Trikuspidna valvula — zaboravljena valvula

Tricuspid valve — the forgotten valve

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Sažetak

Anatomski trikuspidna valvula (TV) je najsloženija od četiri srčane valvule: sastoji se od prstena, tri listića (septalni, prednji i stražnji) te tri papilarna mišića. Prednji listić je najveći, korde spajaju svaki listić s jednim ili više papilarnih mišića, a ušće ima oblik trokuta.

Disfunkcija TV može biti primarna ili sekundarna. Primarni patološki procesi dovode do stenoze i/ili regurgitacije, a sekundarni gotovo isključivo do regurgitacije. Primarna disfunkcija je posljedica morfološki abnormalne valvule i uzrokovana je prirođenim malformacijama, reumatskom bolešću, infekcijskim endokarditisom, karcinoidom, toksičnim učincima lijekova, tumorima, tupom traumom i miksomatoznom degeneracijom. U sekundarnoj disfunkciji valvulni aparat je morfološki uredan osim u slučaju dilatacije prstena. Disfunkcija je najčešće posljedica miokardne i/ili valvulne bolesti lijeve klijetke.

Iako se bolest trikuspidne valvule može relativno lako i pouzdano dijagnosticirati klinički, metode izbora su 2-D ehokardiografija, pulzirajući, kontinuirani te obojeni dopler. Bitni su 2-D prikaz anatomije i dinamike te primjena doplera za mjerenje anterogradnih brzina kroz stenotičku valvulu, kao i obojenog doplera za prikaz regurgitacije. Budući su anatomija i pokreti TV kompleksni, jednodimenzijska ehokardiografija ima malu ulogu u otkrivanju patologije valvule. TV se može prikazati iz više transtorakalnih presjeka: parasternalno iz prikaza ulaznog dijela desne klijetke (DV) vrlo dobro se vide stražnji i prednji listić. U parasternalnoj kratkoj osi i subkostalno dobro se prikazuju septalni i prednji listić, u apikalnoj poziciji četiri šupljine također septalni i prednji listić te odnos s mitralnom valvulom. TV se može također dobro prikazati u različitim presjecima transezofagijskom ehokardiografijom, ali općenito njen doprinos razumijevanju patologije trikuspidnog ušća je manji nego mitralnog. Posljednih nekoliko godina sve se više, posebice u velikim kardikirurškim centrima, u evaluaciji TV primjenjuje i 3-D ehokardiografija.

Klinički se trikspidna regurgitacija (TR) procjenjuje uglavnom kvalitativno kao minimalna (unutar normalnih granica), blaga, umjerena i jaka (teška) regurgitacija. Pomoću obojenog doplera gradira se ljetvicom 1-4+ ovisno o proširenosti sistoličkog protoka u desnu pretklijetku (DA), analogno procjeni mitralne regurgitacije. Na tešku TR upućuju sljedeći kriteriji: 1. površina mlaza obojenim doplerom veća od 30% površine DA, 2. gusti signal kontinuiranim doplerom, 3. dilatacija prstena ≥4cm ili nepotpuna koaptacija kuspisa, 4. konkavna kasnosistolička konfiguracija signala kontinuiranog doplera, 5. brzina utoka krvi ≥1m/s, 6. dilatacija DA i DV, i 7. sistolički reverzni protok u donju šuplju i hepatalne vene.

Na značajno, volumsko opterećenje DV, ukazuje dijastoličko izravnjanje interventrikulskog septuma, najjače izraženo na kraju dijastole, vidljivo u kratkoj parasternal-

Abstract

Anatomically the tricuspid valve (TV) is the most complex of all four cardiac valves: it comprises two rings, three cusps (septal, frontal and rear cusps) and three papillary muscles. The frontal cusp is the biggest, chords connect each cusp with one or more papillary muscles, and the orifice is triangle shaped.

TV dysfunction can be primary and secondary. The primary pathology processes lead to stenosis and/or regurgitation, and the secondary almost always leads to regurgitation. The primary dysfunction is a result of morphologically abnormal valve and is caused by congenital malformations, rheumatic disease, infective endocarditis, carcinoid, toxic effects of drugs, tumors, blunt trauma and myxomatous degeneration. In secondary dysfunction the valve apparatus is morphologically clean except in the case of ring dilatation. Dysfunction is most often a result of myocardial and/or valve disease of the left ventricle.

Although the TV disease can be relatively easily and reliably clinically diagnosed, the methods of choice are 2-D echocardiography, pulse, continuous and color Doppler. 2-D display of anatomy and dynamics is important as well as the use of Doppler for measuring anterograde speed through a stenotic valve as well as colored Doppler for display of regurgitation. Since the TV anatomy and movements are complex, one-dimensional echocardiography has a small role in detecting the valve pathology. TV can be shown from more transthoracic sections: parasternally from the display of the entry part of the right ventricle (RV), rear and frontal cusps are very visible. In the short parasternal axis and subcostally, septal and frontal cusps are very well shown, and also septal and frontal cusps and relation to the mitral valve in the apical position of 4 chambers. TV can also be very well shown in different cross sections with transesophageal echocardiography, but in general its contribution to the understanding of tricuspid orifice is smaller than that of the mitral. During the last several years 3-D echocardiography is increasingly used in the evaluation of the TV, especially in large cardiac centers.

The clinical tricuspid regurgitation (TR) is mostly evaluated qualitatively as a minimum (within normal boundaries), mild, medium and severe regurgitation. With the help of color Doppler, it is graded on the scale 1-4+ depending on the diastolic flow into the right atrium (RA), analogous to estimation of mitral regurgitation. The following criteria indicate severe TR: 1. the surface of the color Doppler flow is 30% larger than the surface of the RA, 2. dense signal of the continuous Doppler, 3. ring dilatation ≥4cm or incomplete cusp coaptation, 4. concave late systolic configuration of the continuous Doppler signal, 5. the velocity of blood inflow ≥1m/s, 6. dilatation of the RA and RV, and 7. systolic and reversal flow into the inferior vena cava and the hepatic vein.

noj osi (tzv. restrikcijsko-dilatacijski sindrom). Stupanj TR može se također dobro procijeniti primjenom kontrastne ehokardiografije. Brzina mlaza TR utvrđena dopleroom koristi se za procjenu sistoličkog tlaka DV, koji u odsustvu opstrukcije izlaznog trakta odgovara sistoličkom tlaku u plućnoj arteriji. To je vrlo korisno klinički jer gotovo 80-90% kardijalnih bolesnika ima izvjesni stupanj TR. Zbog složenog načina zatvaranja minimalna do blaga TR nalazi se, obično u ranoj sistoli, u oko 50-60% zdravih osoba.

Brzina regurgitirajućeg mlaza kroz određeno ušće u direktnom je odnosu sa smanjenjem tlaka kroz valvulu i stoga se koristi u određivanju intrakardijalnih tlakova. Npr. brzina mlaza TR odražava sistoličku razliku tlaka između DV i DA, pa se stoga sistolički tlak u DV može izračunati dodajući očekivani tlak u atriju. Ako je brzina mlaza TR 4,0 m/sec, gradijent kroz trikuspidno ušće u sistoli je 4 x 4 x 4 = 64 mmHg (modificirana Bernoullijeva jednadžba). Ako je očekivani tlak u DA 10 mmHg, sistolički tlak u DV iznosi 74 mmHg. Brzine protoka krvi u izlaznom traktu DV i u trunkusu arterije pulmonalis moraju se izmjeriti u svih bolesnika s povećanom brzinom TR kako bi bili sigurni da nema opstrukcije. Dp/dt DV (pokazatelj kontraktilne funkcije) može se odrediti iz spektra krivulje mlaza TR dobivenog kontinuiranim doplerom. Za vrijeme izovolumetrijske kontrakcije nema značajnijih promjena tlaka u DA i stoga promjene brzine TR u tom razdoblju odražavaju dp/dt. Uobičajeno se mjeri vremenski interval između brzina 1 i 2 m/sec na spektru mlaza TR.

Akutna disfunkcija TV je rijetka i javlja se uglavnom kao sekundarna funkcijska regurgitacija, najčešće u sklopu akutnog tlačnog opterećenja DV (plućna embolija, resekcija pluća), ili rjeđe volumskog opterećenja (akutna ruptura iv septuma kao komplikacija infarkta miokarda) s posljedičnim akutnim zatajivanjem i dilatacijom DV. Akutna TR s ili bez tlačnog opterećenja DV, tj. većinom malih brzina regurgitirajućeg mlaza nastaje u sklopu akutnog inferiornog infarkta sa zahvaćanjem DV, akcidentalne traume (ruptura kordi), jatrogenom traumom jednog ili više listića ili kordi (ozljeda kateterom, bioptomom, elektrodom elektrostimulatora ili kardioverter defibrilatora) ili u sklopu reakcije odbacivanja presatka. U drugim stanjima (miksomatozna degeneracija, bolesti mitralne valvule, plućna hipertenzija različite etiologije, prirođene greške srca, KOPB, plućna fibroza, bolesti vezivnog tkiva, nakon mitralne kirurgije), uglavnom dolazi do akutnog pojačanja prije postojeće TR.

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Diastolic leveling of the interventricular septum indicates a significant volume load on the RV, mostly pronounced at the end of the diastole, visible in the short parasternal axis (so called restriction-dilation syndrome). The TR degree can also be well estimated with the application of contrast echocardiography. The velocity of the TR flow determined by Doppler is used for estimating the systolic pressure of the RV, which in the absence of the obstruction of the outflow tract matches the systolic pressure in the pulmonary artery. This is very clinically useful because almost 80-90% of cardiac patients have a certain degree of TR. Due to the complex way of closure, minimum to mild TR can usually be found in the early systole in around 50-60% of healthy individuals.

The velocity of the regurgitating flow through a certain orifice is in direct relation to the reduction of the pressure through the valve, so it is therefore used for determining the intercardial pressures, eg. the TR flow velocity maintains the systolic pressure difference between the RV and RA and therefore the systolic pressure in the RV can be calculated by adding the expected pressure in the atrium. If the TR flow velocity is 4.0 m/sec, the gradient through the tricuspid orifice in the systole is 4 x 4 x 4 = 64 mmHg (modified Bernoulli's equation). If the expected pressure in the RA is 10 mmHg, the systolic pressure in the RV amounts to 74 mmHg. The blood flow velocities in the outflow tract of the RV and in the truncus of the pulmonary artery must be measured in all patients with an increased TR velocity so we can be sure there is no obstruction. Dp/dt of the RV (contractile function indicator) can be determined from the TR flow spectral curve obtained by a continuous Doppler. During the isovolumetric contraction there are no significant changes in pressure in the RA and therefore the changes in TR velocity during that period reflect the dp/dt. The time interval between velocities of 1 and 2 m/sec are usually measured on the TR flow spectrum.

The acute TV dysfunction is rare and it mostly appears as secondary functional regurgitation, mostly within the acute pressure load of the RV (pulmonary embolism, lung resection), or more rarely the volume load (acute rupture of the iv septum as a complication of the myocardial infarction) with consequential acute failure and dilatation of the RV. The acute TR with or without the RV load i.e. mostly low velocities of the regurgitating flow occurs during an acute inferior infarction which spreads to RV, accidental trauma (chords rupture) or iatrogenic trauma of one or more cusps or chords (injuries by catheter, bioptom, electrode of the electrostimulator or cardioverter defibrillator), or during a transplant rejection reaction. In other conditions (myxomatous degeneration, mitral valve disease, pulmonary hypertension of different etiology, congenital heart disease, KOPB, pulmonary fibrosis, connective tissue disease, after mitral surgery), there is mostly an acute worsening of the pre-existent TR.