INTISARI

Latar Belakang. Prosedur Intervensi Koroner Perkutan (IKP) di lesi percabangan pembuluh darah koroner terdapat masalah 30% karena penyempitan ulang stent dan trombosis stent. Luas sel *strut* stent berperan menjaga keseimbangan antara terbukanya muara cabang dan mencegah prolap plak. Desain geometri stent pembentuk luas sel *strut* berpengaruh terhadap aliran. Tegangan Geser Dinding (TGD) mencerminkan hemodinamik aliran dalam proses penyempitan ulang stent dan trombosis stent. Tujuan penelitian ini mencari pengaruh faktor desain geometri stent pembentuk luas sel *strut* terhadap TGD optimal dan menyusun desain geometri stent baru untuk menghasilkan TGD optimal, serta mencari hubungan antara rasio (luas permukaan *strut*: luas seluruh permukaan sel) dengan persentase luas dinding pembuluh darah yang memiliki TGD optimal.

Metode dan Cara Penelitian. Penelitian dilakukan secara *in-silico*. Faktor desain geometri stent diukur dari stent komersial sebagai sample penelitian. Metode Taguchi dengan matriks faktor dan level dari desain geometri stent digunakan untuk menentukan jumlah rekayasa desain stent. Setiap rekayasa desain stent diimplantasikan di pembuluh darah percabangan menggunakan 2 stent. Analisis dinamika fluida (ADF) dilakukan secara komputasi dan respon diharapkan adalah persentase luas dinding dengan TGD 1-7 Pa di dinding pembuluh utama, dinding sisi luar cabang, dan dinding sisi dalam cabang.

Hasil Penelitian. Perhitungan *Process Capability Ratio Technique for Order Preference by Similarity to Ideal Solution* (PCR-TOPSIS) dilakukan analisis varian menunjukkan jumlah simpul-konektor, panjang cincin, jarak spasi cincin dan tipe hubungan konektor sebagai pembentuk luas sel *strut* berpengaruh terhadap TGD optimal di percabangan. Masing-masing memberikan kontribusi 32,26% dari jarak spasi cincin; 24,58% dari panjang cincin; 20,30% dari jumlah simpul-konektor; 9,52% dari tipe hubungan konektor.

Desain geometri stent baru adalah jumlah simpul-konektor 8-2, panjang cincin 1440 µm, jarak spasi cincin 150 µm dan jenis hubungan konektor adalah tipe tengah-tengah. Terdapat hubungan antara rasio (luas permukaan *strut*: luas seluruh permukaan sel) dengan persentase luas dinding pembuluh darah yang memiliki TGD optimal, dengan p=0,016 dan nilai koefisiensi 0,944.

Kesimpulan. Faktor desain geometri stent pembentuk luas sel *strut*, yaitu jumlah simpul-konektor, panjang cincin, jarak spasi antar cincin dan hubungan konektor tengah-tengah berperan dalam menghasilkan TGD optimal. Tersusun desain stent baru yaitu jumlah simpul-konektor 8-2, panjang cincin 1440µ, jarak spasi cincin 150µ serta tipe hubungan konektor tengah-tengah. Terdapat hubungan antara rasio (luas permukaan *strut*: luas seluruh permukaan sel) dengan luas dinding pembuluh darah yang memiliki TGD optimal, p=0,016 dan nilai koefisiensi 0,944.

Kata kunci: sel *strut*, desain geometri stent, tegangan geser dinding, percabangan pembuluh darah.

ABSTRACT

Background. The Percutaneous Coronary Intervention (PCI) procedure in the coronary bifurcation lesions leaves 30% problem due to in stent restenosis and in stent thrombosis. The area of struts stent cells play a role in maintaining a balance between opening of the branch orifice and preventing plaque prolapse. The geometry stent design was forming the area of strut cells has an effect on hemodynamics flow. Wall Shear Stress (WSS) reflects hemodynamic flow in stent restenosis and in stent thrombosis. The aim of this study was to find out the influence of stent geometry design factors forming the struts cell area on the optimal WSS and to design a new stent geometry to produce an optimal WSS, and to find out the relationship between the Ratio (strut surface area: total cell surface area) with the Percentage of blood vessel wall that has optimal WSS.

Research Methods. The study was conducted in-silico. Geometry stent design factor was measured from commercial stent as the research sample. Taguchi method with a factor matrix and the level of geometry design is used to determine the number of engineering stent design. Each engineering stent design was implemented in blood vessel bifurcation using 2 stent. The fluid dynamics analysis (ADF) was carried out computationally and the expected response was the percentage of the wall area with TGD 1-7 Pa. in the main vessel, in the outside wall of the branch and in the inside wall of the branch.

Research results. The calculation of Process Capability Ratio Technique for Order Preference by Similarity to Ideal Solution (PCR-TOPSIS) carried out Analysis of Variants showed the number of crowns-connectors, ring length, ring spacing and connector connection type as cell-area forming influenced the optimal WSS in bifurcation. Each contributes 32.26% of the distance of the ring space; 24.58% of ring length; 20.30% of the number of crowns-connectors; 9.52% of the connector connection type.

The new geometry design was the number of 8-2 crowns-connectors, 1440 μm ring length, 150 μm ring spacing and the connector connection type were Middle to Middle type. There was a relationship between the Ratio (strut surface area: total cell surface area) with the Percentage of blood vessel wall area which has an optimal WSS, with p = 0.016 and coefficient of 0.944.

Conclusion. Stent geometry design factors forming the struts cell area, was the number of crowns-connector, ring length, ring spacing and the middle to middle type connector play a role to release an optimal WSS. The new stent design composed by the number of 8-2 crowns-connectors, 1440μ ring lengths, 150μ ring spacing, and the Middle-Middle type connector connection. There was a relationship between the Ratio (strut surface area: total cell surface area) with blood vessel wall area which has an optimal WSS, p = 0.016 and coefficient of 0.944.

Keywords: struts cell, stent geometry design factor, wall shear stress, blood vessel bifurcation