Relationship between stent fracture and stent thrombosis

Yue-Hua Ruan and Ren-Qiang Yang

We read with interest the Review by Tommaso Gori and colleagues (Predictors of stent thrombosis and their implications for clinical practice. *Nat. Rev. Cardiol.* **16**, 243–256 (2019))¹. The authors present the different risk factors that potentially lead to stent thrombosis and the new therapies for this condition. One of the risk factors identified for stent thrombosis is stent fracture, with studies by Kuramitsu and colleagues² and Kan and colleagues³ being cited.

In the study by Kuramitsu and colleagues, 1,035 patients with 1,339 lesions treated with everolimus-eluting stents were followed up for 6–9 months². The incidence of stent thrombosis in the stent fracture group was higher than that in the non-stent fracture group (5.1% versus 0.4%; $P=0.018$). In the study by Kan and colleagues, 6,555 patients with 10,751 lesions treated with a drug-eluting stent were followed up for 9–12 months³. Again, the incidence of stent thrombosis in the stent fracture group was higher than that in the non-stent fracture group (4.60% versus 1.03%; $P<0.05$). Therefore, Gori and colleagues inferred that stent fracture is associated with stent thrombosis¹.

However, in a study by Umeda and colleagues, in which 793 patients with 874 lesions treated with a sirolimus-eluting stent were followed up for 4 years, no significant difference was observed in the incidence of stent thrombosis between the stent fracture group and the non-stent fracture group (2.9% versus 0.8%; $P=0.148$)⁴. In addition, Nakazawa and colleagues reviewed high-contrast, film-based radiographs and performed histopathological analysis of 177 consecutive lesions from the CVPATH drug-eluting stent autopsy registry⁵. Only severe stent fracture (with transection causing a gap in the stent segment) was significantly associated with stent thrombosis. In a study of 2,098 patients who had a coronary stent implanted and who underwent follow-up coronary angiography at the Second Affiliated Hospital of Nanchang University, China, between 2012 and 2017, eight patients were found to have stent fracture (four confirmed by intravascular ultrasonography). As of 1 December 2018, the mean duration of follow-up of these eight patients was 903 ± 683 days, and none had developed stent thrombosis (Y.-H.R. and R.-Q.Y., unpublished observations).

In summary, stent fracture and stent thrombosis are both rare but severe complications of coronary procedures with a very complex pathophysiology, but the relationship between them is still uncertain. The classification of coronary stent fracture, the drug coating of the coronary stent and the duration of coronary stent implantation must be carefully considered when exploring the relationship between stent fracture and thrombosis. Perhaps with the increasing awareness of stent fracture, new imaging tools such as intravascular ultrasonography and optical coherence tomography will be used to define the relationship between stent fracture and thrombosis.

Reply to ‘Relationship between stent fracture and thrombosis’

Tommaso Gori, Alberto Polimeni, Ciro Indolfi, Lorenz Räber, Tom Adriaenssens and Thomas Münzel

We are grateful to Yue-Hua Ruan and Ren-Qiang Yang for their interest in our Review (Predictors of stent thrombosis and their implications for clinical practice. *Nat. Rev. Cardiol.* **16**, 243–256 (2019))¹ and for their helpful comments (Relationship between stent fracture and thrombosis. *Nat. Rev. Cardiol.* <https://doi.org/10.1038/s41569-019-0262-6> (2019))². We absolutely agree that the relationship between stent strut fracture and thrombosis (as well as restenosis) requires further investigation.

No agreement exists on the true prevalence of strut rupture, which varies from <1% to 20% in the literature. This variability is influenced by factors such as time after implantation, stent type and implantation technique used, and vessel characteristics. Most importantly, the diagnosis of stent fracture is also influenced by the spatial resolution of the imaging method used. The resolution of either standard radiography or intravascular ultrasonography does not allow stent fractures to be systematically assessed. Optical coherence tomography also has limitations — for instance, in the setting of stent failure, when blood flushing

There is a reply to this letter by Gori, T. et al. *Nat. Rev. Cardiol.* <https://doi.org/10.1038/s41569-019-0263-5> (2019).

Yue-Hua Ruan and Ren-Qiang Yang
Institute of Cardiovascular Disease, Cardiovascular
Medicine, The Second Affiliated Hospital of Nanchang
University, Nanchang, Jiangxi, China.
*e-mail: yangrenqiangcn@163.com

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Competing interests

The authors declare no competing interests.

is often incomplete, and late after stenting, when the visibility of the struts is reduced owing to the presence of neointima. Furthermore, invasive imaging methods provide little information when a stent fracture is not associated with dislodgement of the stent segments.

The discordance between reports also results from the lack of a standardized definition of stent fracture. Nakazawa and colleagues propose a classification for this entity on the basis of pathology findings, which unfortunately cannot be directly applied in routine clinical practice³. We agree with Ruan and Yang that such a classification (most likely on the basis of intracoronary imaging evidence) might help to define the strength and the mechanisms of the association between stent fracture and thrombosis (including whether only ‘major’ fractures lead to an increased risk of thrombotic or restenotic events).

Tommaso Gori¹*, Alberto Polimeni^{1,2}, Ciro Indolfi²,
Lorenz Räber³, Tom Adriaenssens⁴
and Thomas Münzel¹

¹Kardiologie I, Zentrum für Kardiologie, University
Medical Center Mainz and DZHK Standort Rhein-Main,
Mainz, Germany.

²Division of Cardiology, Department of Medical and Surgical Sciences, "Magna Graecia" University, Catanzaro, Italy.

³Department of Cardiology, Bern University Hospital, Bern, Switzerland.

⁴Department of Cardiovascular Medicine, University Hospitals Leuven, Leuven, Belgium.

*e-mail: tommaso.gori@unimedizin-mainz.de

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