OP04-24 Kosukegawa, H (Graduate School of Engineering, Tohoku University, Japan)

Evaluation of Poly (vinyl alcohol) Hydrogel Biomodeling by Using Ultrasound

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Key words: poly (vinyl alcohol) hydrogel, blood vessel, biomodeling, ultrasound, compliance

Background and purpose: A blood vessel biomodeling, which has low surface friction and similar mechanical properties to a real blood vessel, has been developed using poly (vinyl alcohol) hydrogel (PVA-H). It is capable of being used for the training of intervention, preoperative simulation, or the development of medical devices at in-vitro stage. The motion of PVA-H biomodeling is one of the important evaluation points for showing hardness. In this study, we prepared a box-typed PVA-H model having a straight cylindrical hollow, and obtained the diameter-pressure curve of the model by using ultrasound.
Method: PVA powder was dissolved into a mixture of water and organic solvent, and it was cast into an acrylic box, on which a straight aluminum cylinder with diameter of 4 mm was fixed. The box was maintained at −30°C for 24 hours to promote gelation. The PVA-H model was obtained by removing the cylinder. The model was subjected to hydrostatic pressure by adding distilled water and the inner diameter was measured using ultrasound. The diameter-pressure curve of model and Young's modulus were calculated from the strain of inner diameter and the change of inner pressure.
Result and discussion: The inner pressure diameter of model increases linearly as the inner pressure increases, and PVA-H with higher concentration of PVA solution shows higher Young's modulus and lower gradient of the curve. These results indicate that the compliance of PVA-H model is constant without relying on pressure change, and a model with different compliance can be obtained by changing the method to prepare PVA-H. On the other hand, that of real blood vessel changes nonlinearly. This difference may depend on the isotropic characteristics of PVA-H, whereas a real blood vessel is anisotropic. These results indicate that adding anisotropy to model would be necessary to represent the compliance of a real artery.

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Experimental Study on a Catheter Movement for evaluating Catheter Designs

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Key words: catheter, cerebral aneurysm, intervention, poly (vinyl alcohol) hydrogel

Background and purpose: Recently, vascular diseases, such as ischemic heart disease, infarction, aneurysms, stroke and stenosis are the leading cause of serious long-term disability and as high as a mortality rate of cancers in many countries. Moreover, neurovascular intervention using catheters is the use of minimally-invasive endovascular techniques to treat vascular disease of the brain and a navigation system for catheters has been developed for surgical planning and an intra-operative assistance. In this study, several catheter designs were examined by the catheter motion tracking system with Poly (vinyl alcohol) hydrogel.
Materials and Methods: PVA (JAPAN VAM & POVAL CO., LTD., Japan) was dissolved in a mixed solvent of dimethyl sulfoxide (DMSO) (Toray Fine Chemicals Co., Ltd., Japan) and distilled water (80/20, w/w), and the mixture solution was stirred for 2 hours at 100°C until dissolution. Then the PVA solution cast into an acrylic box with the mold was maintained at −30°C for 24 hours to promote PVA crystallization. After gelation, the mold material was removed using water like a lost-wax technique. Different concentration ratio PVA-H (12, 15 and 18 wt%)s , 3 kinds of catheters and 3 different shaped catheter tips were prepared for evaluating the mechanical properties of catheter by monitoring catheter zebra patterns.
Results and Discussion: Several catheter tips were inserted into different concentration ratio PVA model in the catheter tracking system. PVA-H model is transparent and sufficient to observe the catheter zebra patterns on the wall. It could be possible to find out the possibility of evaluation of catheter shape by examining sequent images of catheter motion with time at PVA-H. It will imply that catheters and guide wires can be controlled in the real PVA-H artery phantom model.
Conclusion: In this paper, we described the experimental study on a catheter motion for evaluation of catheter design by applying the system.
Acknowledgement: GCOE and core to core partially support this research.