To the Editor: Valve stenosis and regurgitation can lead to a series of symptoms, including chest distress and dyspnea. Valve replacement is an effective surgical procedure that improves patients’ quality of life and life span and has played an increasingly important role in treating mitral valve diseases. Previous studies have reported different risk factors and independent predictors of increased mortality in patients with mitral valve replacement (MVR) and/or aortic valve replacement (AVR).[1‑3] This study retrospectively reviewed data on patients undergoing valve surgery to determine the risk factors and predictors of short-term mortality in this patient population.

The data of 1254 patients who underwent valve surgery from January 2014 to December 2015 in the First Affiliated Hospital of Zhejiang University were reviewed. Patients with concomitant coronary artery bypass grafting (CABG) were included, while those with concomitant aortic dissection surgery or complex congenital heart disease surgery were excluded. Clinical, echocardiographic, and surgical data from the electronic medical records were reviewed. Short-term mortality was defined as all-cause death during or within 30 days of surgery. The patients, who underwent preoperative transthoracic echocardiography (TTE), electrocardiography (ECG), and coronary artery imaging, mostly received a coronary computed tomography angiogram (CTA) to get useful data. Patients with abnormal coronary CTA results or a high risk of coronary heart disease (CHD) required a coronary angiogram.

The 99% of the patients (1242 of 1254) included in the study underwent surgical procedures through a median sternotomy followed by a cardiopulmonary bypass with systemic hypothermia (central temperature: 28°C–32°C). Concomitant CABG was performed in 35 patients. Valve function was confirmed through TTE after they had been weaned off cardiopulmonary bypass.

Statistical analysis was performed using SPSS version 22.0 (SPSS Inc., Chicago, IL, USA). Pearson’s Chi-square tests were used to compare inhospital mortality rates between groups. All multivariate analyses were performed with < 0.05 as the limit on univariate analysis for entering or removing variables. A P < 0.05 was considered statistically significant.

Among the 1254 patients who underwent valve surgery, 25 (2.0%) short-term deaths were recorded. The causes of death were cardiac failure (8 patients), multiple system failure (7 patients), cerebral infarction (4 patients), thoracic incision infection (3 patients), renal failure (2 patients), and fatal arrhythmia (1 patient). Patients’ baseline characteristics are presented in Table 1. Patients with a New York Heart Association (NYHA)-4 experienced significantly higher post-surgery mortality (15.0% vs. 1.8%, P < 0.001). Compared to nonsmoking patients, patients with a smoking history also had increased mortality (5.0% vs. 1.6%, P < 0.001), as did those with a history of CHD (7.4% vs. 1.9%, P = 0.042). A low ejection fraction (EF) (<50.0%, P < 0.001), moderate or severe mitral regurgitation (P = 0.021), and tricuspid regurgitation (P = 0.012) discovered by ECG were all found to be risk factors for valve surgery. Patients with a history of cardiac surgery had a higher mortality rate (9.4% vs. 1.8%, P = 0.002), and those who underwent valve surgeries with concomitant CABG or reoperation for major bleeding or pericardial tamponade had a significantly higher rate as well (8.6% vs. 1.8%, P = 0.005, and 22.2% vs. 1.7%, P < 0.001, respectively).

Based on univariate analysis, multivariate logistic regression analyses of inhospital mortality showing NYHA-4 (odds ratio [OR]: 8.7, 95% confidence interval [CI]: 2.1–36.2, P = 0.003), smoking history (OR: 3.7, 95% CI: 1.5–9.3, P = 0.005), poor EF (OR: 5.4, 95% CI: 2.2–13.5, P < 0.001), previous cardiac surgery (OR: 10.9, 95% CI: 2.6–46.2, P = 0.001), moderate or severe tricuspid regurgitation (OR: 3.2, 95% CI: 1.3–8.1, P = 0.012), and concomitant CABG (OR: 5.0, 95% CI: 1.3–19.2, P = 0.020) to be potential risk factors for short-term mortality [Table 2].

Over 200,000 patients suffer from chest distress, dyspnea, and poor mobility caused by morphological defects of the heart valves...
| Items                              | Number       | Short-term mortality | $\chi^2$ | $P$   |
|-----------------------------------|--------------|----------------------|----------|-------|
| Age                               |              |                      |          |       |
| <60 years                         | 690 (55.0)   | 12 (1.7)             | 0.51     | 0.476 |
| ≥60 years                         | 564 (45.0)   | 15 (2.7)             |          |       |
| Gender                            |              |                      |          |       |
| Male                              | 563 (44.9)   | 12 (2.1)             | 0.10     | 0.753 |
| Female                            | 691 (55.1)   | 13 (1.9)             |          |       |
| BMI                               |              |                      |          |       |
| <24 kg/m²                         | 844 (67.3)   | 17 (2.0)             | 0.01     | 0.940 |
| ≥24 kg/m²                         | 410 (32.7)   | 8 (2.0)              |          |       |
| NYHA-4                            |              |                      |          |       |
| No                                | 1234 (98.4)  | 22 (1.8)             | 17.60    | <0.001|
| Yes                               | 20 (1.6)     | 3 (15.0)             |          |       |
| Renal dysfunction                 |              |                      |          |       |
| No                                | 1226 (97.8)  | 25 (2.0)             | 0.58     | 0.445 |
| Yes                               | 28 (2.2)     | 0 (0.0)              |          |       |
| Diabetes                          |              |                      |          |       |
| No                                | 1200 (95.7)  | 24 (2.0)             | 0.01     | 0.907 |
| Yes                               | 54 (4.3)     | 1 (1.9)              |          |       |
| Hypertension                      |              |                      |          |       |
| No                                | 986 (78.6)   | 21 (2.1)             | 0.44     | 0.508 |
| Yes                               | 268 (21.4)   | 4 (1.5)              |          |       |
| Smoker                            |              |                      |          |       |
| No                                | 1094 (87.2)  | 17 (1.6)             | 8.48     | 0.004 |
| Yes                               | 160 (12.8)   | 8 (5.0)              |          |       |
| Peripheral vascular disease       |              |                      |          |       |
| No                                | 1221 (97.4)  | 25 (2.1)             | 0.69     | 0.406 |
| Yes                               | 33 (2.6)     | 0 (0.0)              |          |       |
| Cerebrovascular disease           |              |                      |          |       |
| No                                | 1233 (98.3)  | 25 (2.0)             | 0.43     | 0.510 |
| Yes                               | 21 (1.7)     | 0 (0.0)              |          |       |
| Coronary heart disease symptom    |              |                      |          |       |
| No                                | 1227 (97.9)  | 23 (1.9)             | 4.14     | 0.042 |
| Yes                               | 27 (2.1)     | 2 (7.4)              |          |       |
| Atrial fibrillation               |              |                      |          |       |
| No                                | 794 (63.3)   | 19 (2.4)             | 1.77     | 0.184 |
| Yes                               | 460 (36.7)   | 6 (1.3)              |          |       |
| Ejection fraction                 |              |                      |          |       |
| ≥50%                              | 1169 (93.2)  | 17 (1.5)             | 25.68    | <0.001|
| <50%                              | 85 (6.8)     | 8 (9.4)              |          |       |
| Previous cardiac surgery          |              |                      |          |       |
| No                                | 1222 (97.4)  | 22 (1.8)             | 9.16     | 0.002 |
| Yes                               | 32 (2.6)     | 3 (9.4)              |          |       |
| Mitral stenosis                   |              |                      |          |       |
| No                                | 638 (50.9)   | 15 (2.4)             | 0.85     | 0.357 |
| Yes                               | 616 (49.1)   | 10 (1.6)             |          |       |
| Mitral regurgitation              |              |                      |          |       |
| No or mild                        | 780 (62.2)   | 10 (1.3)             | 5.35     | 0.021 |
| Moderate or severe                | 474 (37.8)   | 15 (3.2)             |          |       |
| Mitral valve operation            |              |                      |          |       |
| No                                | 325 (25.9)   | 5 (1.5)              | 0.47     | 0.495 |
| Yes                               | 929 (74.1)   | 20 (2.2)             |          |       |
| Mitral valve replacement          |              |                      |          |       |
| No                                | 108 (11.6)   | 0 (0.0)              | 2.69     | 0.101 |
| Yes                               | 821 (88.4)   | 20 (2.4)             |          |       |

Contd...
in China every year and are recommended for valve surgery. AVR and MVR are the classic treatments for most patients with heart valve disease (HVD), but the ratio of mitral valvuloplasty has been increased in recent years. This study directly evaluated the pre- and postoperative risk factors for short-term mortality in Chinese patients who underwent valve surgery. We thought

### Table 1: Predictors of inhospital mortality by univariate analysis and multivariate logistic regression analysis

| Items                        | Number | Short-term mortality | $\chi^2$ | $P$  |
|------------------------------|--------|----------------------|---------|------|
| **Mitral valve repair**      |        |                      |         |      |
| No                           | 821 (88.4) | 20 (2.4)             | 2.69    | 0.101|
| Yes                          | 108 (11.6) | 0 (0.0)              |         |      |
| **Aortic stenosis**          |        |                      |         |      |
| No                           | 868 (69.2) | 16 (1.8)             | 0.33    | 0.568|
| Yes                          | 386 (30.8) | 9 (2.3)              |         |      |
| **Aortic regurgitation**     |        |                      |         |      |
| No or mild                   | 797 (63.6) | 17 (2.1)             | 0.22    | 0.641|
| Moderate or severe           | 457 (36.4) | 8 (1.8)              |         |      |
| **Aortic valve operation**   |        |                      |         |      |
| No                           | 581 (46.3) | 13 (2.2)             | 0.33    | 0.566|
| Yes                          | 673 (53.7) | 12 (1.9)             |         |      |
| **Tricuspid stenosis**       |        |                      |         |      |
| No                           | 1253 (99.9) | 25 (2.0)             | 0.02    | 0.887|
| Yes                          | 1 (0.1)   | 0 (0.0)              |         |      |
| **Tricuspid regurgitation**  |        |                      |         |      |
| No or mild                   | 1072 (85.5) | 17 (1.6)             | 6.29    | 0.012|
| Moderate or severe           | 182 (14.5) | 8 (4.4)              |         |      |
| **Tricuspid repair**         |        |                      |         |      |
| No                           | 996 (79.4) | 20 (2.0)             | 0.01    | 0.943|
| Yes                          | 258 (20.6) | 5 (1.9)              |         |      |
| **Nonelective surgery**      |        |                      |         |      |
| No                           | 1246 (99.4) | 25 (2.0)             | 0.16    | 0.686|
| Yes                          | 8 (0.6)   | 0 (0.0)              |         |      |
| **Biological valve**         |        |                      |         |      |
| No                           | 978 (78.0) | 19 (1.9)             | 0.06    | 0.808|
| Yes                          | 276 (22.0) | 6 (2.2)              |         |      |
| **Mechanical valve**         |        |                      |         |      |
| No                           | 397 (31.7) | 6 (1.5)              | 0.69    | 0.406|
| Yes                          | 857 (68.3) | 19 (2.2)             |         |      |
| **Concomitant CABG**         |        |                      |         |      |
| No                           | 1219 (97.2) | 22 (1.8)             | 7.97    | 0.005|
| Yes                          | 35 (2.8)  | 3 (8.6)              |         |      |
| **Reoperation**              |        |                      |         |      |
| No                           | 1236 (98.6) | 21 (1.7)             | 38.25   | <0.001|
| Yes                          | 18 (1.4)  | 4 (22.2)             |         |      |

CABG: Coronary artery bypass grafting; NYHA: New York Heart Association.

### Table 2: Predictors of inhospital mortality by univariate analysis and multivariate logistic regression analysis

| Variables                      | Univariate analysis | Multivariate analysis |
|--------------------------------|---------------------|-----------------------|
|                                | OR 95% CI | $P$ | Coefficient OR 95% CI | $P$ |
| NYHA-4                         | 9.7 2.7–35.6 | 0.001 | 2.2 8.7 | 2.1–36.2 | 0.003 |
| Smoking history                | 3.3 1.4–7.9 | 0.006 | 1.3 3.7 | 1.5–9.3 | 0.005 |
| CHD symptoms                   | 4.2 0.9–18.7 | 0.061 |         |         |      |
| EF <50%                        | 5.4 2.3–12.9 | <0.001 | 1.7 5.5 | 2.2–13.5 | <0.001 |
| Previous cardiac surgery       | 9.7 2.7–35.6 | 0.001 | 2.4 10.9 | 2.6–46.2 | 0.001 |
| Mitral regurgitation           | 2.5 1.1–5.6 | 0.028 |         |         |      |
| Tricuspid regurgitation        | 2.9 1.2–6.7 | 0.016 | 1.2 3.2 | 1.3–8.1 | 0.012 |
| Concomitant CABG               | 4.9 1.4–17.3 | 0.013 | 1.6 5.0 | 1.3–19.2 | 0.020 |

CABG: Coronary artery bypass grafting; CI: Confidence interval; CHD: Coronary heart disease; EF: Ejection fraction; NYHA: New York Heart Association; OR: Odds ratio.
that these identified risk factors are very important due to the particular characteristics of the East Asian population, such as a different etiology from the Western population and less stringent postsurgery anticoagulation requirements. This study included a total of 1254 patients who underwent valve surgery in single center. The unadjusted short-term mortality of this study was 2.0%. As expected, preoperative NYHA-4, smoking, poor EF, previous cardiac surgery, moderate or severe tricuspid regurgitation, and concomitant CABG were independent risk factors for short-term mortality. Previous research has reported the similar findings.\cite{1,2} In addition, 18 patients who received reoperation owing to major bleeding or pericardial tamponade accounted for 22.2% of the mortality in our sample.

Several studies have shown that age was an independent risk factor for short-term mortality.\cite{1,2} However, the results of this study suggested no strong correlation between age and short-term mortality. Only 11.5% of the patients in this study were over 70 years old, in which there were patients with NYHA-4 and just one with an EF <30% (data not shown). Due to the low proportion of old-age patients in this study, it was insufficient to conclude that older patients who underwent valve surgery were at greater risk than the younger patients.

With regard to the causes of short-term mortality, only 24.0% of the deaths in this study (6 out of 25) were related to atrial fibrillation, which was found in 36.7% of the patients. These patients with atrial fibrillation accounted for only 1.6% of the deaths following valve surgery. Hence, there was insufficient evidence to identify atrial fibrillation as a risk factor for increased mortality. As a result, in concordance with other research,\cite{4} we concluded that atrial fibrillation was not a risk factor for increased mortality, although several studies have cited it as a postvalve surgery risk factor, which influenced perioperative mortality.\cite{2}

Previous studies have developed preoperative risk assessment models for valve operations, mostly were intended for populations in the USA.\cite{2} These models might not be well suitable for patients in China or Asia because of the differences in demographic characteristics. In this study, such factors such as age, gender, renal dysfunction, diabetes, hypertension, and atrial fibrillation did not make a statistically significant contribution to short-term mortality following valve surgery.

The study had several limitations that should be noticed. First of all, the sample size was not large enough to generalize all obtained variables. Between-factor crosstalk also cannot be ruled out. Second, our data were extracted from a single center, which may not represent the actual short-term mortality in the Zhejiang region. Finally, the variables included in this study were not exhaustive of all variables that potentially affect mortality.

In conclusion, this study statistically analyzed NYHA-4, smoking history, poor EF, previous cardiac surgery, moderate or severe tricuspid regurgitation, and concomitant CABG to be the independent risk factors for short-term mortality in patients who had undergone valve surgery in Zhejiang of China. It helps cardiac surgeons to evaluate the short-term mortality of valve surgeries due to the special demographic characteristics of HVD patients here.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

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