ASSESSMENT OF CORONARY STENT DEPLOYMENT IN TAPERED ARTERIES: IMPACT OF ARTERIAL TAPERING

冠状动脉内支架在锥形动脉中的应用评价:动脉收缩的影响

Coronary stents are used to prop open blocked arteries in order to restore normal blood flow. A major setback in this technology is in-stent restenosis (ISR), which gravely limits the clinical success of stents, especially in tapered vessels.The present study used the finite element method to study the effects of arterial tapering on the biomechanical behavior of both stents and vessels during stent deployment inside tapered arteries. The effect of arterial tapering was demonstrated by a combination of corresponding tapered arteries with various tapering angles, including a straight artery case for comparison. Results indicated that an increase of vessel tapering led to an increase in stent radial recoil, stent tapering following expansion, and von Mises stresses on vessels. However, an increase of vessel tapering also led to a decrease in stent foreshortening. The analysis provides suggestions for clinical application in tapered vessels. The finite element method evaluated mechanical stent behavior in tapered vessels, and can help designers to optimize the design of stents for tapered vessels.

冠状动脉支架是用来支撑开放阻塞的动脉，以恢复正常的血流。这项技术的一个重大挫折是支架内在狭窄(Isr)，严重限制了支架的临床成功，特别是在锥形血管中。本研究采用有限元方法，研究了在锥形动脉内放置支架时，动脉变细对支架和血管生物力学行为的影响。动脉变细的效果由不同变细角度的相应变细动脉组合而成，其中包括一个直动脉病例以供比较。结果表明，随着血管变细的增加，支架径向后坐力增加，支架扩张后逐渐变细，VonMises对血管的应力增加。然而，血管变细的增加也导致支架收缩的减少。分析结果为临床在锥形血管中的应用提供了建议。有限元法对锥形血管内的机械支架行为进行了评价，为设计人员优化锥形血管支架的设计提供了依据。

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Finite element method can be used for numerical modeling in order to provide comprehensive and useful results for analytical investigation of stent deployment in tapered vessels with the aim to avoid complications during implantation. This study investigated the effect of vessel tapering on the deployment of a coronary stent in the tapered vessels. The combination of various tapering angles, including a SA,with corresponding arteries was used to demonstrate the influence of arterial tapering. In this study, the radial recoil and foreshortening of a given design stent were affected by the level of tapering of a vessel. However, this is a design-dependent effect. Moreover, it was found that not only the presence of tapering, but also the level of tapering, have a significant effect on the arterial stress. An increase in vessel tapering resulted in an increase in stent recoil, stent tapering following expansion, and von Mises stresses on vessels. However, an increase in vessel tapering also led to a decrease in stent foreshortening. Numerical simulation results from the present study may help clinicians to select appropriate stents and assist designers to develop new stents, especially for tapered vessels.

有限元法可用于数值模拟，为锥形血管内支架放置的分析研究提供全面而有用的结果，以避免 植入期并发症。本研究探讨了血管变细对锥形血管内冠状动脉支架置入的影响。结合不同的变细角度，包括一个SA，与相应的动脉，以显示动脉变细的影响。在本研究中，设计支架的径向后坐力和缩孔受血管变细程度的影响。然而，这是一种依赖于设计的效果。此外，研究还发现，不仅有变细的存在，而且变细的程度也对动脉压力有显著的影响。血管收缩增加导致支架反冲增加，扩张后支架逐渐变细，血管上的VonMises应力增加。然而，血管变细的增加也导致支架收缩的减少。本研究的数值模拟结果可以帮助临床医生选择合适的支架，并帮助设计者开发新的支架，特别是锥形血管。