A recurring task in the work of a clinical cardiologist is to quantify the degree of mitral regurgitation in patients with valvular incompetence. Its relevance in establishing surgical indications and providing a prognosis for patients with several types of cardiovascular disease makes the attempt to improve the measurement of regurgitant flow in these patients essential. Several clinical signs and invasive/noninvasive methods have recently been used to this end.

The introduction of Doppler color flow mapping several years ago enabled the visualization of cardiac flow. The different types of flow found in the cardiac cavities—normal anterograde flow, shunting, and regurgitant jets—have different characteristics. From this perspective, studying regurgitant jets has obvious diagnostic and prognostic relevance. However, hopes that it would be relatively simple to measure regurgitant lesions with this technique soon proved false. All the methods used to measure the severity of valvular regurgitation by measuring the jet or attempts at reconstructing the jet from several planes have proven difficult. It is now clear that the appearance of turbulent jets depends on factors different from regurgitant flow, while the influence of instrument settings, driving pressure and so-called wall jets is well known. From the point of view of hydrodynamics they have intrinsically different magnitudes because the regurgitant jet includes extra fluid belonging to the receptor chamber and the amount depends on the driving pressure for a given regurgitant volume.

In any case, the clinical use of semiquantitative measurements of regurgitant flow—which enable analyzing the jet, even by simple visual estimation—is undeniably useful and can be validly compared to far more refined methods. Thus, it continues to be the most commonly used method in our setting, not only for the rapid measurement of valvular regurgitation, but also for prognosis by using both the measurement of the jet’s dimensions and the visual estimation mentioned, where the operator combines a series of already known data into the evaluation process.

On the other hand, theoretical work on fluid behavior and the need for a quantitative approach (more comprehensive and reliable measurements) have led to the study of two new methods for measuring regurgitant flow: momentum analysis and flow convergence. Both techniques enable calculating maximum flow, regurgitant flow/beat, and regurgitant flow. It must be mentioned again that, in all these cases, the calculations not only reflect the severity of valvular regurgitation, but also the patient’s current hemodynamic situation, which can vary.

Momentum is the physical parameter that provides the best description of jet patterns. Two methods have been used to calculate this. The first uses the property of dynamic similarity of the jet. This method involves intrinsic difficulties in practice, the first of which, breathing, can be overcome; second, there is the phenomenon of intrinsic flows that impinge on the measurement area; and, third, there are also practical difficulties involved in aligning the Doppler beam with the central jet, which is hindered by cardiac motion and turbulence. The calculation of Um (central velocity of the jet) seems even more difficult to solve and, in the case of wall jets—which are involved in a considerable number of patients—early transfer of momentum before it is fully developed makes it unquantifiable.

The second method for quantifying momentum—where the information on velocity coded in the pixels has a proportional weight, in contrast to the binary
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accepted that convergent flow area is barely affected by the ejection of blood through a small orifice, and that the flow maintains a hemispherical shape. However, the finite viscosity of blood means that the flow will eventually distort the hemispherical shape, leading to the formation of a regurgitant orifice. This orifice is formed due to the interaction between the blood flow and the valve anatomy, which in many cases, is not hemispherical. This distortion is particularly pronounced in the case of mitral valve regurgitation. The principle underlying the phenomenon of proximal acceleration is found in the theory of fluid dynamics, where the flow approaches a specific orifice and then accelerates due to the constraints imposed by the valve anatomy. This acceleration occurs because the flow is constrained by the valve leaflets, which are not perfectly hemispherical.

In order to calculate the regurgitant orifice area, one needs to consider the geometry of the regurgitant orifice and the velocity profile of the blood flow. The regurgitant orifice area can be calculated using the formula $A = \pi \left( \frac{2M}{r u(r)} \right)^2$, where $M$ is the mass flow rate, $r$ is the radius of the orifice, and $u(r)$ is the velocity at the orifice. This formula is derived from the conservation of mass principle, which states that the mass flow rate into a closed system is equal to the mass flow rate out of the system.

Another problem that should be borne in mind is that, in clinical practice, the regurgitant orifice area is calculated using echocardiography and Doppler ultrasound, which includes additional technology. On the other hand, in 2003, the American Society of Echocardiography published new recommendations for estimating the severity of valvular lesions using bidimensional echocardiography and Doppler ultrasound, which was included as a useful parameter for evaluating mitral regurgitation. In this issue of the REVISTA ESPAÑOLA DE CARDIOLOGÍA, they address an aspect that possibly leads to this type of analysis being underestimated in clinical practice, i.e., the introduction of new Doppler ultrasound equipment includes the software and spatial resolution of the equipment available, and the lack of definition around the aliasing area.

Given the above, we arrive at a quantitative method that can be currently applied in the clinical context to any type of jet and that does not need additional technology. On the other hand, in 2003, the American Society of Echocardiography published new recommendations for estimating the severity of valvular lesions using bidimensional echocardiography and Doppler ultrasound, which was included as a useful parameter for evaluating mitral regurgitation. In this issue of the REVISTA ESPAÑOLA DE CARDIOLOGÍA, they address an aspect that possibly leads to this type of analysis being underestimated in clinical practice, i.e., the introduction of new Doppler ultrasound equipment includes the software and spatial resolution of the equipment available, and the lack of definition around the aliasing area.

REFERENCES