Study on the Mechanical Properties of Large Arteries:
The Tissues of the Vessels and the Transplant

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Introduction

We must consider the transplant of a human organ, this process is obtained by the explant from a body donor followed by the implant in the receiving body of the patient.
The first colloquium between the organ arriving and the body of the patient, in which is included, is a colloquium made by the blood when the arteries have been connected and the pressure wave begins to be transmitted from the body into the new element present in the circulatory system.
The point where the sutured arteries is made is in such a moment the most delicate position, and it is important to proceed to investigate, because the mechanical properties of the arterial wall is the fundamental part of our explanation.

Mechanical properties

The studies on cardiovascular system introduced by Max Anliker and coll. have been very important because have opened a new method to look to determine the mechanical properties of the wall of the large vessels.
Anliker started from living tissues in living bodies, obviously using the comparative medicine, he made these experiment in a group of some wolf dogs, because the cardiovascular system of large arteries is very similar to human system considered the particular scopes request by the researches.
The data have given the constant phase velocities for the pressure, axial and torsion waves, also the laws of attenuation of these waves were equal with exponential law with a negative constant multiplied by proportion of distance and wavelength.
The law of attenuation has open a great problem of discussion, because the biological tissues have viscous-elastic properties but not linear as everybody who knows such materials knows.
If the problem apparently could be very simply in it origin the necessity to define the characteristics with a mathematical law was not quite easy to define.
Now if a biological soft tissue has a deformation to return to the original condition is not given by a curve of presenting an equal shape but the presence of Coulomb resistance to deformation gives the particular low damping of the return to original dimension.
The Knopoff theory has been used to arrive to a solution and explication of the experimental results by Anliker. We do not discuss now the mathematical problems and the equations connected to this theoretical biomechanical analysis, but if somebody is interested to discuss we have no problems of it, because we must see the interest of this medical people present now.

Vessels and transplantation

The previous discussion gives us the opportunity to arrive to the very important matter in medical applications and it effects.
In fact when a transplant of organ is made we have the arteries of two different persons are connected and we are in presence of two similar but not equal wall are

sutured, the Young's modulus of elasticity will never been equal one to the other, this point is sometime the origin of a mechanical reject owing to the different diameters of the two parts of the vessels connected and in particular if the second is more soft then the previous part, will generate to a short period of time a stenosis due to a turbulent movement of the blood in the initial part of the new artery, with the process of sedimentation of the blood cells and obviously the sutured part is closed, the blood has at first difficulty to enter in the donor organs and day by day the blood stops and the donor organ is out owing to a necrosis.

If you thought a patient who waited for the implant of the organ as the solution for his life, then after a short period you have to inform him the organ is to eliminate and after to begin again to do other medical care to go on again the implant, you can immediately understand the importance of such a problem we are discussing.

We have seen how this process can arrive to interest till 10% of patient, when the different age between patient and donor is of 15 years and the donor is younger in kidney transplantation.

The definition of this effect was called Bononiensis Control Parameter (BCP).

This process has been then consider in the vascular surgery, when a prosthesis must be applied to correct problems of a part of a vessel. The same effect has been found and the necessity to control the elasticity of the prosthesis when put is now made.

Conclusions

The importance of the determination of the viscous-elastic properties of the great vessels of cardiovascular system of a patient is very important to define and know when a transplant is necessary, looking for and selecting the more similar condition of the donor vessels or prosthesis.