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Which strategy for calcified coronary plaque modification in a patients with low ejection fraction?

Short title: Calcified plaque modification in low ejection fraction patient

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In the era when more and more complex patients require percutaneous coronary treatment, the combination of the different interventional methods is necessary. In patients with heavily calcified coronary lesions and additionally poor left ventricle ejection fraction the simultaneous use of plaque modification technique along with mechanical circulatory support can contribute to the final success.

A 44-year-old man with symptomatic chronic coronary syndrome and recognized advanced heart failure was admitted to our center to complete the diagnostics and qualify for further treatment. The patient was obese with body mass index 33, smoker, with positive cardiovascular family history and pancreatitis in anamnesis. In echocardiography left ventricle was dilated with ejection fraction 23% and inferior wall dyskinesis. Coronary angiography revealed multivessel disease including 80%–90% stenosis of left main (LM) and left anterior descending artery and with proximally occluded right coronary artery (Figure 1A). After Heart-Team discussion the patient was disqualified from open heart surgery (mainly because of very low ejection fraction) and qualified to complex percutaneous coronary intervention.

In initially performed high definition intravascular ultrasound examination significant calcifications including LM (300º–360º) were seen (Figure 1B). This finding substantially increased the risk of the procedure, because some kind of plaque modification technique would be necessary, as well as possibly left ventricle support. Firstly, from currently available calcification modification devices we decided to use intravascular lithotripsy (IVL, Shockwave Medical, Fremont, CA, US) instead of rotational and orbital atherectomy. Secondly, we decided to use Impella CP support (Abiomed, Danvers, CO, US), but only if absolutely necessary. Our strategy was to place a pig-tail catheter in the left ventricle to monitor end diastolic pressure during balloon inflation. Whereas, even during 5 seconds IVL application blood pressure was decreasing and left ventricle end diastolic pressure was increasing, not achieving full balloon deployment (Figure 1C). Impella support was therefore necessary to finish the procedure.

With functioning Impella full 8 cycles of IVL were applied with visible temporary ventricular-aortic uncoupling on the Impella monitor. We managed to deploy the balloon fully after that (Figure 1D). Finally, 3 stents in LM and left anterior descending artery were implanted without complications and with patent side-branches (Figure 1E). Final confirmation of widening calcified lesions and proper stents apposition was done by intravascular ultrasound (Figure 1F).

When percutaneous intervention with calcified plaque modification is necessary, different methods can be discussed, including cutting/scoring balloons, very high-pressure balloons, rotational atherectomy, orbital atherectomy, IVL. The risk is higher in case of complex lesions and accompanying heart failure [1, 2]. Every strategy has some advantages and disadvantages. For instance, rotational and orbital atherectomy carry an increased risk of no/slow-flow phenomenon. On the other hand IVL balloon requires 10 seconds of vessel occlusion, what in case of LM disease is of great importance. Balloon techniques can modify deep calcium, while atherectomy devices are more effective in tight stenoses [3]. After deep analysis of coronary angiography and, importantly, intravascular imaging we are better prepared to choose proper device for particular patient. Noteworthy, sometimes every of 3 calcium debulking methods would be acceptable, another time we have to use 2 of them together [4].

Article information

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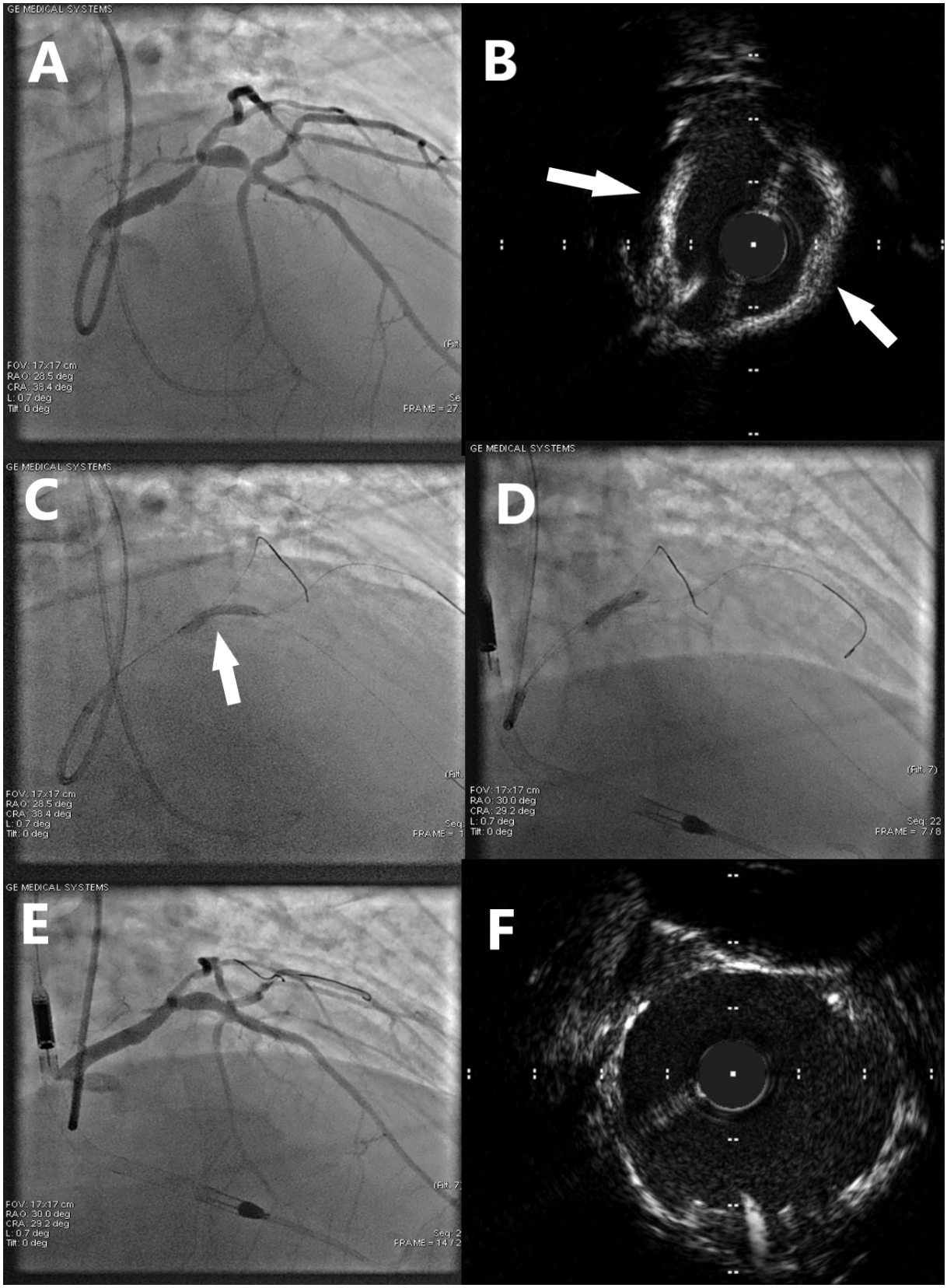

Figure 1. A. Coronary angiography revealing tight stenoses in left main and left anterior descending artery. **B.** Intravascular ultrasound with visible excessive calcifications in the left main (white arrows). **C.** Not fully deployed balloon (white arrow) during predilatation and with

a pig-tail catheter in the left ventricle. **D.** Full balloon opening after intravascular lithotripsy applications with functioning Impella device. **E.** Final coronary angiography after 3 stents implantation. **F.** Intravascular ultrasound showing proper stent apposition in calcified plaques.