Comparison of Health-Related Quality of Life in Adults Undergoing Transthoracic and Transcatheter Device Closure for Ventricular Septal Defects
Kai-Peng Sun, Ning Xu, Shu-Ting Huang, Liang-Wan Chen and Qiang Chen

Summary
This study aims to compare and analyze the health-related quality of life (HRQoL) of adult patients with ventricular septal defects (VSDs) who underwent transthoracic or transcatheter device closure.

The HRQoL data of 30 patients who underwent transthoracic device closure for VSDs and 30 who underwent transcatheter device closure for VSDs were retrospectively evaluated before and one year after the procedure. The Medical Outcomes Study 36-Item Short-Form (SF-36), the Hospital Anxiety and Depression Scale (HADS), and a self-designed questionnaire were used as evaluation tools.

After treatment, both groups showed significant improvements in SF-36 and HADS scores. After comparing the two groups regarding the SF-36, there was a significant difference in the two dimensions of vitality and mental health. There were no statistically significant differences in the HADS-A and HADS-D scores between these two groups. The results of the self-designed questionnaire also showed that the subjective feedback of the two groups was roughly the same. In the process of exploring the influential factors, we found that the scores of patients on most dimensions of the SF-36 in the two groups showed a significantly negative trend with increasing age. In terms of HADS scores, patients in both groups showed a tendency toward increasing scores with age.

The HRQoL of adult patients undergoing transthoracic and transcatheter device closure for VSDs was similar, and the HRQoL was affected by the patient’s own condition, so it is necessary to pay more attention to patients after device closure.

Key words: SF-36, Prognosis, HADS

As one of the most common congenital heart diseases, ventricular septal defects (VSDs) account for 80% of congenital heart disease cases. Surgical repair for VSDs with extracorporeal circulation as an effective treatment has been widely used in clinical practice. With the continuous development of occluder and interventional technologies, transcatheter device closure for VSDs has gradually become another reliable treatment. In recent years, transthoracic device closure for VSDs has been widely used and has produced good results, especially in China. Many studies have examined the postoperative prognosis of patients with VSDs, but most of them have focused on postoperative complications and cardiac function and have paid less attention to the health-related quality of life (HRQoL) of patients. There has been no research comparing the postoperative HRQoL in Chinese patients undergoing transthoracic and transcatheter device closure for VSDs. The purposes of this study were (1) to compare the postoperative HRQoL in patients with different device closure treatments and (2) to explore the factors influencing HRQoL in patients undergoing different device closure treatments for VSDs.

Methods
Patients: A total of 66 patients who successfully underwent transthoracic or transcatheter device closure for VSDs in the heart center of our hospital from January 2017 to January 2018 were followed up before and one year after the procedure. The inclusion criteria were as follows: (1) The patient survived after device closure for VSDs and was willing to undergo follow-up, (2) there was no severe organ dysfunction or other major surgery, and (3) the patient had no mental disorders and could cooperate with the examination. The sample size was determined with PASS 15.0. The alpha value was set at 0.05.
with a power of 0.90. Based on the calculation, the resulting minimum sample size was 56 patients. Considering a 15% dropout rate, we included 66 patients in the study.

Before choosing the treatment, all the patients were informed of the advantages, disadvantages, indications, and contraindications of the two different types of device closure for VSD. The patients chose their own treatment based on their treatment preference and their condition and then were divided into two groups. Patients in group A underwent transthoracic device closure, and those in group B underwent transcatheter device closure. In the occluder.3,4,7)

Device closure technology: The procedure was performed under general anesthesia in group A. A lower median sternum incision was selected, and the sternum was partially split. The pericardium was opened and suspended to expose the right ventricle. Right ventricular puncture was performed, and a guidewire was inserted into the puncture site. Under transesophageal echocardiography (TEE) guidance, the guidewire was inserted into the left ventricle via the VSD. A transport sheath was inserted along the guidewire to establish the transport track. The occluder was implanted along the transport sheath and released on both sides of the ventricular septum to close the VSD. TEE was used to detect and ensure the correct location of the occluder.3,4,7)

In group B, the procedure was performed under local or general anesthesia and X-ray fluoroscopy, followed by puncture of the femoral artery and vein and left and right cardiac catheterization. A pigtail catheter was inserted into the left ventricle, and left ventriculography was used to observe the shape and size of the VSD and to determine whether valve regurgitation was present. The track of the femoral artery-aorta-left ventricle-VSD-right ventricle-femoral vein was established. The delivered sheath tube was inserted along the guidewire, and an occluder with a diameter larger than the VSD as measured by angiography (1-4 mm) was selected. The occluder was advanced along the sheath and released under the guidance of radiography.8)

Questionnaire: The questionnaires included the Medical Outcomes Study 36-Item Short-Form (SF-36) and the Hospital Anxiety and Depression Scale (HADS), which were completed by all patients before they received the treatment. One year after device closure for VSD, the patients were followed up in the outpatient department. After the patients were examined for cardiac function with card-

### Table 1. Participants’ Sociodemographics and Clinical Data

| Variable                  | Group A (n = 30) | Group B (n = 30) | All participants (n = 60) |
|---------------------------|-----------------|-----------------|--------------------------|
| Age (years)               |                 |                 |                          |
| 18-30                     | 15 (50.0%)      | 14 (46.7%)      | 29 (48.3%)               |
| 31-50                     | 9 (30.0%)       | 10 (33.3%)      | 19 (31.7%)               |
| > 50                      | 6 (20.0%)       | 6 (20.0%)       | 12 (20.0%)               |
| Sex                       |                 |                 |                          |
| Male                      | 19 (63.3%)      | 14 (46.7%)      | 33 (55.0%)               |
| Female                    | 11 (36.7%)      | 16 (53.3%)      | 27 (45.0%)               |
| Marital status            |                 |                 |                          |
| Married                   | 16 (53.3%)      | 16 (53.3%)      | 32 (53.3%)               |
| Unmarried                 | 14 (46.7%)      | 14 (46.7%)      | 28 (46.7%)               |
| Education level           |                 |                 |                          |
| Junior high school education or below | 9 (30.0%) | 10 (33.3%) | 19 (31.7%) |
| High school diploma       | 15 (50.0%)      | 12 (40.0%)      | 27 (45.0%)               |
| Undergraduate degree or higher | 6 (20.0%) | 8 (26.7%) | 14 (23.3%) |
| Employment                |                 |                 |                          |
| Full time                 | 12 (40.0%)      | 14 (46.7%)      | 26 (43.3%)               |
| Part time                 | 9 (30.0%)       | 7 (23.3%)       | 16 (26.7%)               |
| Unemployment              | 9 (30.0%)       | 9 (30.0%)       | 18 (30.0%)               |
| Clinical symptoms         |                 |                 |                          |
| Dyspnea                   | 1 (3.3%)        | 1 (3.3%)        | 2 (3.3%)                 |
| Fatigue                   | 7 (23.3%)       | 4 (13.3%)       | 11 (18.3%)               |
| Cough                     | 5 (16.7%)       | 4 (13.3%)       | 9 (15.0%)                |
| Hemodynamic data          |                 |                 |                          |
| Heart rate (beats/minute) | 9.1 ± 1.9       | 9.2 ± 1.7       | 9.2 ± 1.8                |
| Systolic blood pressure (mmHg) | 71.0 ± 13.3 | 74.5 ± 10.1 | 73.7 ± 11.8 |
| Diastolic blood pressure (mmHg) | 120.3 ± 12.1 | 117.1 ± 13.4 | 118.7 ± 12.6 |
| PaO₂ (%)                  | 77.6 ± 8.2      | 72.8 ± 9.2      | 75.2 ± 9.0               |
| Mets                      | 98.7 ± 1.8      | 97.9 ± 2.2      | 98.3 ± 2.0               |

Mets indicates exercise tolerance in metabolic equivalents.
We designed a questionnaire to investigate the subjective responses of patients to improvements in HRQoL after device closure for VSDs.

The following statements were included in the questionnaire to evaluate the HRQoL of the patients.

- My quality of life is worse than it was before the procedure.
- My quality of life is no better than it was before the procedure.
- My quality of life is slightly better than it was before the procedure.
- My quality of life is significantly better than it was before the procedure.

The psychological domain includes vitality, social function, role-emotional, and mental health. The score on each dimension ranges from 0 to 100, and higher scores indicate better health.

**SF-36:**

We used the standard Chinese translation of the SF-36 scale to evaluate the postoperative HRQoL of the patients. The scale consists of 36 standardized questions and contains two aspects: the physiological domain and the social psychology domain; each aspect contains four dimensions. The physiological domains include physical functioning, role-physical, bodily pain, and general health. The psychology domain includes vitality, social functioning, role-emotional, and mental health. The score on each dimension ranges from 0 to 100, and higher scores indicate better health.

**HADS:**

The HADS is a self-reported standard scale that focuses on the anxiety and depression of patients. It contains 14 questions: 7 on the anxiety subscale (HADS-A) and 7 on the depression subscale (HADS-D). For each question, there are four choices on a scale from 0 to 3 to indicate the degree of severity of the given symptom. Both the HADS-A and HADS-D are scored from 0 to 21 points. Higher scores indicate more severe symptoms of anxiety or depression.

**Self-designed questionnaire:**

We designed a questionnaire to investigate the subjective responses of patients to improvements in HRQoL after device closure for VSDs. The following statements were included in the questionnaire: (1) My quality of life is worse than it was before the procedure, (2) my quality of life is no better than it was before the procedure, (3) my quality of life is significantly better than it was before the procedure, (4) my quality of life is significantly better than it was before the procedure, and (5) I feel that my quality of life is the same as that of normal people.

**Statistics:**

SPSS 18.0 was used for the statistical analysis. A chi-square test was used to compare the differences in the distributions of demographic characteristics between groups A and B. Normality tests were carried out for the SF-36 data in groups A and B, and the data were all normally distributed. T tests were used to compare the eight dimensions of the SF-36 in groups A and B. The HADS-A and HADS-D data of groups A and B were tested for normality, and the data did not conform to a normal distribution. The Mann-Whitney U test was used to compare the HADS-A and HADS-D scores between groups A and B. The Kruskal-Wallis test and Mann-Whitney U test were used to compare the SF-36 and HADS scores of the internal subgroups in groups A and B. P < 0.05 was considered statistically significant.

**Results**

Results showed that there were no statistically significant differences in the distributions of age, sex, marital status, education level, and employment status between the two groups. Echocardiographic results of the study participants showed that in most patients, the cardiac malformations had been corrected and cardiac function had been improved after treatment, while the results of echocardiography of groups A and B showed that there were no significant differences in most indicators of cardiac function between the two groups (Table II).

A comparison of preoperative and postoperative SF-36 scores in both groups showed that the patients showed significant improvement on most dimensions after VSD closure treatment. According to the statistical analysis of postoperative SF-36 scores in groups A and B, there was no significant difference in physical function, role-physical, bodily pain, general health, social functioning, or role-emotional between the two groups. There were statistically significant differences in vitality (A: 64.5 ± 12.1, B: 73.5 ± 13.4, P = 0.008) and mental health (A: 61.2 ± 14.7, B: 73.9 ± 14.0, P = 0.001) (Table III).

In the comparison of preoperative and postoperative HADS scores in both groups after VSD closure treatment, significant trends of improvement in the scores on both the HADS-A and HADS-D were found. However, the results of the postoperative HADS scores in groups A and B showed that the scores of the two groups were similar. The statistical results showed that the scores on the HADS-A were 4.3 ± 3.8 in group A and 4.1 ± 3.7 in group B, P = 0.899, and that the scores on the HADS-D were 3.3 ± 3.3 in group A and 4.2 ± 4.0 in group B, P = 0.923, with no significant difference between them (Table II).

**Table II. Echocardiographic Data Between Two Groups After Treatment**

| Item                                      | Group A       | Group B       |
|-------------------------------------------|---------------|---------------|
| End-systolic length of the right atrium (mm) | 44.6 ± 4.7    | 46.2 ± 6.4    |
| End-systolic width of the right atrium (mm) | 38.2 ± 5.6    | 36.9 ± 6.3*   |
| End-diastolic length of the right ventricle (mm) | 61.2 ± 11.7   | 60.5 ± 12.5   |
| End-diastolic width of the right ventricle (mm) | 31.4 ± 8.6    | 32.5 ± 10.3   |
| End-systolic length of the left atrium (mm) | 45.5 ± 6.3    | 46.7 ± 5.3    |
| End-systolic width of the left atrium (mm) | 38.2 ± 3.5    | 36.4 ± 5.5*   |
| End-systolic width of the left ventricle (mm) | 31.5 ± 4.5    | 32.0 ± 6.7    |
| End-systolic length of the left ventricle (mm) | 50.2 ± 8.3    | 49.5 ± 6.6    |
| End-diastolic width of the left ventricle (mm) | 45.4 ± 4.8    | 47.5 ± 5.4*   |
| End-diastolic length of the left ventricle (mm) | 68.7 ± 7.9    | 70.1 ± 6.8    |
| Left ventricular ejection fraction (%)      | 63.5 ± 5.0    | 62.6 ± 7.8    |

*P < 0.05. Data are presented as mean ± standard deviation.
In the heart

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Figure 1. The distribution of the two groups’ responses to the self-designed questionnaire.

Table III. SF-36 Mean Scores for Each Group

| HRQoL domain          | Group A | Group B | P1  | P2  | P3  |
|-----------------------|---------|---------|-----|-----|-----|
|                       | Pre     | Post    | Pre | Post|     |
| Physical functioning  | 43.0 ± 21.5 | 60.3 ± 13.6 | 48.3 ± 18.1 | 62.2 ± 12.1 | 0.001 | 0.001 | 0.584 |
| Role-physical         | 47.5 ± 23.6 | 53.3 ± 26.9 | 55.8 ± 24.3 | 64.2 ± 21.5 | 0.313 | 0.095 | 0.090 |
| Bodily pain           | 47.9 ± 18.6 | 58.6 ± 14.0 | 48.3 ± 16.8 | 62.6 ± 12.9 | 0.013 | 0.002 | 0.256 |
| General health        | 40.2 ± 17.2 | 60.2 ± 19.5 | 39.2 ± 16.5 | 66.3 ± 13.5 | 0.001 | < 0.001 | 0.159 |
| Vitality              | 58.0 ± 12.8 | 64.5 ± 12.1 | 57.8 ± 13.6 | 73.5 ± 13.4 | 0.027 | < 0.001 | 0.008 |
| Social functioning    | 55.8 ± 15.0 | 69.1 ± 14.7 | 57.9 ± 15.8 | 70.2 ± 13.6 | 0.005 | 0.002 | 0.768 |
| Role-emotional        | 61.1 ± 32.3 | 53.3 ± 25.7 | 56.7 ± 27.9 | 64.2 ± 21.5 | 0.309 | 0.664 | 0.640 |
| Mental health         | 64.3 ± 17.0 | 61.2 ± 14.7 | 66.3 ± 13.5 | 73.9 ± 14.0 | 0.393 | 0.005 | 0.001 |

Dates are expressed as mean ± SD, score ranging from 0 to 100, higher scores indicating better health status. P1 indicates P value of the postoperative and preoperative SF-36 score in group A; P2, P value of the postoperative and preoperative SF-36 score in group B; and P3, P value of postoperative SF-36 score between the two groups. *P < 0.05 was considered statistically significant.

Table IV. Summary of Patient HADS Outcomes

| N | Group A | Group B | Pre HADS-A | HADS-D | Post HADS-A | HADS-D | Pre HADS-A | HADS-D | Post HADS-A | HADS-D |
|---|---------|---------|------------|--------|------------|--------|------------|--------|------------|--------|
|   |         |         | Mean ± SD  |        | Mean ± SD  |        | Mean ± SD  |        | Mean ± SD  |        |
|   |         |         | 6.4 ± 4.8  | 6.5 ± 4.3| 4.3 ± 3.8* | 7.4 ± 4.5| 7.9 ± 4.9  | 4.1 ± 3.7*| 4.2 ± 4.0*|
|   |         |         | 0.0        | 0.0    | 0.0        | 1.0    | 1.0        | 0.0    | 0.0        |
|   |         |         | 16.0       | 15.0   | 14.0       | 18.0   | 17.0       | 14.0   | 16.0       |

* P < 0.05

Comparison of self-designed questionnaire respondents

With regard to the subjective feedback of patients in terms of their own perception of their HRQoL one year after the procedure, most of the patients felt that their HRQoL had somewhat improved than their HRQoL before the procedure (group A, 13/30; group B, 15/30), and only a few of them felt that their HRQoL was worse than it was before the procedure (group A, 1/30; group B, 1/30) (Figure 1).

In this study, we also explored some factors that might affect the HRQoL of patients. In the analysis of the survey results of the postoperative SF-36, the scores in...
groups A and B on most dimensions showed a negative trend with increasing age, and the difference was statistically significant. Other factors had no significant effect on the postoperative SF-36 scores in groups A and B (Figure 2). When studying the factors influencing patients’ postoperative HADS scores, we found a trend toward a positive correlation with age in terms of the HADS-A and HADS-D scores in both groups (Figure 3). However, other factors had no significant effects on the HADS-A and HADS-D scores in either group.
Discussion

VSDs represent one of the most common congenital heart diseases. Due to historical reasons and economic and cultural limitations, there are still some adult VSD patients in clinical practice in China who need medical intervention. Research has shown that with the continuous upgrading of interventional devices and with clinicians becoming increasingly skilled in terms of the performance of device closure for VSDs, people expect increasing therapeutic effects from device closure for VSDs. However, while paying attention to the therapeutic effect of VSD closure, we should also pay attention to the postoperative HRQoL of patients to better track the prognosis of this disease. HRQoL is not only physical but also psychological and even social. In addition to understanding the recovery of physical function, we should also pay attention to emotional and mental changes to achieve the dual rehabilitation of physical and psychological factors. Studying the postoperative HRQoL of adult patients with VSDs after transcatheter or transcatheter device closure can not only help us understand the postoperative living conditions of patients but also allow us to compare the different effects of the two treatments on patients and help improve the clinical treatment scheme. To obtain a better and more comprehensive understanding of patients’ HRQoL, we used the standard SF-36, the HADS, and a self-designed questionnaire as our evaluation tools in this study.

As a general standard questionnaire used to explore HRQoL, the SF-36 is widely used to study congenital heart disease. The characteristics of the SF-36, including physiological and psychosocial factors, also make it more comprehensive with regard to reflecting the HRQoL of patients. The HADS, which focuses on anxiety and depression, is also widely used to explore the psychological health of patients.

As two safe and effective treatments for VSDs, transcathartic and transcathartic device closure treatment have been increasingly applied in the clinic. In some existing studies, researchers have explored HRQoL in patients with VSD after either thoracic or catheter closure. In most of these studies, the objective was to compare the changes in HRQoL in patients before and after treatment or to compare patients’ HRQoL with that of healthy peers during the same period to explore the positive effects of treatment. However, there has been no cross-sectional comparison between the two treatments, so research on the different effects of these two treatments on the postoperative HRQoL of adult patients is still needed.

In this study, we found that there was no significant difference in SF-36 scores between groups A and B except for the two dimensions of vitality and mental health. The reason might be that the patients subjectively felt that the transcatheter procedure had less impact on the body than the transcathartic procedure and thus had more positive feedback in the psychological domain.

Many studies have shown that anxiety and depression play important roles in the prognosis of heart disease. A series of physiological changes caused by different types of mental stress often lead to different prognoses, so it is critical to strengthen research on postoperative anxiety and depression in patients. In the statistical analysis of postoperative HADS scores, the feedback results of patients in the two groups in terms of anxiety and depression were similar, and there was no significant difference. The results suggest that there is no significant difference between the effects of transcatheter and transstrahoracic procedures on anxiety and depression in patients. By comparing the feedback results on the self-designed questionnaire in this study, it was found that the two groups of patients had similar attitudes toward the improvements in their HRQoL after VSD treatment. It might be concluded that transcatheter and transstrahoracic device closure treatments for VSDs had similar effects on the HRQoL of patients, so the two groups of patients had similar subjective evaluations of postoperative HRQoL.

After a comprehensive analysis of the results of the SF-36, HADS, and self-designed questionnaire, we found that the effects of the two treatment methods on quality of life were roughly similar. In addition, after referring to some studies on postoperative complications and cardiac function after the two surgeries, we speculate that the two treatments may not be very different from each other in terms of quality of life.

In the process of exploring the factors that affected the HRQoL of patients, we found that age might be a major concern. In the analysis of SF-36 scores, the results of both groups showed that the HRQoL of patients tended to decline with age on most dimensions, which was statistically significant. This is similar to the work of Loup, et al., who studied quality of life after congenital heart surgery in adults with congenital heart disease. Age plays an important role in quality of life. The reason might be that as patients grow older, their physical function declines, they are at a disadvantage in terms of many activities than young people, and they have a reduced ability to respond to psychological setbacks with resilience, which might lead to patients’ lack of confidence and motivation in life. Similarly, in the HADS analysis, patients showed more depression or anxiety with increasing age, perhaps because older patients were more likely to worry about their health and were less confident about their health than younger patients. Perhaps, we should pay more attention to elderly patients and strengthen their psychological support to achieve better physical and mental rehabilitation.

Limitations: The limitations of this study mainly include the following aspects: (1) There were only 60 subjects in this study, and the results might have been skewed due to selection bias, so the number of subjects should be increased in future studies. (2) This study was an observational and cross-sectional study, so it could not reflect the long-term changes in patients’ HRQoL. Therefore, in future studies, the investigation period should be extended to achieve longitudinal observation and to clarify the causal relationship between the influencing factors and the results. (3) This was a retrospective study, and we hope to perform a prospective randomized controlled study in the future.
Conclusion

After comparing the HRQoL of adult patients with VSDs who underwent transthoracic or transcatheter device closure, it was found that the effects of the two different treatments on the HRQoL of patients were basically the same, and there was no significant difference in the effects on patients’ mental stress and patients’ self-evaluated HRQoL. With regard to the factors affecting HRQoL, age may be an important factor, and the HRQoL of patients seems to change with changes in their condition. Therefore, it is still necessary to pay more attention to patients after these procedures.

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Disclosure

Conflicts of interest: The authors declare that they have no competing interests.

Author Contributions: K-pS, QC, and HC designed the study, performed the statistical analysis, participated in the operation, and drafted the manuscript. NX and S-th collected the clinical data. HC and L-wC provide technical support. All authors read and approved the final manuscript.

References

1. Anderson BR, Stevens KN, Nicolson SC, et al. Contemporary outcomes of surgical ventricular septal defect closure. J Thorac Cardiovasc Surg 2013; 145: 641-7.
2. Santhanam H, Yang L, Chen Z, Tai BC, Rajgor DD, Quek SC. A meta-analysis of transcatheter device closure of perimembranous ventricular septal defect. Int J Cardiol 2018; 254: 75-83.
3. Xing Q, Wu Q, Shi L, Xing Y, Yu G. Minimally invasive transthoracic device closure of isolated ventricular septal defects without cardiopulmonary bypass: long-term follow-up results. J Thorac Cardiovasc Surg 2015; 149: 257-64.
4. Chen Q, Hong ZN, Zhang GC, et al. Intraoperative device closure of isolated ventricular septal defects: experience on 1,000 cases. Ann Thorac Surg 2018; 105: 1797-802.
5. Rahmath MR, Numan M, Dilawar M. Medium to long-term echo follow-up after ventricular septal defect device closure. Asian Cardiovasc Thorac Ann 2016; 24: 422-7.
6. Bai Y, Liu J, Qin YW, Wu H, Zhao XX. Percutaneous closure of perimembranous ventricular septal defect with modified double-disc occluder: what is the outcome at 10-year Follow-up? Congenit Heart Dis 2016; 11: 45-51.
7. Hong ZN, Chen Q, Huang LQ, Cao H. A meta-analysis of percutaneous ventricular device closure of perimembranous ventricular septal defect. J Cardiothorac Surg 2019; 14: 119.
8. Santhanam H, Yang L, Chen Z, Tai BC, Rajgor DD, Quek SC. A meta-analysis of transcatheter device closure of perimembranous ventricular septal defect. Int J Cardiol 2018; 254: 75-83.
9. Ware JE Jr, Sherbourne CD, The MOS. 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992; 30: 473-83.
10. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983; 67: 361-70.
11. Boukouvala M, Müller J, Ewert P, Hager A. Effects of congenital heart disease Treatment on quality of life. Am J Cardiol 2019; 123: 1163-8.
12. Schoormans D, Mulder BJ, van Melle JP, et al. Illness perceptions of adults with congenital heart disease and their predictive value for quality of life two years later. Eur J Cardiovasc Nurs 2014; 13: 86-94.
13. Kamphuis M, Ottenkamp J, Vliegen HW, et al. Health related quality of life and health status in adult survivors with previously operated complex congenital heart disease. Heart 2002; 87: 356-62.
14. Cox D, Lewis G, Stuart G, Murphy K. A cross-sectional study of the prevalence of psychopathology in adults with congenital heart disease. J Psychosom Res 2002; 52: 65-8.
15. Amedro P, Basquin A, Gressin V, et al. Health-related quality of life of patients with pulmonary arterial hypertension associated with CHD: the multicentre cross-sectional ACHILLE study. Cardiol Young 2016; 26: 1250-9.
16. Yang Y, Ding R, Hu D, Zhang F, Sheng L. Reliability and validity of a Chinese version of the HADS for screening depression and anxiety in psycho-cardiological outpatients. Compr Psychiatry 2014; 55: 215-20.
17. Lee SM, Song JY, Choi JY, et al. Transcatheter closure of perimembranous ventricular septal defect using Amplatzer ductal occluder. Catheter Cardiovasc Interv 2013; 82: 1141-6.
18. Yang J, Yang L, Yu S, et al. Long-term follow-up and quality of life after closure of ventricular septal defect in adults. Eur J Cardiothorac Surg 2007; 32: 215-9.
19. Sun KP, Chen Q, Hong ZN, Huang JS, Cao H. Health-related quality of life in adults undergoing transthoracic device closure of ventricular septal defect. J Cardiothorac Surg 2019; 14: 176.
20. Huang JS, Huang ST, Sun KP, et al. Health-related quality of life in children and adolescents undergoing intraoperative device closure of isolated perimembranous ventricular septal defects in southeastern China. J Cardiothorac Surg 2019; 14: 218.
21. Li H, Shi Y, Zhang S, et al. Short- and medium-term follow-up of transcatheter device closure of perimembranous ventricular septal defects. BMC Cardiovasc Disord 2019; 19: 222.
22. Chauvet-Gelinier JC, Bonin B. Stress, anxiety and depression in heart disease patients: A major challenge for cardiac rehabilitation. Ann Phys Rehabil Med 2017; 60: 6-12.
23. Wang Q, Hay M, Clarke D, Menahem S. The prevalence and predictors of anxiety and depression in adolescents with heart disease. J Pediatr 2012; 161: 943-6.
24. Szukataik M, Kasa J, Bialkowski J. Percutaneous closure of perimembranous ventricular septal defects with Amplatzer occluders-a single centre experience. Kardiol Pol 2008; 66: 941-7; discussion 948.
25. Arora R, Trehan V, Kumar A, Kalra GS, Nigam M. Transcatheter closure of congenital ventricular septal defects: experience with various devices. J Interv Cardiol 2003; 16: 83-91.
26. Song X, Xing Q, Wu Q, Ren Y, Wan H, Li J. Transantracohorac device closure of juxtaarterial ventricular septal defects: midterm follow-up results. Ann Thorac Surg 2017; 104: 841-6.
27. Loup O, von Weissenwcluz C, Gahl B, Schwerzmann M, Carrle T, Kadner A. Quality of life of grown-up congenital heart disease patients after congenital cardiac surgery. Eur J Cardiothoracic Surg 2009; 36: 105-11; discussion 111.
28. Govers AC, Buurman BM, Jue P, de Mol BA, Dongelmans DA, de Rooij SE. Functional decline of older patients 1 year after cardiothoracic surgery followed by intensive care admission; a prospective longitudinal cohort study. Age Ageing 2014; 43: 575-80.
29. Keeney T, Fox AB, Jette DU, Jette A. Functional trajectories of persons with cardiovascular disease in late life. J Am Geriatr Soc 2019; 67: 37-42.
30. Vetrano DL, Rizzuto D, Calderón-Larrañaga A, et al. Trajectories of functional decline in older adults with neuropsychiatric and cardiovascular multimorbidity: A Swedish cohort study. PLOS Med 2018; 15: e1002503.