Should we have surgery before pregnancy for women with congenital heart disease?

Yang Liu[1], Yanna Li[1], Jun Zhang[1], jiachen li[1], Yichen Zhao[1], Kemin Liu[1], Xiangming Fan[1], and Jiangang Wang[1]

[1]Capital Medical University Affiliated Anzhen Hospital

November 11, 2021

Abstract

Objective: To investigate whether it is better to have surgery before pregnancy for pregnant women with congenital heart disease (CHD). **Methods:** Patients with CHD in Beijing Anzhen Hospital from 2010 to 2019 were collected and divided into surgical and non-surgical group, and the differences of events between the two groups were compared. **Results:** A total of 999 patients with CHD (mean age, 28.7±4.3years) were collected, including 403 cases (40.0%) in the surgical group and 596 cases (60.0%) in the non-surgical group. The most common CHD was atrial septal defect(33.1%), followed by ventricular septal defect (26.9 %), patent ductus arteriosus (9.9 %), and Tetralogy of Fallot (6.9 %). There were significant statistical differences in region, education degree and gravidity (P¡0.05), and the percentage of almost all events in the surgical group was higher. Pre-term delivery (17.1 vs. 9.9), low birth weight (11.6 vs. 6.5), heart failure (6.7 vs. 2.7), cesarean section (85.9 vs. 75.7), pulmonary arterial hypertension (36.2 vs. 13.6), Eisenmenger syndrome (9.7 vs. 0.2), and death (2.3 vs. 0.5) had statistically significant (P¡0.05). A total of 16 (1.6%) patients died, 14 (87.5%) in the surgical group, more than 2 (12.5%) in the non-surgical group. **Conclusions:** The outcome of surgical group was better than that of non-surgical group, surgery before pregnancy can reduce maternal and infant risk.

Should we have surgery before pregnancy for women with congenital heart disease?

Yang Liu, MD[1] Yanna Li, MD[2] Jun Zhang, MD, PhD[2] Jiachen Li, MD[1]Yichen Zhao, MD[3] Kemin Liu, MD[3]Xiangming Fan, MD[1*] Jiangang Wang, MD, PhD[3*]

Corresponding author: Jiangang Wang, Capital Medical University, Beijing Anzhen Hospital, No.2 Anzhen Road, Chaoyang District, Beijing, China. Postcode: 100029. Tel: +86-10-64456384, Email:*jiangangwang@ccmu.edu.cn.*

Author Details

1, Department of Pediatric Cardiac Center, Beijing Anzhen Hospital, Capital Medical University, No 2 Anzhen Road, Chaoyang District, Beijing, China.

2, Department of Obstetrics and Gynecology, Beijing Anzhen Hospital, Capital Medical University, No 2 Anzhen Road, Chaoyang District, Beijing, China.

3, Department of Adult Cardiac surgery center, Beijing Anzhen Hospital, Capital Medical University, No 2 Anzhen Road, Chaoyang District, Beijing, China.

Abstract

Objective:

To investigate whether it is better to have surgery before pregnancy for pregnant women with congenital heart disease (CHD).

Methods:

Patients with CHD in Beijing Anzhen Hospital from 2010 to 2019 were collected and divided into surgical and non-surgical group, and the differences of events between the two groups were compared.

Results:

A total of 999 patients with CHD (mean age, 28.7±4.3years) were collected, including 403 cases (40.0%) in the surgical group and 596 cases (60.0%) in the non-surgical group. The most common CHD was atrial septal defect(33.1%), followed by ventricular septal defect (26.9 %), patent ductus arteriosus (9.9 %), and Tetralogy of Fallot (6.9 %). There were significant statistical differences in region, education degree and gravidity (P¡0.05), and the percentage of almost all events in the surgical group was higher. Pre-term delivery (17.1 vs. 9.9), low birth weight (11.6 vs. 6.5), heart failure (6.7 vs. 2.7), cesarean section (85.9 vs. 75.7), pulmonary arterial hypertension (36.2 vs. 13.6), Eisenmenger syndrome (9.7 vs. 0.2), and death (2.3 vs. 0.5) had statistically significant (P¡0.05). A total of 16 (1.6%) patients died, 14 (87.5%) in the surgical group, more than 2 (12.5%) in the non-surgical group.

Conclusions:

The outcome of surgical group was better than that of non-surgical group, surgery before pregnancy can reduce maternal and infant risk.

Key words:

Surgery, Congenital Heart Disease, Pregnancy, Women

Introduction

Due to improvement in the treatment of congenital heart disease (CHD), most women with CHD now survive to adulthood, get married and try conception, and concomitant CHD is thought to increase perinatal risk[1-3]. Traditional thinking that cardiac surgery prior to pregnancy improves maternal and fetal outcome in patients with CHD. However, there are a few relevant studies, large samples were less[4-6]. Moreover, whether and when CHD parturients need surgery still needs to be discussed.

In 2007, Beijing Anzhen Hospital affiliated to Capital Medical University, was designated as the only referral and consultation center of pregnancy with heart diseases in Beijing. Almost all pregnant women with CHD visited Beijing Anzhen Hospital for consultation, treatment, and gave birth to children, which has laid the research foundation for this study.

In the previous study of our team, it was had determined that the risk of maternal complications during pregnancy with CHD was higher than that without CHD. In this study, we will further investigate whether it is better to have surgery before pregnancy or after surgery for pregnant women with CHD.

Methods

This study retrospectively analyzed the clinical data of 999 patients with CHD who were admitted to our hospital between January 2010 and December 2019 (**Figure 1**). Patients were divided into surgical and non-surgical group, and the differences of obstetric events, cardiovascular events, delivery procedure, fetal events, and other events between the two groups were compared. Obstetric events included hypertension during pregnancy, placenta previa, gestational diabetes, placental abruption, hemorrhage, pre-term delivery, and preeclampsia. Cardiovascular complications included heart failure (HF), arrhythmias, and thromboembolic events such as stroke and pulmonary embolism. Delivery procedure included cesarean section (CS), artificial rupture of the membranes, and induction. Fetal events included fetal distress, fetal growth restriction, fetal malformation, fetal death or stillbirth, and low birth weight (LBW). Moreover, there were other events

like pulmonary hypertension (PH), Eisenmenger syndrome (ES), death, respiratory diseases, and systemic hypertension. Meanwhile, all patients and their offspring were followed up by telephone.

Statistical analysis

The normality of the variables was analyzed by Kolmogorov-Smirnov test and Shapiro-Wilk test. For the variables that were approximately to normal distribution descriptive statistics such as mean, standard deviation and the range values were calculated. For non-normal data median values were compared. Comparison of two group means were tested using student independent test. Categorical variables were expressed in terms of frequency and percent values. Logistic regression was used to calculate crude odds ratios and adjusted odds ratios and their 95% confidence intervals for each comorbidity as well as cardiovascular, obstetric, fetal, delivery, and other events. We performed univariable analysis at first, and multivariable logistic regression analysis was performed for the variables with $P < 0.1$. For all analyses, statistical significance was assigned based on a p-value <0.05. All statistical analyses were conducted using SPSS (IBM-SPSS Statistics v22.0, Inc. Chicago, IL) and R version 4.0.4 (R Foundation for Statistical Computing, Vienna, Austria, 2021).

Results

A total of 999 patients (mean age, 28.7+-4.3years) with CHD were collected, including 403 cases (40.0%) in the surgical group and 596 cases (60.0%) in the non-surgical group. The most common CHD was atrial septal defect(ASD, 33.1%), followed by ventricular septal defect (VSD, 26.9%), patent ductus arteriosus (PDA, 9.9%) and tetralogy of Fallot (TOF) (**Figure 2**). The classification of various CHD are shown in **Supplementary Table 1** .

The overall percentage of patients who didn't get surgery (60.0%) had a higher percentage than those who got surgery(40.0%). And there was a higher rate of surgery for complex CHD, such as TOF (89.9%), a lower rate of surgery for simple CHD, such as patent foramen ovale (PFO, 0.0%). For each type of CHD, the rate of surgical versus non-surgical is shown in **Figure 3** and **Supplementary Table 1** .

We collected sociodemographic information of these women, region, education degree, gravidity and parity, which were summarized in the**Table 1** . There was no statistically significant difference in age, mean pregnant weeks and parity between the two groups. P¡0.05 in the comparison of region, education degree and gravidity.

In obstetric events, cardiovascular events, delivery procedure, fetal events and other events, the incidence of almost all events was higher in the surgical group. And there were significant differences in pre-term delivery, LBW, HF, CS, PH and death between the two groups (P¡0.05). More details are shown in **Table 2** .

A total of 16 patients (1.6%) died in the two groups, including 2 patients in the surgical group and 14 patients in the non-surgical group. More details are shown in **Table 3.** And there were 8 newborns (0.8%) died in the hospital.

Follow-up

The mean follow-up was 5.9+-2.8 years. In the surgical group, no mother died after discharge, and 1 (0.2%) offspring died after discharge. The corresponding number were 6 (1.5%) and 4 (0.7%) in the non-surgical group. (**Figure 4 and 5**). There were 21 (5.2%) patients with PH in the surgical group and 119 (20.0%) patients with PH in the non-surgical group, most of them required targeted drug therapy. In addition, there were 5 (1.2%) patients with cardiac insufficiency in the surgical group, less than 21 (3.5%) in the non-surgical group.

Discussion

Although it is traditionally believed that women with CHD should undergo surgery before pregnancy, this view is still controversial[7].

In our sociodemographic information, the rate of CHD surgery is higher in cities than in rural areas, which may be related to economic reasons, some families in the rural areas couldn't pay for hospitalization in the

early days, so the surgery was delayed. And the proportion of patients who underwent surgery had a college education was higher than those who did not, which may be related to physical fitness, a healthy body was guaranteed to go to school. Moreover, patients in the non-surgical group tend to have children after multiple pregnancies for reasons such as spontaneous or induced abortion.

The incidence of simple CHD such as ASD, VSD is higher than that of complex CHD. On the one hand, the incidence of simple CHD is higher than that of complex CHD. On the other hand, some patients with complex CHD have died before they reach reproductive age or choose not to have children, including abortion after pregnancy. It should be noted that in our classification, some cases are combined with malformations, and we mainly classify them according to the most major malformations. For example, if one patient has a double outlet right ventricle (DORV) combined with VSD, the statistics was calculated according to DORV.

In our study, the proportion of non-surgical patients (60.0%) was higher. On the one hand, because there were more simple CHD, such as ASD, VSD, etc, and some small defects had no symptoms in the early stage, pregnancy was generally well-tolerated, and even CHD was known until during pregnancy physical examination. In addition, some cases, such as PFO, do not need surgical treatment because of their small defect and little pathophysiological impact. None of the 20 cases of PFO were operated in our study. This was in agreement with the study of Bredy C et al[8]. On the other hand, some patients with complicated CHD, such as TOF, should be operated at an early stage, but there were still 7 cases (10.1%) in our group without surgery, most of them were due to family economic reasons. A few complex CHD patients did not have an operation because they didn't take seriously, which delayed treatment. And some patients were advised to have surgery, but they refused treatment.

In our study, the incidences of almost all adverse events in the non-surgical group were higher than that in the surgical group, and some events such as pre-term delivery, LBW, HF, CS, PH, and death existed obvious differences (P¡0.05). We believe that surgery can reduce maternal and fetal risk, which was different from the study of Vikas Yadav, et al[7].

A total of 16 maternal deaths in this study, all of who were related to PH and HF and other reasons. The two cases dead in the surgical group were due to too late CHD surgery and had irreversible PH, resulting in death during childbirth. Therefore, CHD such as VSD, ASD, PDA, which can result in PH and develop into ES in late-stage, surgical treatment should be conducted as early as possible to avoid irreversible results. In this study, there were patients who wanted surgery due to PH and lost the chance of surgery, or those who were prepared for surgery, but stopped during the operation due to severe PH, which was in agreement with the view of Karen Sliwa et al[9,10]. There were 59 ES patients in this study, and 58 (98.3%) in the non-surgical group, which further illustrated the necessity of early surgery. Of course, there were also complicated CHD cases, although the doctors didn't recommend giving birth, they didn't follow the advice and insisted on giving birth. A few such patients had bad outcome. Of course, there were positive news, for example, a mother with complicated CHD who had c-TGA, PA, ASD, VSD, PDA, underwent Glenn surgery for the first time, and then underwent a total caval pulmonary connection. She became pregnant a few years later, and gave birth to a child, and both mother and child were well in the follow-up. which is consistent with the report of M A Naguib et al[11].

The events of maternal PH, HF, death, and neonatal death were also more in the non-surgical group during our follow-up, further supporting our view.

It should be pointed out that if CHD needs treatment, try to treat it before pregnancy, but the operation itself has risks, it is important to choose an experienced cardiac center for treatment, and a "pregnancy heart team" is needed[12-14]. Moreover, the rate of arrhythmia in the surgical group was higher than that in the surgical group (14.4 vs 12.1), which suggested that more arrhythmias may occur after surgery. This was consistent with the reports of Jason W Greenberg et al[15,16].

All in all, CHD with left-to-right shunts, such as ASD, VSD, underwent surgery before severe PH occurred, and the outcome of pregnancy and childbirth was good. Some complicated CHD, such as TOF, generally tolerated pregnancy well after surgical correction. Patients who have had systemic-pulmonary shunt or

palliative procedures, which need to be evaluated to see the functional status of their shunt. For those with severe PH and complicated CHD without surgery, the risk of mother and child during the perinatal period is significantly increased. Through our research, we believed that early surgery was helpful to reduce the risk of both mother and child during the perinatal period. For these patients who still have left-to-right shunts, the attendant risk of embolization should be kept in mind.

Study limitations

This was a retrospective single-center study in which data were collected from medical records. We focused on the delivery period, as most patients were referred in the later stages of pregnancy, and we were often unable to obtain information on events occurring early during pregnancy, the subsequent analysis may be biased in that sense. Meanwhile, a few data remained incomplete, incorrectly entered, or unavailable. In addition, there was a lack of data on scheduled or unscheduled cesarean sections. Moreover, some simple CHD such as PFO, ASD with small defect, actually have very little impact on the body, which can cause bias. What's more, there were also differences in the number, age, and other aspects of specific CHD between the two groups, which can also cause selection bias.

Conclusions

The overall outcome of women with CHD and their offspring was good, and the outcome of the surgical group was better than that of the non-surgical group, surgery before pregnancy can reduce maternal and infant risk.

Abbreviations and Acronyms

ASD =atrial septal defect

CHD =congenital heart disease

CS =cesarean section

DORV= double outlet right ventricle

ES =Eisenmenger syndrome

HF =heart failure

LBW= low birth weight

PDA =patent ductus arteriosus

PFO =patent foramen ovale

PH =pulmonary hypertension

TOF =tetralogy of Fallot

VSD =ventricular septal defect

Declarations

Ethics approval and consent to participate

All procedures performed in this study were in accordance with the ethical standards of the Beijing Anzhen Hospital research committee, who permitted the collection of data for audit and research purposes. In addition, this study obeyed the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent for publication

All authors have read and agreed to publish this paper.

Availability of data and material

The datasets generated and analyzed for this current study are available, from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interest.

Author Contribution

Y L: data collect, summarize the data, data analysis, follow-up, drafting and revised the article. YN L, J Z: obstetrics and gynecology data analysis. JC L, YC Z, KM L: data statistics, drawing. XM F, revised the article. JG W: plan the study, study design, revised the article. All authors critically reviewed the manuscript, provided important intellectual input, approved the final version and agreed to be accountable for their contributions.

Funding

This study was supported by grants from the National Natural Science Foundation of China (8177020153). Professor Jiangang Wang owned the funding, the member of designers of this study.

References

1. Vera Regitz-Zagrosek, Jolien W Roos-Hesselink, Johann Bauersachs, et al. 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy. Eur Heart J. 2018 Sep 7;39(34):3165-3241.

2. Lauren E Schlichting, Tabassum Z Insaf, Ali N Zaidi, et al. Maternal Comorbidities and Complications of Delivery in Pregnant Women With Congenital Heart Disease. J Am Coll Cardiol. 2019 May 7;73(17):2181-2191.

3. Jolien Roos-Hesselink, Lucia Baris, Mark Johnson, et al. Pregnancy outcomes in women with cardiovascular disease: evolving trends over 10 years in the ESC Registry Of Pregnancy And Cardiac disease (ROPAC). Eur Heart J. 2019 Dec 14;40(47):3848-3855.

4. Kana Wang, Junguo Xin, Xiaodong Wang, et al. Pregnancy outcomes among 31 patients with tetralogy of Fallot, a retrospective study. BMC Pregnancy Childbirth. 2019 Dec 10;19(1):486.

5. Oktay Tutarel, Karishma P Ramlakhan, Lucia Baris, et al. Pregnancy Outcomes in Women After Arterial Switch Operation for Transposition of the Great Arteries: Results From ROPAC (Registry of Pregnancy and Cardiac Disease) of the European Society of Cardiology EURObservational Research Programme. J Am Heart Assoc. 2021 Jan 5;10(1):e018176.

6. Katsuragi S, Kamiya C, Yamanaka K, et al. Risk factors for maternal and fetal outcome in pregnancy complicated by Ebstein anomaly. Am J Obstet Gynecol 2013;209:452.e1-6.

7. Vikas Yadav, J B Sharma, S Mishra, et al. Maternal and fetal outcome in operated vs non-operated cases of congenital heart disease cases in pregnancy. Indian Heart J. Jan-Feb 2018;70(1):82-86.

8. Bredy C, Mongeon FP, Leduc L, Dore A, Khairy P. Pregnancy in adults with repaired/unrepaired atrial septal defect. J Thorac Dis 2018;10(Suppl 24):S2945-S2952.

9. Karen Sliwa, Iris M. van Hagen, Werner Budts, et al. Pulmonary hypertension and pregnancy outcomes: data from the Registry Of Pregnancy and Cardiac Disease (ROPAC) of the European Society of Cardiology. Eur J Heart Fail. 2016 Sep;18(9):1119-28.

10. Magalie Ladouceur, Louise Benoit, Jelena Radojevic, et al. Pregnancy outcomes in patients with pulmonary arterial hypertension associated with congenital heart disease. Heart. 2017;103:287–292.

11. M A Naguib, D P Dob, M A Gatzoulis, et al. A functional understanding of moderate to complex congenital heart disease and the impact of pregnancy. Part II: tetralogy of Fallot, Eisenmenger's syndrome and the Fontan operation. Int J Obstet Anesth. 2010 Jul;19(3):306-12.

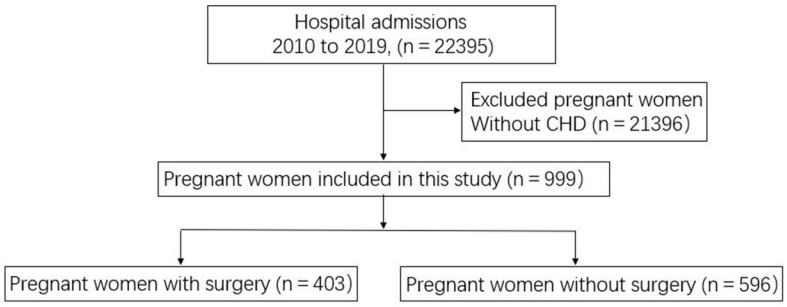
12. Helmut Baumgartner, Julie De Backer, Sonya V. Babu-Narayan, et al. 2020 ESC Guidelines for the management of adult congenital heart disease. European Heart Journal. (2020) 00, 1-83.

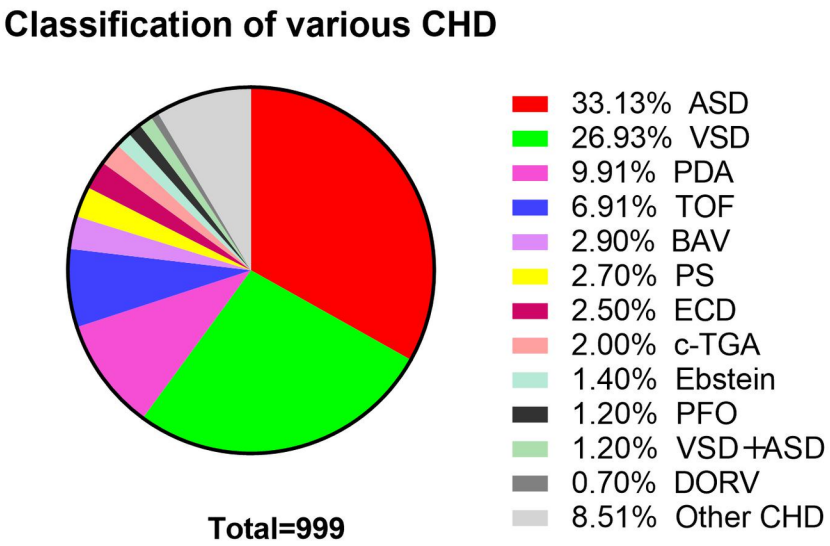
13. Matthias Greutmann, Petronella G. Pieper. Pregnancy in women with congenital heart disease. Eur Heart J. 2015 Oct 1;36(37):2491-9.

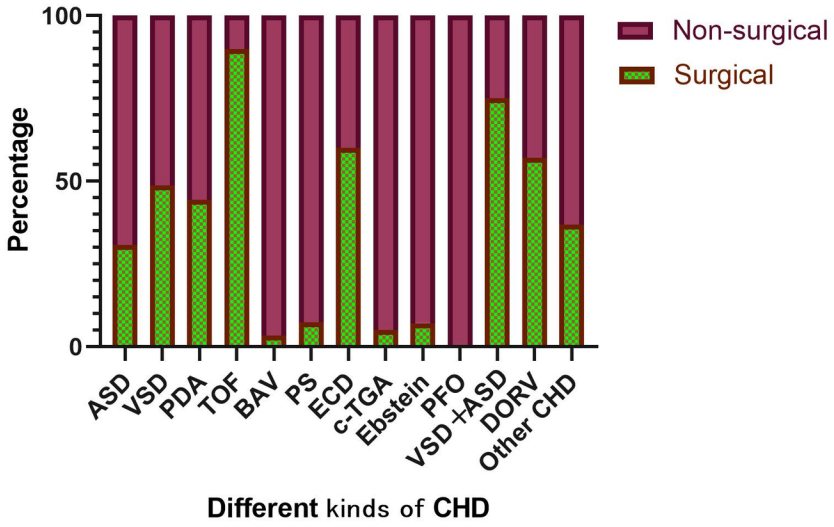
14. Matthew Cauldwell, Francois Dos Santos, et al. Pregnancy in women with congenital heart disease. BMJ. 2018 Mar 9;360:k478.

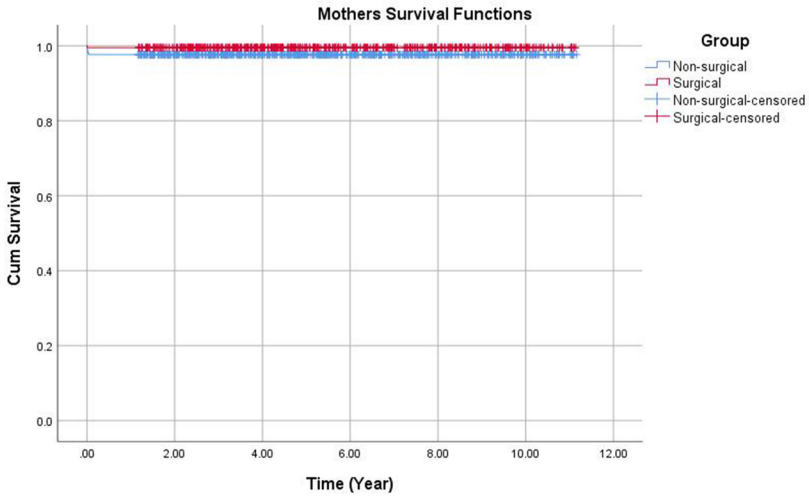
15. Jason W Greenberg, Timothy S Lancaster, Richard B Schuessler, et al. Postoperative atrial fibrillation following cardiac surgery: a persistent complication. Eur J Cardiothorac Surg. 2017 Oct 1;52(4):665-672.

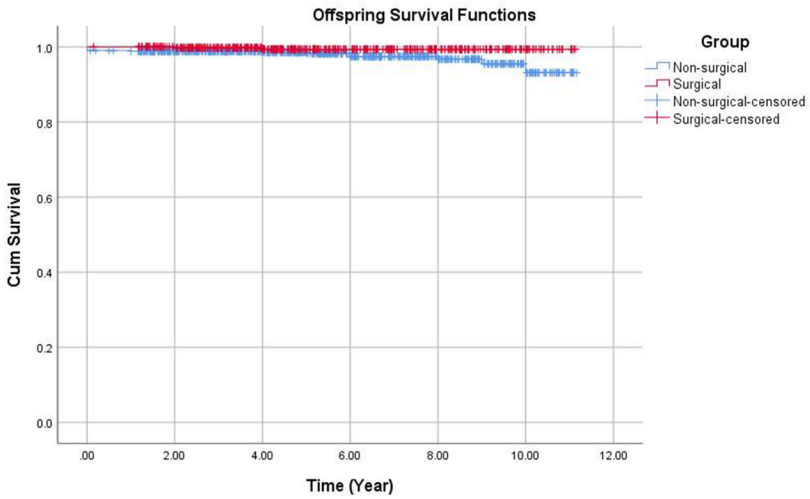
16. Sana M Al-Khatib, William G Stevenson, Michael J Ackerman, et al. 2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. J Am Coll Cardiol. 2018 Oct 2;72(14):e91-e220.











Hosted file

`Table 1.docx` available at https://authorea.com/users/382868/articles/545110-should-we-have-surgery-before-pregnancy-for-women-with-congenital-heart-disease

Hosted file

`Table 2.docx` available at https://authorea.com/users/382868/articles/545110-should-we-have-surgery-before-pregnancy-for-women-with-congenital-heart-disease

Hosted file

`Table 3.docx` available at https://authorea.com/users/382868/articles/545110-should-we-have-surgery-before-pregnancy-for-women-with-congenital-heart-disease

Hosted file

`Supplementary Table 1.docx` available at https://authorea.com/users/382868/articles/545110-should-we-have-surgery-before-pregnancy-for-women-with-congenital-heart-disease