n* (%) | | | | | |
| Men | 21 (3.7) | 547 (96.3) | .288 | – | – |
| Women | 4 (2.1) | 186 (97.9) | | | |
| Elective admission, *n* (%) | 21 (3.2) | 640 (96.8) | .626 | – | – |
| Emergency admission, *n* (%) | 4 (4.1) | 93 (95.9) | | | |
| Hazardous alcohol consumption | | | | | |
| No, *n* = 651 | 18 (2.8) | 633 (97.2) | .043* | 4.37 (1.60–11.95) | .004* |
| Yes, *n* = 107 | 7 (6.5) | 100 (13.6) | | | |
| Age, median (IQR) | 71.0 (67.5–75.0) | 68.0 (60.0–73.0) | .047* | 1.06 (1.01–1.12) | .014* |
| SAPS II without age score, median (IQR) | 14.0 (10.0–21.0) | 13.0 (9.0–18.0) | .365 | | |

*Note*: Continuous variables were expressed as medians and interquartile ranges (IQR). Categorical data are presented as absolute numbers (*n*) and percentages. *p*-value <.05 statistically significant.
Abbreviations: ICU, intensive care unit; SAPS II, simplified acute physiology score II.

**TABLE 4** Postoperative arrhythmias and preoperative and postoperative ejection fraction according to alcohol consumption as nonhazardous (AUDIT-C score <5 in women and <6 in men) and hazardous (AUDIT-C score ≥5 in women and ≥6 in men).

| | Nonhazardous alcohol consumption | Hazardous alcohol consumption | *p*-value |
|---|---|---|---|
| Postoperative arrhythmias, cardioversions, and need for permanent pacemakers | | | |
| AF/AFL | 333 (51.2) | 53 (49.5) | .942 |
| VT/VF | 46 (7.1) | 12 (11.2) | .135 |
| Preoperative echocardiography[a] | *n* = 613 | (*n* = 105) | .067 |
| EF normal >50%, *n* (%) | 409 (62.8) | 63 (58.9) | |
| EF 40%–50%, *n* (%) | 145 (22.3) | 28 (26.2) | |
| EF 30%–39%, *n* (%) | 42 (6.5) | 13 (12.1) | |
| EF < 30%, *n* (%) | 17 (2.6) | 1 (0.9) | |
| Postoperative echocardiography (3–6 months after surgery)[b] | *n* = 534 | *n* = 89 | .300 |
| EF normal >50%, *n* (%) | 394 (60.5) | 56 (52.3) | |
| EF 40%–50%, *n* (%) | 98 (15.1) | 23 (21.5) | |
| EF 30%–39%, *n* (%) | 36 (5.5) | 8 (7.5) | |
| EF < 30%, *n* (%) | 6 (0.9) | 2 (1.9) | |

*Note*: Categorical data are presented as percentages and absolute numbers (*n*). *p*-value <.05 statistically significant.
Abbreviations: AF, atrial fibrillation; AFL, atrial flutter; AUDIT-C, alcohol use disorders identification test consumption; EF, ejection fraction; VF, ventricular fibrillation; VT, ventricular tachycardia.
[a]Data missing of *n* = 38 (5.8%)/*n* = 2 (1.9%) patients.
[b]Data missing of *n* = 117 (18.0%)/*n* = 18 (16.8%) patients.

between 15 and 74 years of age[18,19] and remarkably lower than in general ICU patients reported in previous studies in Finland.[20–22] In our study, patients with preoperative hazardous alcohol consumption were younger and predominantly male, like in previous studies on critically ill patients, and in the general population in Finland.[18,20–24]

Previous studies in noncardiac surgery patient populations show that hazardous alcohol consumption may increase intraoperative and postoperative complications through many pathophysiological mechanisms.[8] Hazardous alcohol consumption impairs immune capacity, which may contribute to the higher incidence of postoperative infections.[8–10] In earlier studies on critically ill patients, hazardous alcohol consumption has been shown to be a risk factor for severe complications, such as sepsis, ICU-acquired bacterial infection, and acute respiratory distress syndrome.[24–26] In our study, one in three patients received postoperative antimicrobial treatment for various indications. We found no association between alcohol use and the prevalence of postoperative antimicrobial treatment, but patients with hazardous alcohol consumption had an increased risk of severe

**TABLE 5** Indications of postoperative antimicrobial treatment in patients without (AUDIT-C score <5 in women and <6 in men) and with (AUDIT-C score ≥5 in women and ≥6 in men) hazardous alcohol consumption.

| | Nonhazardous alcohol consumption ($n = 651$) | Hazardous alcohol consumption ($n = 107$) | *p*-Value |
|---|---|---|---|
| Respiratory infection (excl. pneumonia necessitating ICU treatment), *n* (%) | 17 (2.6%) | 1 (0.9%) | .333 |
| Urinary tract infection, *n* (%) | 10 (1.5%) | 0 (0%) | |
| Skin infection, *n* (%) | 11 (1.7%) | 0 (0%) | |
| *Clostridium difficile*, *n* (%) | 2 (0.3%) | 1 (0.9%) | |
| Unclear infection, *n* (%) | 44 (6.7%) | 4 (3.7%) | |
| Surgery wound infection, *n* (%) | 53 (8.1%) | 10 (9.3%) | |
| Severe infection, *n* (%) | 18 (2.8%) | 8 (7.5%) | .013* |
| Preoperative infection, antimicrobial treatment continues postoperatively, *n* (%) | 52 (8.0%) | 14 (13.1%) | .617 |
| Antimicrobial treatment postoperatively for prophylactic reasons, *n* (%) | 11 (1.7%) | 3 (2.8%) | |

*Note*: Categorical data are presented as percentages and absolute numbers (*n*). A more detailed description of infection types is presented in Table S4.
*p*-value <.05 statistically significant.
Abbreviations: AUDIT-C, alcohol use disorders identification test consumption.

**TABLE 6** Univariable and multivariable analysis of association of hazardous alcohol use with severe infection.

| All | Severe infection | No severe infection | | | |
|---|---|---|---|---|---|
| $n = 758$ | $N = 27$ | $N = 731$ | *p* | Exp B (95% CI) | *p* |
| Sex, *n* (%) | | | | – | – |
| Men | 22 (3.9) | 546 (96.1) | .424 | | |
| Women | 5 (2.6) | 185 (97.4) | | | |
| Elective admission, *n* (%) | 21 (3.2) | 640 (96.8) | .135 | 1.64 (0.61–4.43) | .325 |
| Emergency admission, *n* (%) | 6 (6.2) | 91 (93.8) | | | |
| Hazardous alcohol consumption, *n* (%) | | | .005* | 3.26 (1.42–7.54) | .005* |
| No, $n = 651$ | 18 (2.8) | 633 (97.2) | | | |
| Yes, $n = 107$ | 9 (8.4) | 98 (91.6) | | | |
| Age, median (IQR) | 67.0 (56.0–73.0) | 68.0 (60.0–73.0) | .508 | – | – |
| SAPS II without age score, median (IQR) | 15.0 (10.0–26.0) | 13.0 (9.0–18.0) | .129 | 1.20 (0.99–1.46) | .061 |

*Note*: Continuous variables were expressed as medians and interquartile ranges (IQR). Categorical data are presented as absolute numbers (*n*) and percentages. *p*-value <.05 statistically significant.
Abbreviations: ICU, intensive care unit; SAPS II, simplified acute physiology score II.

infections. We also found more ICU re-admissions in patients with hazardous alcohol consumption. The reasons for ICU re-admission were varying arrhythmias, respiratory failure, delirium, and severe infections, such as pneumonia, sepsis, endocarditis, pericarditis, mediastinitis, or sternal osteitis. Indeed, postoperative delirium can cause sternal dehiscence in patients undergoing sternotomy, predisposing them to deep sternal wound infections.[27] Due to low number of patients with very high AUDIT-C score and patients with severe complications, we did not assess whether there was a linear association between AUDIT-C and complication frequency.

Perioperative bleeding and transfusions are common in adult cardiac surgery patients.[28,29] Data on the association of hazardous alcohol consumption with bleeding complications and transfusion requirements are contradictory in other surgery populations.[8,30] Despite evidence of alcohol-associated changes in platelet number and functions and toxic effects on blood-forming organs,[31] we found no difference in relevant preoperative laboratory values, or intraoperative bleeding associated with hazardous alcohol consumption. Interestingly, hazardous alcohol consumers received fewer RBC transfusions during and after the operation than other patients. One possible explanation is that most of them were men, and their preoperative Hb values were clearly above the reference values. MCV increases with excessive alcohol intake,[32] and in our study, MCV values were slightly higher but within the reference range in the hazardous alcohol consumption group.

We found no association between preoperative or postoperative ejection fraction (EF) and hazardous alcohol consumption. Hazardous, chronic alcohol use is one of the main causes of nonischemic dilated

cardiomyopathy, which is characterized by left ventricle dilatation, systolic dysfunction,[33,34] and lower left EF.[35–37] The prevalence of AF or AFL was high in our study, but no association with hazardous alcohol use was observed. Previous studies have found an association between hazardous alcohol consumption and arrhythmias.[7,38,39] Hazardous alcohol consumption may promote cardiac arrhythmias through multiple pathophysiological mechanisms.[39,40] Postoperative AF is generally common after cardiac surgery, with an incidence of 20%–40%.[41] The higher proportion in our study may be explained by our inability to differentiate between acute and chronic AF and AFL. Hazardous preoperative alcohol use was not associated with the prevalence of arrhythmias.

Our study has some limitations. First, the study was retrospective with all the inherent limitations, and it was performed in a single center. Second, the AUDIT-C scores were not available for all patients, and there were missing data. Imputations for missing values were not performed. Patients with missing AUDIT-C scores differed from the study population as they were predominantly admitted as emergency surgery patients, with limited options for a detailed interview. Third, elective cardiac surgery patients are interviewed before being placed in the surgery queue, and it is possible to intervene in the hazardous use of alcohol before surgery. Our research does not reveal how many patients had decreased their alcohol consumption before surgery. Fourth, the number of patients with very high AUDIT-C scores was relatively low in our study. Fifth, data on other risk factors such as smoking were not available. There are also some important strengths of our study. The data on alcohol use were based on a systematically used validated questionnaire, which provided information about preoperative alcohol use in a high proportion (82.5%) of patients. To our knowledge, this is the largest study on the prevalence of hazardous alcohol consumption and its associations with perioperative complications in a cardiac surgery population.

## 5 | CONCLUSION

The prevalence of hazardous alcohol consumption in cardiac surgery patients is similar as that reported in the Finnish general population. Cardiac surgery patients with a history of hazardous alcohol consumption are significantly younger than other patients and are predominantly male. Hazardous alcohol consumption is associated with an increased frequency of severe postoperative infections and ICU re-admissions, but not with other complications.

### AUTHOR CONTRIBUTIONS

The Study conception and design: EN, JH, SD, RS; data collection: EN; analysis and interpretation of results: EN, JH; draft manuscript preparation: EN, JH All authors reviewed the results and approved the final version of the manuscript.

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### CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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