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SCIENTIFIC EDITORIAL

# Right ventricular systolic function in heart failure: A long story but still the same question

## *La fonction systolique du ventricule droit chez l'insuffisant cardiaque : une longue histoire mais toujours la même question !*

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Over recent decades, several studies have clearly demonstrated the important role of the right ventricle (RV) in the pathophysiology of different cardiac and pulmonary diseases. Heart failure is a severe chronic disease [1,2] and risk stratification of patients is an important step in their management. Right ventricular (RV) systolic function is a key determinant of prognosis in patients with left ventricular systolic dysfunction [3—5]. The RV has a complex geometry, making it hard to analyse its contractility. Since the mid 1990s, several studies have analysed different methods — from right heart catheterization to magnetic resonance imaging (MRI) — to accurately determine RV ejection fraction (RVEF). However, in 2016, we are still looking for the most practical parameter of RV systolic function.

In this issue of the *Archives*, Venner et al. have retrospectively evaluated the prognostic effect of RV systolic function in 136 patients with idiopathic dilated cardiomyopathy (DCM) [6]. Their mean age was 59.0 ± 13.2 years and their mean left ventricular ejection fraction was 27.5 ± 8.7%. The population was treated according to current guidelines: 88% received angiotensin-converting enzyme inhibitors, 90% beta-blockers and 37% mineralocorticoid receptor antagonists. Moreover, 43% of the patients had an internal cardiac defibrillator and 31% had undergone resynchronization therapy. During a mean follow-up of 2.7 years, there were 49 major cardiac events (36% of patients), including 20 cardiac-related deaths. They used the tricuspid annular plane systolic excursion (TAPSE) for the estimation of RV systolic

*Abbreviations:* DCM, Dilated cardiomyopathy; MRI, Magnetic resonance imaging; RV, Right ventricle or right ventricular; RVEF, Right ventricular ejection fraction; TAPSE, Tricuspid annular plane systolic excursion; TAPSV, Tricuspid annular peak systolic velocity.

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function with a cut-off value of 15.4 mm. They demonstrated — in both a multivariable Cox analysis and a propensity score analysis — the independent prognostic information derived from TAPSE in patients with DCM (hazard ratio: 2.35, 95% confidence interval 1.27—4.34) [6].

Various methods are available for the determination of RV systolic function. Selected studies that demonstrate the prognostic role of the RV parameters are detailed in the Table 1. The gold standard is considered to be MRI, but there are three major limitations of this technique: its limited availability, its expense and, currently, its contraindication in patients with devices, which applies to the majority of our patients. Radionuclide angiography is an alternative to MRI, and we have demonstrated that radionuclide RVEF is more powerful than echocardiographic parameters for the risk stratification of outpatients with stable left ventricular systolic dysfunction [7]. However, radionuclide angiography is not always available, is expensive and induces irradiation to patients, albeit less than a computed tomography scan, which is not a technique used in daily practice for the analysis of the RV. These different techniques need a sinus rhythm or a quite regular cardiac rhythm, which is also a limitation. The thermodilution technique is, of course, an invasive method and is not performed routinely in stable patients. Finally, the easiest way to analyse the RV is, of course, echocardiography.

Most of the studies shown in the Table 1 were echocardiographic studies. Echocardiography can be performed immediately at the bedside for all patients, regardless of their haemodynamic situation. In addition to the analysis of RV systolic function, echocardiography has the advantage of providing important information on the size of the different cavities, the estimation of haemodynamic data, left ventricular function and valvular function. However, echocardiography has also several limitations, the first one being the echogenicity of the patient. The second limitation is that pressures are estimated and several studies have demonstrated the modest correlation between invasive measures and echocardiographic estimations. The third limitation is the great number of RV echocardiographic parameters [8,9], which suggests that echocardiographic estimation of RV function is not yet optimal. The main parameters are RV fractional area change, RV performance index, RV contractility (dP/dt), TAPSE, tricuspid annular

**Table 1** Selection of some studies related to RVEF and prognosis in systolic heart failure.

| Study | Publication year | *n* | Aetiology | Methods | Parameters | Cut-off values |
|---|---|---|---|---|---|---|
| Polak et al. [14] | 1983 | 34 | Ischaemic | Radionuclide | RVEF | 35% |
| Di Salvo et al. [3] | 1995 | 67 | All | Radionuclide | RVEF exercise | 35% |
| Juillière et al. [5] | 1997 | 62 | DCM | Thermodilution | RVEF | 50% |
| Sun et al. [15] | 1997 | 100 | DCM | Echo | RV/LV ratio | 0.5 |
| Karatasakis et al. [16] | 1988 | 48 | All | Echo | RV shortening | 12.5 mm |
| de Groote et al. [4] | 1998 | 205 | All | Radionuclide | RVEF | 39% |
| Ghio et al. [17] | 2001 | 377 | All | Thermodilution | RVEF | 35% |
| Zornoff et al. [18] | 2002 | 416 | Post-MI | Echo | RV FAC | 32.2% |
| Gavazzi et al. [19] | 2003 | 76 | All | RHC | RVEF and NTG | 30% |
| Meluzin et al. [20] | 2005 | 177 | All | Echo | TAPSV/TAPEDV | 10.8/8.9 cm/s |
| Field et al. [21] | 2006 | 77 | Post-CRT | Echo | RV MPI | Continuous |
| Dokainish et al. [22] | 2007 | 100 | All | Echo | TAPSV | 9 cm/s |
| Larose et al. [23] | 2007 | 147 | Post-MI | MRI | RVEF | 40% |
| Kjaergaard et al. [24] | 2007 | 817 | All | Echo | TAPSE | 14 mm |
| Bistola et al. [25] | 2010 | 102 | All | Echo | TAPSV | 7.3 cm/s |
| Damy et al. [26] | 2012 | 722 | All | Echo | TAPSE | 15.9 mm |
| de Groote et al. [7] | 2012 | 527 | All | Radionuclide/Echo | RVEF/TAPSE, TAPSV | 37%/18.5 mm, 9.7 cm/s |
| Melenovsky et al. [27] | 2013 | 408 | All | Echo | TAPSE/TAPSV (combined) | 10 mm/6 cm/s |
| Gulati et al. [28] | 2013 | 250 | DCM | MRI | RVEF | 45% |
| Iacoviello et al. [11] | 2016 | 332 | All | Echo | RV strain | Global: −14% RV free wall: −20.6% |

CRT: cardiac resynchronization therapy; DCM: dilated cardiomyopathy; Echo: echocardiography; FAC: fractional area change; LV: left ventricle; MI: myocardial infarction; MPI: myocardial performance index; MRI: magnetic resonance imaging; NTG: nitroglycerine; RV: right ventricle; RVEF: right ventricular ejection fraction; TAPSE: tricuspid annular plane systolic excursion; TAPEDV: tricuspid annular peak early diastolic velocity; TAPSV: tricuspid annular peak systolic velocity.