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http://dx.doi.org/10.5339/qfarc.2016.HBPP3190

On the Way to the Optimal Design of an Aortic Heart Valve -or- Discovering the Obvious?

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The first task of tissue engineer trying to make a scaffold of a heart valve, is to adapt some model of a heart valve to establish target geometries and properties that should be recreated in artificial scaffold. The natural way to do so is to conduct literature research and find the current scientific consensus on the topic. Here the problems start, each researcher seems to have an individual opinion about optimal geometry of valve. What makes situation more complex is that each researcher has carefully chosen arguments to explain why that particular design is better than others. Hence, the consensus is not there yet, we chosen to contribute to this discussion. The analysis of available reports enable to “cook out” 2 distinguishable and to some extent contrary hypothesis.

1st –the optimal architecture of artificial valve is an architecture of native one.

2nd-there is not such a thing as optimal architecture of a heart valve, and never will be

The first option is very tempting due to its simplicity. Of course, in most of human beings the valves work fine for entire life so let’s make the same structure for the sick patient. But which one? – Literally mine or yours? Maybe we should make an average from 1000 or million healthily examples? Hypothetically, if you would need new face, would you like to have the “median” appearance or you rather would go for the most beautiful one? Let’s take it further - what is an optimal design of human face, perhaps one would wish to obtain the most beautiful face possible, while others would opt for younger variant of their old one. When it comes to faces, it is easy to distinguish beautiful from average and ugly. Using our internal standards, we are doing this every day hundreds times. But valves are usually not visible, so do we need to work out the standard of “beauty” for HV. Frequently, clinicians and researchers seem to use the same face-related-internal standards to propose geometries of scaffold. “I like this more than that, because

Cite this article as: Liberski AR, Kot R. (2016). On the Way to the Optimal Design of an Aortic Heart Valve -or- Discovering the Obvious? Qatar Foundation Annual Research Conference Proceedings 2016: HBPP3190 http://dx.doi.org/10.5339/qfarc.2016.HBPP3190.

its follows better my internal visual standards of HV beauty". But this is not the way to go. We need hard core evidence to distinguish structure that is better than the other.

The second option is more radical – each patient needs individually chosen design of the heart valve that will reflect its specific needs and conditions. This is obviously very elegant but horribly expensive solution, since an individualized scaffold not only needs to be designed but also produced only in few copies.

The consensus of both strategies is in our opinion the establishing the most "beautiful HV" but according to objective physical parameters. What additionally supports this logic is that under physiological condition the scaffold will adjust to patient by changing the geometries.

To confirm our observation and conclusion we contacted 30 prominent clinicians (n=11) and tissue engineers (n=19) with question: What is an optimal design of aortic heart valve? In this report we are presenting their responses and comments.