

First performance of transcatheter edge-to-edge mitral and tricuspid valve repair in a single procedure in Latin America: case report

Estreia da terapia de reparo transcatheter *edge-to-edge* nas valvas tricúspide e mitral em um único procedimento na América Latina: relato de caso

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DOI: 10.31160/JOTCI202230A202204

ABSTRACT - We present the first case in Latin America of transcatheter edge-to-edge mitral and tricuspid valve repair in a single procedure, in a patient at high risk for surgery. The patient progressed to heart failure and limitation in her daily living activities when she was submitted to transcatheter mitral and tricuspid valve repair. Six months later, she was asymptomatic and performing her daily living activities. We discuss the most updated recommendations for transcatheter repair when both valvar conditions coexist, and show the knowledge gaps.

Keywords: Mitral valve insufficiency; Tricuspid valve insufficiency; Heart failure; Risk factors; Recovery of function; Transcatheter

RESUMO - Apresentamos o caso debutante na América Latina de reparos transcatheteres *edge-to-edge* nas valvas mitral e tricúspide em um único procedimento em paciente de alto risco para cirurgia. A paciente evoluía com insuficiência cardíaca e limitações em suas atividades diárias quando foi submetida ao procedimento, no qual foram realizados os reparos transcatheteres das valvas mitral e tricúspide. Aos 6 meses de evolução, estava assintomática e realizando suas atividades diárias. Debateremos as recomendações mais atualizadas sobre a terapia transcatheter para coexistência dessas doenças valvares, assim como expomos as lacunas no conhecimento.

Descritores: Insuficiência da valva mitral; Insuficiência da valva tricúspide; Insuficiência cardíaca; Fatores de risco; Recuperação da função; Transcatheter

INTRODUCTION

The tricuspid valve was once considered as having no clinical significance and called the “forgotten valve”. It has recently been the topic of many studies, since in modern Cardiology, it was acknowledged as an important valve due to the high morbidity and mortality rates associated to its diseases, primarily the severe tricuspid regurgitation (TR). The revolution of its treatment by transcatheter techniques is “knocking at one’s door”. There are devices for tricuspid annuloplasty and for edge-to-edge repair approved for clinical use in European countries.¹⁻³

There are many patients with coexisting functional TR and severe mitral regurgitation (MR). When patients are referred for mitral surgery, the most updated guidelines recommend surgeons to perform tricuspid repair in the same procedure if the tricuspid annulus is dilated. The rationale is that tricuspid dysfunction can evolve in up to one third of patients, and reperforming the surgery is a high-risk procedure.⁴

How to cite this article:

Martins EC, Bernardi FL, Oliveira DC, Leite RS, Pestana LR, Fuks V, et al. First performance of transcatheter edge-to-edge mitral and tricuspid valve repair in a single procedure in Latin America: case report. J Transcat Intervent. 2022;30:eA2022004. <https://doi.org/10.31160/JOTCI202230A2022004>

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Received on:

Apr 15, 2022

Accepted on:

May 23, 2022



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In the era of transcatheter mitral treatment, many authors suggest transcatheter mitral valve repair (TMVR) must be the first procedure to be performed, and three months later, TR should be reassessed. Nonetheless, up to half of patients submitted to this strategy are submitted to transcatheter tricuspid valve repair (TTVR).⁵

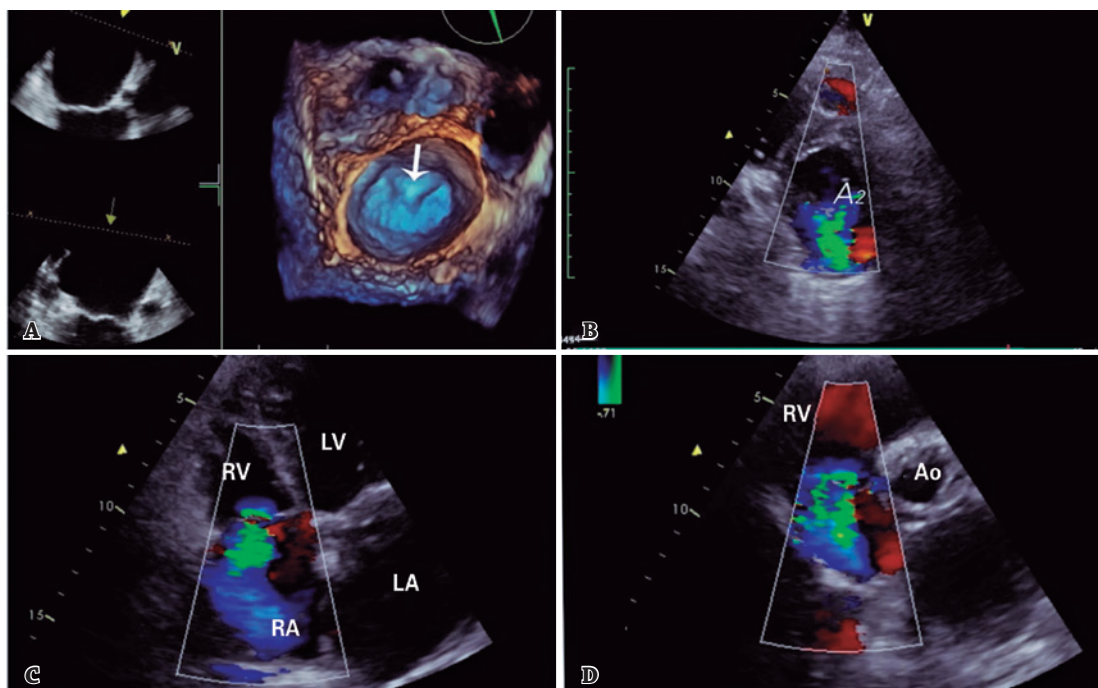
The objectives of this report were to describe a transcatheter mitral and tricuspid valve repair and discuss the data available about this strategy. The Galeão Area Force Hospital, in Rio de Janeiro (RJ), evaluated and approved this study (protocol 5.120.008; CAAE 52842721.7.0000.5250) that was conducted according to the Declaration of Helsinki for clinical research in humans.

CASE REPORT

An 83-year-old female patient was referred to our hospital for evaluation of dyspnea class IV of the New York Heart Association (NYHA) and progressive edema of lower limbs in the past 6 months. She presented with severe primary MR and severe secondary TR. She was on spironolactone, angiotensin-converting enzyme inhibitor, beta blockers, furosemide, and rivaroxaban. Upon physical examination, bilateral rales on bases, peripheral edema 3+/4+, ascites and hepatomegaly. The heart team contraindicated surgical valvar repair due to high surgical risk and frailty.

Her past medical history included persistent atrial fibrillation, hypertension, morbid obesity (body mass index of 43.28), osteoporosis, breast cancer five years before (underwent breast resection, chemotherapy, and radiation therapy), frailty (Rockwood clinical frailty scale of 6) and bilateral knee replacement. The mortality risk predicted by the Society of Thoracic Surgeons (STS) was 9.77%.

The electrocardiogram (ECG) upon admission confirmed atrial fibrillation. Transthoracic echocardiography showed left ventricle ejection fraction of 64.7%, and final diastolic and systolic diameter of 48 mm and 27 mm, respectively; mitral valve with severe primary regurgitation due to A2 prolapse (Figures 1A and 1B) (effective regurgitant orifice area – EROA of 0.7cm²; *vena contracta* of 0.9 cm and peak velocity of 5.8 mL/s), with a 9-mm long posterior leaflet and mitral valve area of 3.9 cm²; basal gradient of 1.05 mmHg; left atrium diameter of 4.7cm, volume of 52mL/m²; pulmonary artery systolic pressure of 46 mmHg; right ventricle with tricuspid annular plane systolic excursion (TAPSE) of 20mm; tricuspid valve with severe insufficiency (Figures 1C and 1D) with *vena contracta* of 1.1cm; peak velocity of 3.04mL/s and tricuspid annulus of 37 mm. Diagnoses of severe MR and severe TR were confirmed.



A2: mitral valve A2 segment; RV: right ventricle; LV: left ventricle; LA: left atrium; RA: right atrium; Ao: aortic valve.

Figure 1. Three-dimensional transthoracic echocardiogram before the procedure. (A) Three-dimensional reconstruction of the mitral valve showing prolapse of the anterior leaflet in segment A2 (arrow). (B) Frontal view of the mitral valve showing the central regurgitant jet (A2/P2). (C) A 4-chamber view showing severe tricuspid regurgitation. (D) Short axis confirming severe tricuspid regurgitation.

Transcatheter repair

On September 3rd, 2020, the transcatheter edge-to-edge mitral and tricuspid valve repair was performed under general anesthesia and guided by transesophageal echocardiography. After access to the right common femoral vein, a 6F introducer was placed. The transeptal puncture was performed in a position superior and posterior to the oval fossa with a BRK needle and transeptal sheath, followed by full heparinization. After positioning the 0.035" stiff wire in the left superior pulmonary vein, the steerable guide catheter (SGC) for MitraClip® (Abbott Laboratories, Chicago, Illinois) was placed on the left atrium. The clip delivery system was then advanced and oriented towards the mitral valve, and a NTR clip was implanted in the central position (A2/P2). After confirming the successful treatment in the mitral valve, the SGC was retracted to the right atrium, and next a XTR clip delivery system was advanced and aligned to the tricuspid plane, to the regurgitant jet, and coaptation line between the septal and anterior leaflets (Figures 2A and 2B). With a XTR clip between the anterior and septal cusps, the TR changed from severe to mild (Figures 2C and 2D).

At 3- and 6-month follow-up, the transesophageal echocardiography confirmed persistent reduction of mitral regurgitation (MR) and TR (Figure 3). Negative remodeling of the right chambers of the heart when comparing the transesophageal echocardiography at 3- and 6-month follow-up (Figure 4).

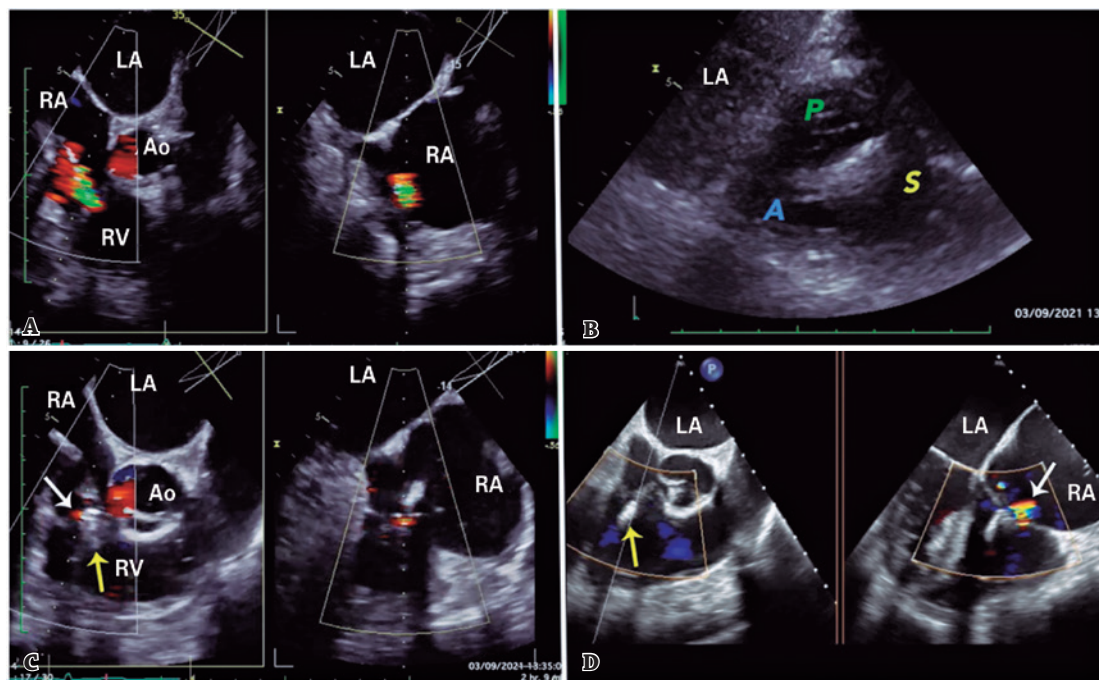
DISCUSSION

We describe a patient submitted to TTVR and TMVR in a single procedure, who presented relief of symptoms and better quality of life.

A comparative analysis of the registries TRIVALVE (Transcatheter Tricuspid Valve Therapies), with 122 patients, and TRAMI (Transcatheter Mitral Valve Interventions), with 106 patients, revealed patients submitted to simultaneous TTVR and TMVR had lower mortality rate after one year, as compared to those undergoing only TMVR (16.4% versus 34%; $p=0.03$). There are some limitations and comparing diverse groups of patients is one of the most important.⁶

Kavsir et al.⁷ carried out a study and assessed 531 patients submitted to edge-to-edge mitral valve repair, and most individuals presenting TR showed improved regurgitation when submitted to TMVR. The analysis of 102 patients with severe TR and submitted to TMVR showed reduction in TR in 38% of them (39 patients).

When TR reduction was observed it occurred within the first three months. Patients who got better had lower admission rates due to heart failure. Atrial fibrillation, mitral reflux at end of TMVR $\geq 2+$ and tricuspid annulus diameter ≥ 34 mm were described as factors likely to hinder reduction of TR.⁷

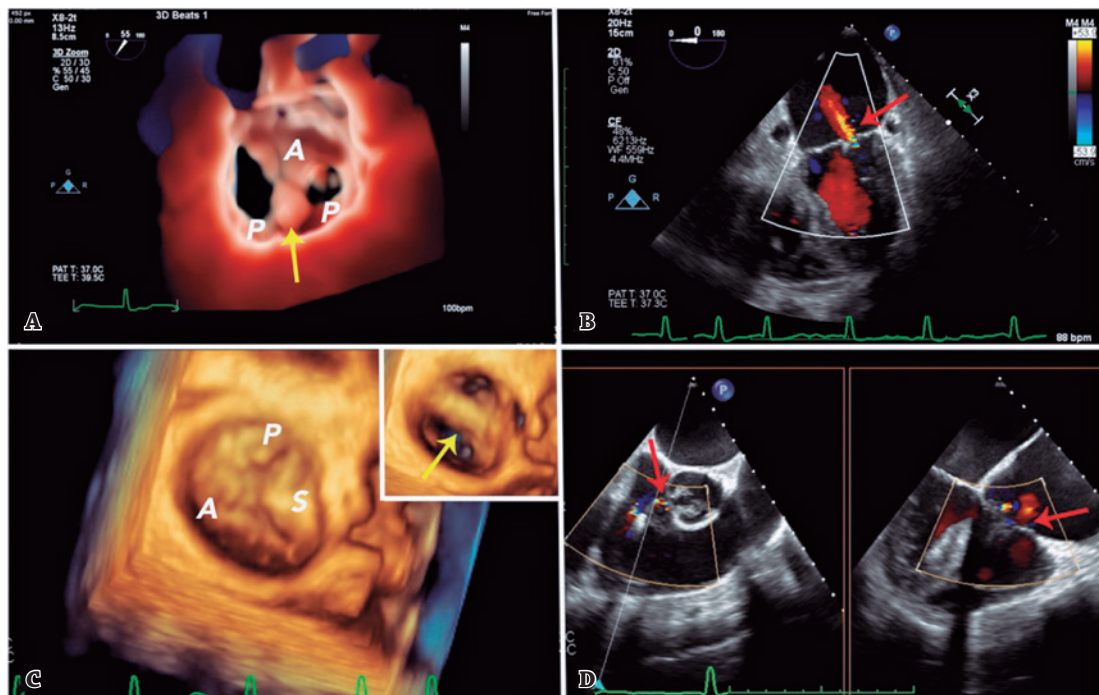


RA: right atrium; LA: left atrium; Ao: aorta; RV: right ventricle; P: posterior leaflet; S: septal leaflet; A: anterior leaflet. White arrow: tricuspid regurgitation; yellow arrow: clip.

Figure 2. Periprocedural transesophageal echocardiography. (A) Alignment of the clip to the regurgitant jet in the short axis (on the left) and corresponding X-plane (on the right). (B) Transgastric view showing alignment of the clip at 2 o'clock, between the septal and anterior leaflets. (C) Same view as A, showing the clip with closed arms, resulting in change of regurgitation from severe to mild. (D) After release of the clip, confirming maintenance of mild tricuspid regurgitation.

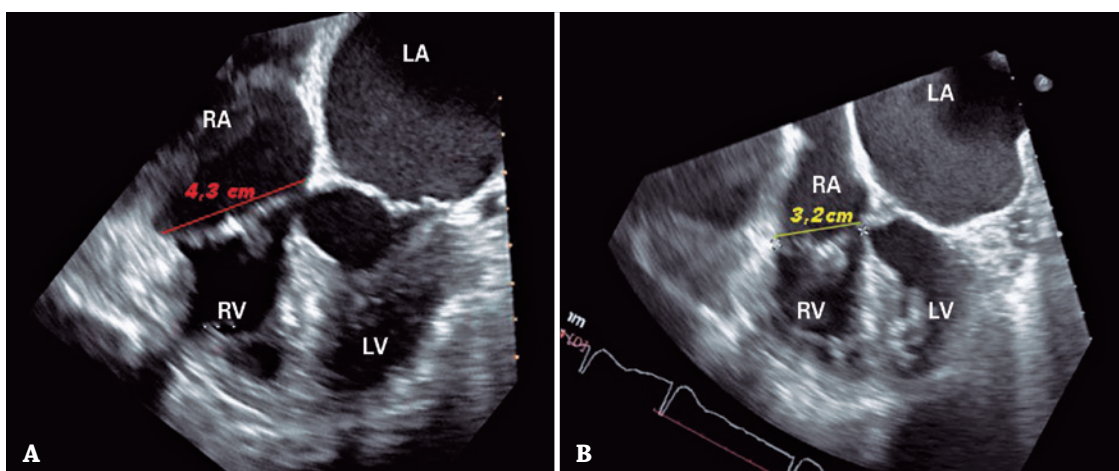
Initially the TTVR was performed using a device designed for TMVR,⁸ but a specific device was developed for tricuspid valve repair, which was tested in the TRILUMINATE trial.⁹ The results of this study were promising regarding safety and efficacy of the device, which also facilitated the procedure.

In management of patients with concurrent severe MR and TR, besides determining the factors associated to lack of TR response after TMVR alone (favoring TTVR in the same procedure), it is crucial to identify the characteristics anatomical not favorable to edge-to-edge tricuspid repair, such as a large lateral septal coaptation gap >8.5mm;



A: anterior leaflet; S: septal leaflet; P: posterior leaflet.

Figure 3. Transesophageal echocardiography at 3- and 6-month. (A) Three-dimensional reconstruction of mitral valve (ventricular face) showing a well-positioned clip between the segments A2 and P2. (B) Mild mitral regurgitation observed on color Doppler. (C) Three-dimensional reconstruction of tricuspid valve showing the leaflets. In close view, the clip between the anterior and septal leaflets (yellow arrow). (D) Color echo Doppler confirming mild tricuspid regurgitation.



RA: right atrium; LA: left atrium; LV: left ventricle; RV: right ventricle.

Figure 4. Transesophageal echocardiography at 3- and 6-month. (A) Echocardiography at 3 months showing tricuspid annular dilation still present. (B) Echocardiography at 6 months demonstrating a considerable reduction in the right heart dimensions, especially in the tricuspid annular diameter.

thickening, shortening or perforation of the leaflet; dense chordae with marked leaflet tethering; localization of the anteroposterior jet; poor echocardiographic visualization of the leaflets; cables of the electronic device implanted in the right ventricle causing impact in the leaflets; unfavorable approximation of the device angle and coaptation depth >1cm.^{5,7,10}

The combined procedure has the potential to reduce costs, avoid anesthesia in elderly and fragile patients, and reduce hospital admission due to heart failure. On the other hand, the strategy to reassess within 3 months may avoid unnecessary procedures.^{5,11}

Hence, it is important to identify independent predictors of improvement of severe TR in patients candidate to TMVR, as well as the anatomic factors not favorable to TTVR. Therefore, a selection of optimized patients for transcatheter mitral valve repair alone or with concomitant TTVR can be done. It is worth mentioning there is no robust randomized clinical study defining the best strategy among those herein mentioned.

SOURCE OF FINANCING

None.

DECLARATION OF CONFLICTS OF INTEREST

MT is a consultant for Abbott, Edwards Lifescience, Boston Scientific, 4Tech, Shensi Medical, Simulands, MTE, and Occlufit and receives speaker fees from Edwards Lifescience. All other authors have reported they have no relationship relevant to the contents of this paper to disclose.

CONTRIBUTION OF AUTHORS

Conception and design of the study: ECCM; FLMB; DCO and MT; data collection: ECCM; FLMB; DCO and MT; data interpretation: ECCM; FLMB; DCO; RSL; DVS and MT; text writing: ECCM; FLMB; DCO and MT; approval of the final version to be published: ECCM; FLMB; DCO; RSL; LRSP; VF; JLF; SMJ; FCM; DVS and MT.

REFERENCES

1. Oliveira DC, Oliveira CG. The forgotten, not studied or not valorized tricuspid valve: the transcatheter revolution is coming. *Cardiol Res.* 2019;108(4):199-206. <https://doi.org/10.14740/cr874>
2. Topilsky Y, Maltais S, Medina Inojosa J, Oguz D, Michelena H, Maalouf J, et al. Burden of tricuspid regurgitation in patients diagnosed in the community setting. *JACC Cardiovasc Imaging.* 2019;12(3):433-42. <https://doi.org/10.1016/j.jcmg.2018.06.014>
3. Rodés-Cabau J, Taramasso M, O'Gara PT. Diagnosis and treatment of tricuspid valve disease: current and future perspectives. *Lancet.* 2016;388(10058):2431-42. [https://doi.org/10.1016/S0140-6736\(16\)00740-6](https://doi.org/10.1016/S0140-6736(16)00740-6)
4. Writing Committee Members, Otto CM, Nishimura RA, Bonow RO, Carabello BA, Erwin JP 3rd, Gentile F, et al. 2020 ACC/AHA Guideline for the Management of Patients with Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol.* 2021;77(4):e25-e197. <https://doi.org/10.1016/j.jacc.2020.11.018>. Erratum in: *J Am Coll Cardiol.* 2021;77(4):509. Erratum in: *J Am Coll Cardiol.* 2021;77(9):1275.
5. Praz F, Muraru D, Kreidel F, Lurz P, Hahn RT, Delgado V, et al. Transcatheter treatment for tricuspid valve disease. *EuroIntervention.* 2021;17(10):791-808. <https://doi.org/10.4244/EIJ-D-21-00695>
6. Mehr M, Karam N, Taramasso M, Ouarrak T, Schneider S, Lurz P, et al.; TriValve and TRAMI Investigators. Combined tricuspid and mitral versus isolated mitral valve repair for severe MR and TR: an analysis from the TriValve and TRAMI Registries. *JACC Cardiovasc Interv.* 2020;13(5):543-50. <https://doi.org/10.1016/j.jcin.2019.10.023>
7. Kavsir R, Iliadis C, Spieker M, Brachtendorf BM, Tiyerili V, Metzke C, et al. Predictors and prognostic relevance of tricuspid alterations in patients undergoing transcatheter edge-to-edge mitral valve repair. *EuroIntervention.* 2021;17(10):827-34. <https://doi.org/10.4244/EIJ-D-20-01094>
8. Nickenig G, Kowalski M, Hausleiter J, Braun D, Schofer J, Yzeiraj E, et al. Transcatheter treatment of severe tricuspid regurgitation with the edge-to-edge MitraClip technique. *Circulation.* 2017;135(19):1802-14. <https://doi.org/10.1161/CIRCULATIONAHA.116.024848>
9. Lurz P, Stephan von Bardeleben R, Weber M, Sitges M, Sorajja P, Hausleiter J, et al.; TRILUMINATE Investigators. Transcatheter edge-to-edge repair for treatment of tricuspid regurgitation. *J Am Coll Cardiol.* 2021;77(3):229-39. <https://doi.org/10.1016/j.jacc.2020.11.038>
10. Taramasso M, Alessandrini H, Latib A, Asami M, Attinger-Toller A, Biasco L, et al. Outcomes after current transcatheter tricuspid valve intervention: mid-term results from the international TriValve registry. *JACC Cardiovasc Interv.* 2019;12(2):155-65. <https://doi.org/10.1016/j.jcin.2018.10.022>
11. Kornowski R. Managing combined mitral and tricuspid regurgitation: should we clip the percutaneous clip procedures? *JACC Cardiovasc Interv.* 2020;13(5):551-3. <https://doi.org/10.1016/j.jcin.2019.11.013>