How big is small?

See page 247, doi:10.1053/euhj.2001.2730 for the article to which this Editorial refers

The clinical benefit of coronary balloon angioplasty and newer techniques such as stent implantation was initially tested in large coronary artery segments, usually 3 mm or greater in diameter[1-6].

It has long been acknowledged that interventions in so-called small coronary arteries are associated with less short- and long-term success and a higher incidence of complications compared to larger coronary artery segments[7-9]. However, luminal dimensions defining a ‘small’ coronary artery have never been fixed.

A variety of vessel diameters ranging between 3·0 and 2·25 mm are used, beyond which a coronary artery is determined to be small.

In addition to the lack of definition and consensus, the coronary angiogram, which depicts the coronary artery tree, does not reflect the real vessel size since it only allows the size of the vessel lumen opacified by contrast medium to be determined. Despite the availability of very sophisticated computer systems for quantitative coronary angiography, which allow the quantification of luminal dimensions, this particular limitation cannot be overcome[10]. In clinical practice, the vessel size is determined from the lumen diameter of a so-called non-stenotic reference segment proximal to the target lesion or as an interpolated reference diameter between two non-stenotic vessel segments proximal and distal to the lesion either using worst view evaluation or taking the average of two orthogonal views. Nevertheless, true vessel size, which includes the lumen and vessel wall, is difficult if not impossible to determine. This is supported by various autopsy studies, which document a wide variety of vessel wall thickening because of the underlying atherosclerotic process even in reference vessel segments which angiographically appear unobstructed[11,12]. Furthermore, the process of atherosclerosis increases vessel wall size even before it starts to compromise the lumen, as was stated by Glagov[12,13].

Intravascular ultrasound is a much better tool for judging true vessel size since it allows illustration and quantitation of the vessel wall and lumen[13-17]. Thereby, the angiographic limitations in defining coronary artery size are overcome. The American College of Cardiology Clinical Expert Consensus Document on Standards for Acquisition, Measurement and reporting of Intravascular Ultrasound clearly defines lesion and reference segment borders[18]. Proximal or distal reference sites are defined as the site with the largest lumen proximal or distal to a stenosis but within the same segment (usually within 10 mm of the stenosis but with no major intervening branches), which may not be the site with the least plaque. Vessel size is determined by the area surrounded by the external elastic membrane, which in most cases can be easily identified by intravascular ultrasound. Nevertheless, this consensus document does not provide quantitative measures to define a small coronary artery.

In this issue Briguori et al.[19] report on the discrepancy in reference vessel dimensions, measured by intravascular ultrasound and quantitative coronary angiography, for small (≤2·75 mm angiographic diameter) or larger coronary vessels (>2·75 mm angiographic diameter). It is remarkable that 96% of the evaluated cases in the smaller vessel group and 80% in the larger vessel group showed a minimum difference of 0·5 mm between angiographic and intravascular ultrasound results. These percentages are reduced to 71% in the smaller vessel group and to 49% in the larger vessel group, if the threshold is increased to ≥1·0 mm difference between angiographic and intravascular ultrasound images. Proximal or middle lesion site, female sex and lesion length were identified as predictors for this large discrepancy. The results additionally showed that this mismatch is more pronounced in angiographically smaller vessels which were frequently identified by intravascular ultrasound as larger vessels with a high plaque burden. This message is well taken.

The clinical implications of these findings are directed towards the use of larger balloon sizes or higher balloon to artery ratios. This strategy has been followed in the past[20]. The authors came to the conclusion that in about 70% of lesions a balloon to artery ratio of 1·4 is appropriate. This strategy appears quite aggressive and needs additional support before it can be safely applied in general clinical practice without increased complication rates (dissections, perforations). The authors state that with the use of intravascular ultrasound to guide balloon sizes, this aggressive strategy can be safely performed in small coronary arteries. This idea of balloon sizing by intravascular ultrasound was originally proclaimed by Stone et al[21]. Data from prospective randomized
trials are needed to support the long-term benefit of this strategy with a reduction of restenosis. Numerous data support the hypothesis that greater balloon to artery ratios based on angiography are associated with greater vessel wall injury and subsequent neointimal proliferation causing restenosis\[^{22-24}\]. It can be hypothesized that in these studies balloon to artery ratios were inappropriate and that the use of intravascular ultrasound allows a better definition of the individual balloon to artery ratio.

If this aggressive balloon to artery ratio sizing does not provide long-term benefits, the additional costs for the intravascular ultrasound imaging, which add substantially to the costs of the angioplasty procedure, are not justified. On the other hand, if this strategy proves to provide long-term benefits with reduced restenosis rates and no increase in complication rates, a health economics evaluation is required to support the additional costs for the intravascular ultrasound imaging. Finally, it needs to be evaluated whether this strategy can be performed with the same success if intravascular ultrasound is not applied.

In summary, the findings of Briguori et al\[^{19}\] are an important contribution to the understanding of coronary vessel sizes and its evaluation by coronary angiography and intravascular ultrasound. The derived therapeutic strategies using larger balloon to artery ratios based on intravascular ultrasound need to be supported by prospective randomized data.

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References


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