COMPARATIVE ECHOCARDIOGRAPHIC METHODS IN THE ASSESMENT OF MITRAL STENOSIS SEVERITY: GENERALITIES

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Abstract:*The principal cause of mitral stenosis (MS) is rheumatic fever which remains endemic in developing countries. Several echocardiographic techniques have been introduced as means of mitral valve area (MVA) assessment: Pressure gradient-maximal and mean mitral gradient are calculated by integrated software using the trace of the Doppler diastolic mitral flow wafe forms on the display screen.; Planimetry method - measurement is obtained by direct tracing of the mitral orifice including opened commissures on parasternal short-axis view; Pressure half-time-is defined as the time interval in millisecondes between the maximum mitral gradient in early diastole and the time point where the gradient is half the maximum initial value; Continuity equation –is based on the conservation of mass; Proximal isovelocity surface area- is based on the hemispherical shape of the convergence of diastolic mitral flow on the atrial side of the mitral valve..*

Cuvinte cheie:
Stenoza mitrala, metoda planimetrica, PHT, PISA (proximal isovelocity surface area

Rezumat: *Principala cauza de stenoza mitrala(SM) este reumatismul articular acut (RAA) care ramane endemic in tarile in curs de dezvoltare. Numeroase metode au fost introduce in evaluarea ariei valvulare mitrale (AVM) :Gradientul de presiune- gradientul maximal si cel mediu sunt calculate cu un soft integrat , folosind traseul Doppler diastolic mitral; Metoda planimetrica – masura orificiului mitral este obtinuta prin trasarea directa a orificiului mitral incluzand comisurile deschise intr-o incidenta parasternal ax scurt; PHT (pressure hal-time) - definit ca intervalul de timp in milisecunde intre gradientul mitral maxim in diastola precoce si timpul unde gradientul este jumatate din valoarea initiala maxima; Ecuatia de continuitate se bazeaza pe conservarea maselor; Metoda PISA (Proximal isovelocity surface area)-se bazeaza pe forma hemisferica a convegentei fluxului mitral situata pe fata atriala a valvei mitrale*

INTRODUCTION

The principal cause of mitral stenosis is rheumatic fever (RAA) which remains endemic in developing countries; therefore, MS is still a major public health problem in these countries.

Assesment of the mitral valve area (MVA) is of considerable importance being the main factor in the clinical evaluation of patients with MS for the determination of various aspects, such as treatment options and long-term outcomes.

Several echocardiografic techniques have been introduced as means of MVA assessment, two of which, the two-dimensional planimetry and pressure half-time (PHT) methods are currently the most widely used.(2)(3)(4).

1. Pressure gradient

The estimation of the systolic pressure gradient is derived from transpulmonary velocity flow curve using the simplified Bernoulli equation: ΔP=4□2.

This estimation is reliable, as shown by the good correlation with invasive measurement using cardiac catheterization.(5).

The use of continuous wave Doppler (CWD) is preferred to ensure maximal velocities are recorded.

When pulsed-wave Doppler is used, the sample volume should be placed at the level or just after leaflet tips.

Maximal and mean mitral gradients are calculated by integrated software using the trace of the Doppler diastolic mitral flow waveforms on the display screen.

Mean gradient is the relevant haemodynamic finding.Maximal gradient is of little interest as it derives from peak mitral velocity,which is influenced by left atrial (LA)compliance and left ventricular (LV) diastolic function.(6).

Mitral gradient, although reliably assessed by Doppler, is not the best marker of the severity of MS since it is independent on the mitral valve area (MVA) as well as a number of other factors that influence transmitral flow rate: heart rate, cardiac output,a nd associated mitral regurgitation.(MR). (7).

2. Planimetry method (MVA pln)

Planimetry using 2D echocardiography of the mitral orifice has the advantage of being a direct measurement of MVA and, unlike other methods, does not involve any hypothesis regarding flow conditions, cardiac chamber compliance, or associated valvular lesions.

Planimetry measurement is obtained by direct tracing of the mitral orifice, including opened commissures, if applicable, on a parasternal short-axis view.

Scanning from the apex to the base of the LV is required.

The optimal timing of the cardiac cycle to measure planimetry is mid-diastole.This is best performed using the cineloop mode on a frozen image.

Although its accuracy justifies systematic attempts to

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perform planimetry of MS, it may not be feasible even by experienced echocardiographers when there is a poor acoustic window or severe distorsion of valve anatomy, in particular with severe valve calcifications of the leaflet tips.

The percentage of patients in whom planimetry is not feasible has been reported as low as 5%.(8).The above-mentioned problems are more frequent in the elderly who represent a significant proportion of patients with MS in the industrialized countries.(9).

3. PHT method

T ½ is defined as the interval in milliseconds between the maximum mitral gradient in early diastole and the time point where the gradient is half the maximum initial value.

MVA is calculated using empirical formula (10):

MVA= 220/T1/2, T1/2 is obtained by tracing the deceleration slope of the E-wave on Doppler spectral display of transmitral flow.

PHT measurement is not influenced by cardiac outflow and associated mitral regurgitation.(10).

The assessment of MVA using PHT method is not very accurate when MS is severe because PHT is influenced by LV diastolic filling rate.

MVA is overestimated by PHT measurement in case of severe mitral regurgitation when LV diastolic filling pressure rapidly increases.

MVA pht is overcalcullated by shortenes of PHT in impaired LV diastolic function. (Elderly,ischemia, high blood pressure).

PHT is not recommended in the assessment of degenerative mitral stenosis (11).

In the first 24-72 hours after mitral comisurotomy, PHT is an inaccurate measure of MVA due to delayed changes in LV and LA compliance, and it is recommended to use planimetry.(12).

4. Continuity equation

The continuity equation is based on the conservation of mass or sanguine volume.

The filling volume of diastolic mitral flow is equal to aortic or pulmonary flow volume.

The continuity equation:

MVA =π (D^2/4) IVT TEVS/IVT mitral

Where:

D is the diameter of the LVOT (in cm)

IVT TEVS is the integrated velocity-time of subaortic flow

Mitral IVT is integrated velocity-time of mitral flow

This method cannot be used in cases of atrial fibrilliation or associated significant MR or AR.(11).

The values of MVA using continuity equation are smaller after mitral comisurotomy.(13).

5. PISA method (The proximal isovelocity surface area method).

This method is based on the conservation of the mass. Based on the hemispherical shape of the convergence of diastolic mitral flow on the atrial side of the mitral valve, as shown by colour Doppler, it enables mitral flow to be assessed and thus, to determine MVA by dividing mitral volume flow by the maximum velocity of diastolic mitral flow as assessed by CWD.

MVA = $2\pi r^2$ Valiasing/V mitral max · α/180°

Where

r -the radius of the convergence hemisphere

Valiasing - the aliasing maximum velocity (in cm/s) of the diastolic transmitral flow.

This method can be used in the case of significant mitral stenosis, but requires multiple measurements. Its accuracy is impacted upon by uncertainties in the measurement of the radius of the convergence hemisphere and the opening angle.

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