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OUTCOMES OF BALLOON MITRAL VALVULOPLASTY IN PREGNANT WOMEN: A SINGLE-CENTER EXPERIENCE

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ABSTRACT

Analysis of the results and evaluation of the effectiveness of balloon mitral valvuloplasty (BMV) using the Inoue technique was conducted in 32 pregnant patients with rheumatic mitral stenosis, aged between 21 and 39 years (mean age 29.8 ± 5.2 years). The gestational age ranged from 23 to 33 weeks (mean 26 ± 1.6 weeks). Four patients (12.5%) had restenosis of the mitral orifice following closed mitral commissurotomy. Initially, 29 patients (90.6%) presented with New York Heart Association (NYHA) Class II heart failure, and 3 patients (9.4%) had Class III heart failure. The indication for intervention was based on the clinical presentation and a mitral orifice area (MOA) of less than 1.5 cm². All pregnant patients successfully underwent BMV without any complications. According to echocardiographic data, the mitral orifice area immediately after BMV ranged from 1.6 to 2.4 cm². On average, the MOA increased from 1.0 ± 0.2 cm² to 2.1 ± 0.2 cm² ($p<0.05$). The trans-mitral gradient decreased from an average of 22.9 ± 4.6 mm Hg to 12.9 ± 5.0 mm Hg ($p<0.05$). All patients reported an improvement in their condition immediately after the successful BMV procedure in the catheterization laboratory. Subsequently, they delivered healthy children without any complications. Based on the obtained

data, it is concluded that BMV using the Inoue technique under echocardiographic monitoring with minimal use of fluoroscopy is both feasible and highly effective in pregnant patients.

Key words: mitral valve stenosis, rheumatism, pregnancy, balloon mitral valvuloplasty.

INTRODUCTION

Surgical treatment of heart valve pathology during pregnancy is one of the most challenging issues in cardiology. Mitral stenosis, a narrowing of the left atrioventricular orifice, leads to impaired diastolic blood flow from the left atrium (LA) to the left ventricle (LV). The incidence of rheumatic heart disease in the population of the Russian Federation is 250 per 100,000 people [14]. In the Republic of Uzbekistan, the frequency of valve defects in one or more heart valves in chronic forms of rheumatism is 350-400 cases per 100,000 population. The majority of affected individuals are of working age. Mitral valve involvement is noted in 90% of all cases of rheumatic heart disease. Isolated mitral stenosis accounts for 40% of all rheumatic heart valve defects, and it is four times more common in women than in men [9].

Hemodynamic changes that occur during normal pregnancy are exacerbated by the presence of cardiac pathology. In severe mitral stenosis, the prognosis is generally unfavorable, as the increased circulating blood volume and tachycardia, typical of pregnancy, place additional strain on the heart and raise the risk of atrial fibrillation (AF). AF, in turn, worsens the reduction in cardiac output. In severe mitral stenosis (MS), the risk of intrauterine growth restriction and preterm labor increases. Maternal mortality in mild MS is less than 1%, in severe cases about 5%, and with the onset of AF, it rises to 17% [12].

There are several treatment options for heart defects and pregnancy management, ranging from conservative labor management to simultaneous commissurotomy and cesarean section. The criterion for choosing a treatment strategy is to ensure the possibility of carrying the pregnancy to term and facilitating physiological childbirth [5, 16].

Despite the complexities of surgical treatment for heart valve pathology during pregnancy, until recent decades, closed mitral commissurotomy was considered the optimal method for correcting mitral stenosis in pregnant women across the CIS countries [6]. The development of catheter-based technologies in medicine has enabled the use of these techniques for the effective treatment of various cardiovascular diseases, including stenotic valve lesions [3, 10, 18]. The introduction of minimally invasive fluoroscopy-guided endovascular technologies has expanded the indications for radical heart disease treatment during pregnancy, making them a viable alternative to open-heart surgery.

Given the critical importance of rheumatic mitral valve stenosis in cardio-obstetric practice, the first minimally invasive procedure performed on a pregnant patient was percutaneous balloon mitral valvuloplasty (BMV) using the Inoue technique [1, 4, 15].

The aim of this study is to analyze the outcomes and assess the effectiveness of Inoue BMV in pregnant women, based on the experience of the Department of Interventional Cardiology, Arrhythmology, and Endovascular Surgery at the Republican Specialized Scientific and Practical Medical Center of Surgery named after academician V. Vakhidov.

Materials and methods

BMV was performed on 32 pregnant patients with rheumatic MS aged 21 to 39 years (mean age 29.8±5.2) from 2005 to 2016 The gestational age ranged from 23 to 33 weeks (mean 26±1.6 weeks). In 4 patients (12.5%), restenosis of the mitral orifice occurred following a previous closed mitral commissurotomy.

According to echocardiography (EchoCG) data, the mitral orifice (MO) area ranged from 0.7 to 1.5 cm² (mean 1.0±0.2 cm²). The mitral valve (MV) pressure gradient varied between 15 and 31 mmHg, with an average of 22.9±4.6 mmHg. The LA size ranged from 3.5 to 6.1 cm (mean 4.4±0.6 cm). Mitral valve regurgitation (MR) up to grade 1 was present in 8 patients (25%), and grade I mitral valve calcification was observed in 3 patients (9.4%). Tricuspid valve insufficiency of grade I was found in 10 patients (31.3%), grade II in 4 patients (12.5%), and grade III in 2 patients (6.25%).

Initially, 29 patients (90.6%) had NYHA class II heart failure (HF), and 3 patients (9.4%) had class III HF. The indication for the procedure was the presence of clinical signs of MS and a mitral orifice area of less than 1.5 cm², along with a transmitral gradient greater than 10 mmHg. Contraindications for the procedure in pregnant women included mitral regurgitation of grade II or higher, as well as the presence of left atrial thrombi. The procedure was performed under local anesthesia.

In all cases, we used the Inoue technique for BMV, accessing the heart through the right femoral vein. Balloon catheters such as "Inoue" by "Toray" (Japan), "Gen-Card" by "Gentco Medical Ltd" (Hong Kong), and "HPMV" by "Heartmate" (Hong Kong) were utilized, with sizes ranging from 24 to 30 mm. The balloon size was selected based on the patient's height: balloons size 24 were used for patients shorter than 147 cm, size 26 for those 147-160 cm tall, size 28 for heights between 161 and 180 cm, and size 30 for those taller than 180 cm.

To catheterize the LA, a transseptal puncture was performed in the region of the oval fossa. A "pigtail" catheter was inserted through the left femoral artery as a

guide at the aortic root during the septal puncture. Heparin was administered at a dose of 50 IU/kg only after successful transseptal puncture. The Inoue balloon was then advanced via the guidewire into the LA. By manipulating the stylet, the balloon was positioned in the LV, and after fixation at the MV level, sequential balloon inflation was performed (Fig. 1).

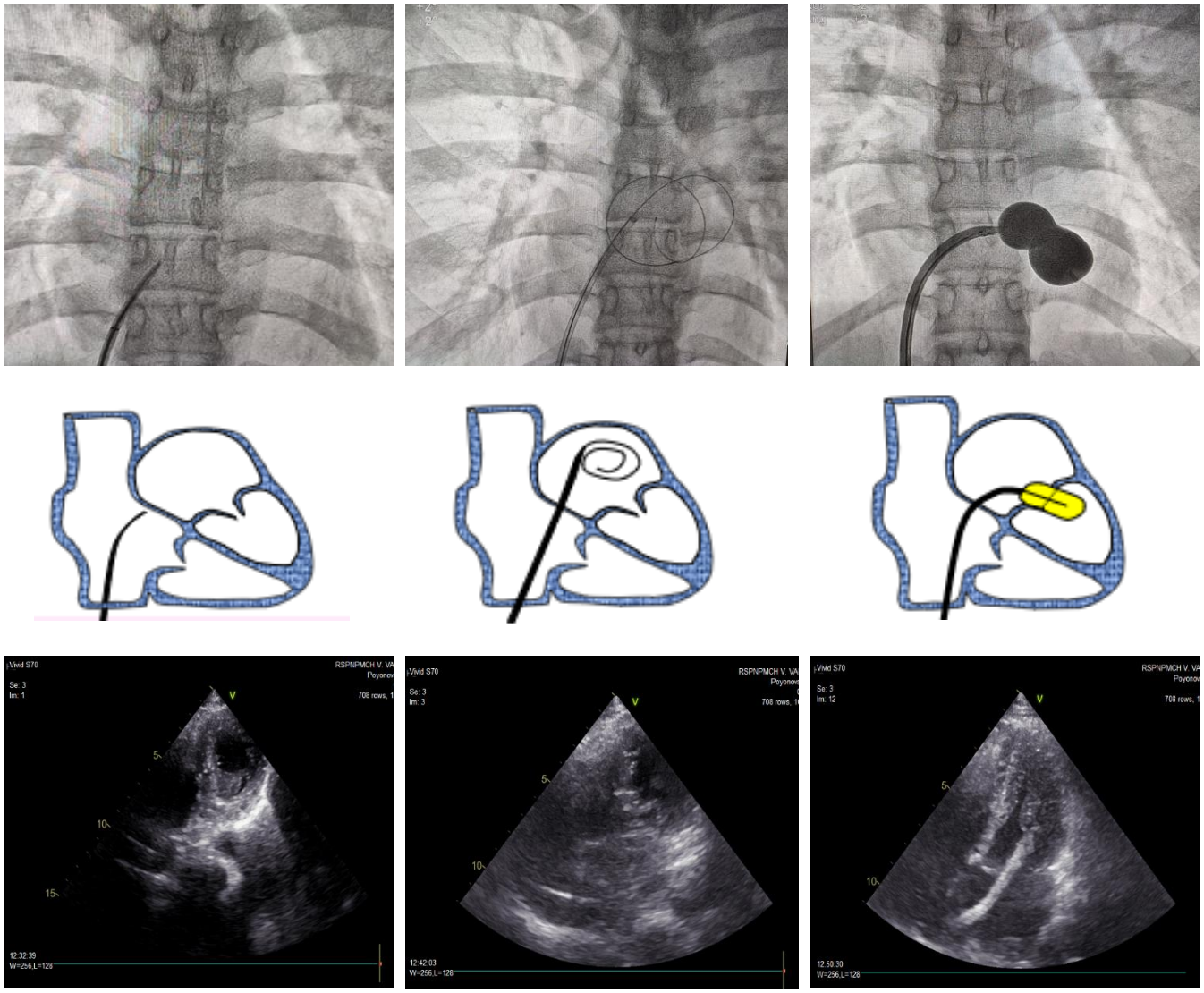

Figure 1. Key stages of balloon mitral valvuloplasty in fluoroscopic images (top row), schematic representation (middle row), and images under echocardiographic guidance (bottom row).

Echocardiographic monitoring was performed at each stage (Fig. 2). In all cases, the aim was to completely open the commissures. The criteria for stopping the intervention included complete opening of at least one of the commissures or an increase in mitral regurgitation of more than 1 grade. The result was considered acceptable if the MO area was expanded to more than 1.5 cm², with no more than grade II mitral regurgitation present.

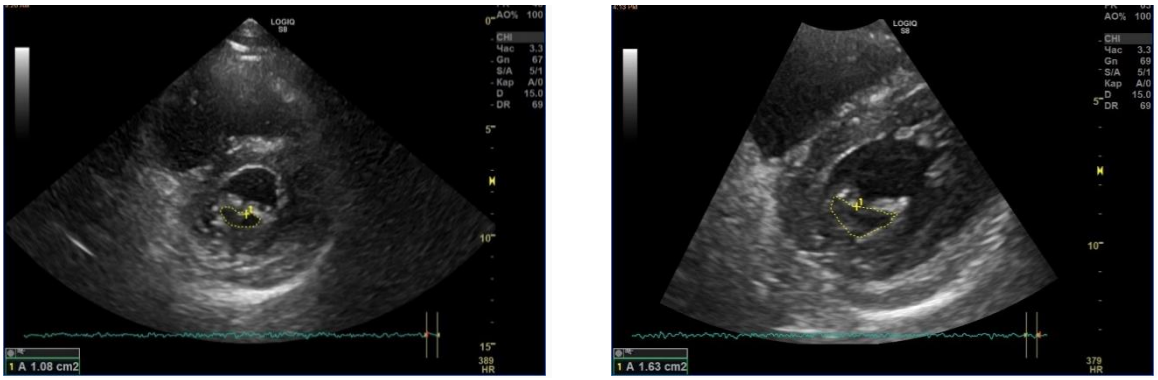

Figure 2. Transthoracic 2D echocardiographic image of the mitral valve with planimetric measurement of its area before (left) and after (right) balloon mitral valvuloplasty.

Given the potential risks of mitral regurgitation in pregnant women, efforts were made to perform BMV as a single-stage procedure. Key considerations for performing BMV in pregnant women included minimizing the duration of the procedure and reducing radiation exposure. The abdominal area was covered with a radiation protection apron. Fluoroscopy was used only during the transseptal puncture, while advancing the balloon portion of the catheter from the LA to the LV, and during balloon dilation.

Results were assessed through transthoracic echocardiography, focusing on the degree of MO opening and the presence of mitral regurgitation. After BMV, patients received antibiotic therapy and were discharged from the hospital within three days.

Results and discussion

All pregnant patients successfully underwent balloon mitral commissurotomy. According to echocardiographic data, the mitral orifice area immediately after BMV ranged from 1.6 to 2.4 cm². On average, the MO area increased from 1.0±0.2 cm² to 2.1±0.2 cm² ($p<0.05$) after BMV. The transmitral gradient decreased from 22.9±4.6 mmHg to 12.9±5.0 mmHg ($p<0.05$), and the mean left atrial pressure decreased from 30.4±9.5 mmHg to 15.4±4.5 mmHg ($p<0.05$).

Among 18 patients with MS without pre-existing MR, regurgitation of up to grade 0.5 occurred in 3 patients (16.7%), and up to grade 1 in 2 patients (11.1%). Of the 8 patients with baseline regurgitation of grade 1, 7 (87.5%) maintained the same level, while 1 patient (12.5%) experienced an increase to grade 1.5. Despite the appearance or moderate increase in MR in this category of patients, all showed positive dynamics in intracardiac hemodynamics.

In patients with mitral valve calcification (n=3), BMV was performed without technical difficulties, yielding good results and no complications. In these patients, the MO area increased from an average of 1.2±0.2 cm² to 1.9±0.3 cm², and the transmitral gradient decreased from 19±0.3 mmHg to 9.1±0.2 mmHg, which was nearly indistinguishable from patients without MVC. Like some other authors [13], we believe that grade I-II MVC in pregnant women is not a contraindication for BMV, provided there are no intramural calcifications.

Regarding the timing of BMV in pregnant women, Presbitero P. et al. [13] recommend performing percutaneous interventions in the fourth month of pregnancy. Okhapkin M.B. et al. [11] recommend it after the first trimester. We also recommend performing balloon mitral valvuloplasty starting from 23-26 weeks of gestation (second trimester), when organogenesis is complete.

Before BMV, ultrasound identified fetal hypoxia in 3 patients (9.4%), polyhydramnios in 1 (3.1%), oligohydramnios in 2 (6.3%), and threatened miscarriage in 2 (6.3%), all of whom received preventive therapy. The condition of the fetus was normal in the remaining patients.

After BMV, 1 patient (3.1%) experienced a threatened miscarriage, which was corrected with medication, while the fetal condition remained normal in the others.

In the dynamics observed within the first day post-procedure, all patients reported an improvement in their clinical status. All patients noted an improved state immediately in the operating room, characterized by a feeling of "eased breathing, breathing freely with a full chest." After the procedure, no signs of heart failure were observed. It is important to note that in pregnant patients, we conducted BMV under maximum protection from ionizing radiation. In addition to standard protection, we ensured the abdominal area was covered on all sides with a protective apron. We also minimized fluoroscopy time and used it only to monitor the most critical stages of the procedure (transseptal puncture, catheter advancement, and balloon dilation). The fluoroscopy was performed at a low regimen and in pulsed mode. This approach significantly reduced radiation exposure for both the mother and the fetus. On the third day, all patients were discharged in satisfactory condition from the hospital. Subsequently, all patients delivered healthy children without complications. This finding is consistent with data from other authors [7, 19].

According to the literature, BMV under fluoroscopic guidance is an effective and safe treatment method for selected patients with rheumatic MS [8, 17]. The use of intraoperative echocardiography allowed us to monitor all stages of the procedure, assess its adequacy, and facilitate the early diagnosis of potential

complications. Additionally, it enabled us to avoid the use of contrast agents for angiocardiography during BMV.

Conclusion

Balloon mitral valvuloplasty using Inoue technique is a safe treatment method for pregnant patients with mitral valve stenosis. BMV leads to a significant improvement in the clinical condition of pregnant patients and allows for the continuation of the pregnancy until successful delivery. Intraoperative echocardiographic monitoring enables the assessment of the procedure stages and reduces radiation exposure during the intervention.

REFERENCES

1. Ananthakrishna Pillai A, Ramasamy C, V SG, Kottyath H. Outcomes following balloon mitral valvuloplasty in pregnant females with mitral stenosis and significant sub valve disease with severe decompensated heart failure. J Interv Cardiol. 2018 Aug;31(4):525-531. doi: 10.1111/joic.12507. Epub 2018 Mar 11. PMID: 29527717.

2. Chatterjee K, Khanna R, Sahu A, Kumar S, Garg N, Tewari S, Kapoor A, Goel PK. Immediate and long-term outcomes of balloon mitral valvotomy in pregnancy. Indian Heart J. 2020 Jul-Aug;72(4):248-251. doi: 10.1016/j.ihj.2020.05.015. Epub 2020 May 30. PMID: 32861378; PMCID: PMC7474116.

3. Desnos C, Iung B, Himbert D, Ducrocq G, Urena M, Cormier B, Brochet E, Ou P, Vahanian A, Bouleti C. Temporal Trends on Percutaneous Mitral Commissurotomy: 30 Years of Experience. J Am Heart Assoc. 2019 Jul 2;8(13):e012031. doi: 10.1161/JAHA.119.012031. Epub 2019 Jun 29. PMID: 31256703; PMCID: PMC6662374.

4. Firouzi A, Samiei N, Ahmadi S, Naderi N, Sadeghipour P, Sanati HR, Kashfi F, Sattarzadeh R, Hantoushzadeh S, Bayat M, Pourtaghi S, Nasiri M. Percutaneous Transluminal Mitral Commissurotomy in Pregnant Women with Severe Mitral Stenosis. J Tehran Heart Cent. 2019 Jan;14(1):12-17. PMID: 31210765; PMCID: PMC6560256.

5. Hussein A, Eid M, Mahmoud SED, Sabry M, Altaher A. The Outcomes of PBMV in Pregnancy, and When is the Best Time? Vasc Health Risk Manag. 2023 Jan 14;19:13-20. doi: 10.2147/VHRM.S388754. PMID: 36687312; PMCID: PMC9849788.

6. Iung B, Nicoud-Houel A, Fondard O, et al. Temporal trends in percutaneous mitral commissurotomy over a 15-year period. Eur Heart J 2004;25:701–7.

7. Liaw J, Walker B, Hall L, Gorton S, White AV, Heal C. Rheumatic heart disease in pregnancy and neonatal outcomes: A systematic review and meta-analysis. PLoS One. 2021 Jun 29;16(6):e0253581. doi: 10.1371/journal.pone.0253581. PMID: 34185797; PMCID: PMC8241043.

8. Liu Y, Guo GL, Wen B, Wang S, Ou-Yang WB, Xie Y, Pan XB. Feasibility and effectiveness of percutaneous balloon mitral valvuloplasty under echocardiographic guidance only. Echocardiography. 2018 Oct;35(10):1507-1511. doi: 10.1111/echo.14055. Epub 2018 Jun 19. PMID: 29920758.

9. Masharipova R. T. The Course of Rheumatism in Pregnant Women of Fertile Age in the Khorezm Region // Science, Technology and Education. 2022, Vol. 1 (84).

10. Nunes MC, Nascimento BR, Lodi-Junqueira L, et al. Update on percutaneous mitral commissurotomy. Heart 2016;102:500–7.

11. Okhapkin, Mikhail Borisovich. Feto-Placental Insufficiency in Pregnant Women with Extragenital Pathology (Pathogenesis, Diagnosis, Treatment): Abstract of the Dissertation for the Degree of Doctor of Medical Sciences: 14.00.01. - Moscow, 1993. - 44 pages: illustrations.

12. Perelshtein Brezinov O, Simchen MJ, Ben Zekry S, Kuperstein R. Maternal and Neonatal Complications of Pregnant Women with Mitral Stenosis. Isr Med Assoc J. 2019 Feb;21(2):88-93. PMID: 30772958.

13. Presbitero, Patrizia, and others, 'Pregnancy and Heart Disease', in A. John Camm, Thomas F. Lüscher, and Patrick W. Serruys (eds), *The ESC Textbook of Cardiovascular Medicine*, 2 edn, The European Society of Cardiology (Oxford, 2009; online edn, Oxford Academic, 1 Aug. 2009), https://doi.org/10.1093/med/9780199566990.003.033, accessed 22 Oct. 2024.

14. Sazonenkov M. A., Ismatov K. K., Ernst E. E., Moskalev A. S., Kuzubova A. V., Askari I. V., Blizhenkaya N. N., Kovalenko I. B. Operated Mitral Valve Defects: Structure, Etiology, and Types of Surgical Interventions from 2015 to 2020 in the Cardiac Surgery Department of the Saint Ioasaf Hospital // Current Problems in Medicine. 2020, Vol. 4.

15. Sharma JB, Yadav V, Mishra S, Kriplani A, Bhatla N, Kachhawa G, Kumari R, Toshayan V. Comparative study on maternal and fetal outcome in pregnant women with rheumatic heart disease and severe mitral stenosis undergoing percutaneous balloon mitral valvotomy before or during pregnancy. Indian Heart J. 2018 Sep-Oct;70(5):685-689. doi: 10.1016/j.ihj.2018.01.018. Epub 2018 Jan 9. PMID: 30392507; PMCID: PMC6204450.

16. Sreerama D, Surana M, Moolchandani K, Chaturvedula L, Keepanasseril

A, Keepanasseril A, Pillai AA, Nair NS. Percutaneous balloon mitral valvotomy during pregnancy: A systematic review and meta-analysis. Acta Obstet Gynecol Scand. 2021 Apr;100(4):666-675. doi: 10.1111/aogs.14029. Epub 2020 Nov 2. PMID: 33070306.

17. Ubben T, Frerker C, Kuck KH, Schmidt T. Successful balloon valvuloplasty of rheumatic mitral valve stenosis in a pregnant patient without fluoroscopy: a case report. Eur Heart J Case Rep. 2018 May 16;2(2):yty058. doi: 10.1093/ehjcr/yty058. PMID: 31020137; PMCID: PMC6177101.

18. Vahanian A, Beyersdorf F, Praz F, Milojevic M, Baldus S, Bauersachs J, Capodanno D, Conradi L, De Bonis M, De Paulis R, Delgado V, Freemantle N, Gilard M, Haugaa KH, Jeppsson A, Jüni P, Pierard L, Prendergast BD, Sádaba JR, Tribouilloy C, Wojakowski W; ESC/EACTS Scientific Document Group. 2021 ESC/EACTS Guidelines for the management of valvular heart disease. Eur Heart J. 2022 Feb 12;43(7):561-632. doi: 10.1093/eurheartj/ehab395. Erratum in: Eur Heart J. 2022 Feb 18;: PMID: 34453165.

19. Vinayakumar D, Vinod GV, Madhavan S, Krishnan MN. Maternal and fetal outcomes in pregnant women undergoing balloon mitral valvotomy for rheumatic mitral stenosis. Indian Heart J. 2016 Nov-Dec;68(6):780-782. doi: 10.1016/j.ihj.2016.04.017. Epub 2016 May 20. PMID: 27931546; PMCID: PMC5143819.