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The importance of autopsy studies in elucidating coronary venous diseases

We congratulate Sławek-Szmyt *et al.*¹ for their study wherein they examined coronary venous anatomy in unfixed cadaveric hearts. For the successful cannulation of coronary veins, they examined the largest series in this field on autopsy and developed a new and perfect morphological typing for Thebesian valve (TV) because they considered the previous classifications to be insufficient.¹ Research on cadavers is the most important study method to better understand coronary venous anatomy and to elucidate coronary vein diseases. Sławek-Szmyt *et al.*¹ stated in the introduction of their article that the function of TV is not completely known; however, it is believed that TV prevents the regurgitation of blood into the coronary sinus (CS). A recently published study used cardiac magnetic resonance imaging and reported that the regurgitation fraction and regurgitation volume into CS was higher in individuals without TV.² Furthermore, Sławek-Szmyt *et al.*¹ reported that especially the CS ostium area was significantly related to the right atrium diameters in cadavers without TV, supporting the hypothesis that the regurgitation volume in those without TV may expand CS over time.

Coronary venous angioplasty (CVAP) application to facilitate transvenous left ventricular lead placement has become widespread in recent years, and the experiences gained since many years are still being published.³ Although focal stenoses are reported to be the most common reason for CVAP application, which may especially be required to facilitate cardiac resynchronization therapy (CRT), the aetiology of these stenoses (venous atherosclerosis, intimal hyperplasia etc.) is unclear.³ Venous arteriosclerosis is triggered when venous grafts are exposed to high volume and pressure load.⁴ As a result of the higher occurrence of wide CS in patients without TV and higher regurgitation fraction and regurgitation volume in those without TV, the types of studies with the highest likelihood of shedding light on whether CS reflux has an effect on venous atherosclerosis are autopsy studies focusing on the coronary venous system.^{1,2} In a recently published meta-analysis, ventricular arrhythmia and deaths due to all causes were found to be significantly higher in CRT non-responders.⁵ It seems that

autopsy studies may also be important to better understand CRT non-responders and coronary venous anatomy, to be able to detect coronary venous diseases and to elucidate their aetiology. In addition to performing the autopsy study in the largest series to examine the coronary venous system, unlike other autopsy studies, Sławek-Szmyt *et al.*¹ did not fix the tissue with formalin because they immediately examined the heart tissues in the postmortem days 1–3, and they showed great dedication and success methodologically by performing their studies under similar *in vivo* conditions.

To conclude, conducting autopsy studies using the methodology that Sławek-Szmyt *et al.* used will enable us to better understand the coronary venous system and coronary venous diseases as well as their effects on the heart (effect of CS reflux on myocardium, atherosclerosis in native coronary veins, etc.).

Conflict of interest: none declared.

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The importance of autopsy studies in elucidating coronary venous diseases: Authors' reply

We thank Dr Akşit *et al.*¹ for their interest in our study regarding peculiarities of coronary sinus (CS) anatomy² and their supportive comments. We are especially grateful for sharing their own experience with the assessment of the coronary venous system.³ To continue the discussion in this reply, we elaborate on the elements that authors raised up in their statements.

As the authors pointed out in their study performed using magnetic resonance imaging the blood regurgitation fraction and regurgitation volume into CS were higher in individuals without Thebesian valve (TV); however, the differences were not statistically significant.³ Nevertheless, only anatomical studies identify CS anatomy in details, especially fenestrated or residual TVs. In our study, the TV was present in 79.5% of the specimens, while in Akşit *et al.*³ study TV was detected only in 15.4%. Moreover, the median percentage of CS ostium (CSO) coverage by the TV in our series (assessed for semilunar, fenestrated, and mixed shaped valve types) was 55% (interquartile range 40–73%). We have also identified the new types of TVs—fused strands and mixed-shaped, which visibility in imaging studies may be a particular difficulty due to their unique structure.

Interestingly, the CSO area strongly correlated with the CS length. We hypothesized that it could be related to the increased blood flow causing also stretching of myocardial sleeve covering the CS and thus increasing the CS length and the CSO area. Nonetheless, it also could be linked with CS reflux as pointed out by Akşit *et al.*³ It has been reported that CS reflux can be triggered by conditions that increase the right atrial pressure, atrial contraction, or absence of TV.³ However, a small amount of reflux is considered physiological (e.g. due to atrial contraction). Moreover, if the absence of the TV would cause significant reflux, we would expect significant differences in the maximum diameter of the CS between patients with and without TV. We did not reveal such differences in our sample size.

In our study, we found that the CSO area as well as CS length positively correlated with the right atrium's (RA) transverse and longitudinal dimensions. What is in line with previous