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Expandable polyurethane stent valve, as an option for pediatric patients with valve diseases: Result of physical, hydrodynamic and experimental studies

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Background: An expandable polyurethane (PU) stent valve, with a special design for pediatric patients, may be an option for biological prostheses whose calcification or mismatch, in child's development, shorten their durability. (Average of 5 years)

Methods: 1- In vitro tests: I- Physical test: The prostheses were submitted to universal tests, of samples of PU, pre and post crimping: A- Strength versus deformation (stretching). B- Scanner for surface and electrical and mechanical properties using Atomic Force Microscopy. II- Hydrodynamic test: Using a pulsatile flow, for study of valvular area, gradient and regurgitation, under physiological and stress conditions, using 12, 15, 18 and 22 mm valve stent diameters. 2- In vivo test: III- Experimental: 10 sheep were submitted to implantation of prosthesis by catheter, in pulmonary position. Expansion diameter: Group A: 22mm (7 cases) and Group B: 18mm (3 cases)

Results: I - In vitro tests: PU showed to be a thermoplastic structure with high deformation, resistant to crimping and elongation. The hydrodynamic test showed low gradients, regardless of the diameter of the prosthesis. In vivo tests: After 5 months of implantation of the prosthesis in sheep, the 3D echocardiographic study showed: satisfactory hemodynamic performance, with no significant trans-valvular gradient (5.80 to 10 mmHg, M = 6.92 mmHg), no regurgitation and calcification-free of the PU leaflet.

Discussion: Published papers on the durability of bio-prosthetic devices in pediatric patients show that 20 to 30% of patients are free of reoperation after 9 years of follow-up. The development of the pediatric patient with cardiac prosthesis causes mismatch that requires the replacement of the prosthesis until adulthood.

Conclusions: Monitoring of favorable results confirms that the PU valve stent can be implanted in children, below 5 years, during conventional surgery and above 7 years, by catheter implantation.

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