"Achieving Optimum Scientific Standards for Producing Fabrics Suitable for Heart Prosthesis "

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Science & Arts 2004

Abstract

The cardiac valve prostheses

The first clinical use of a cardiac - valve prostheses took place in 1952 , when Brcharles Hufngel implanted the first artificial caged ball valve for aortic insufficiency .The first implant of a replacement valve in the anatomic position took place in 1960, since then many different types of heart valve prostheses have been developed and used in general during the past 10 years . The surgical implantation of prosthetic heart valves has become successful. Today there are many different ways of making prosthetic valves, because of the various complications , which occur with different valves .

The ideal heart prostheses should
1-Be fully sterile at the time of implantation and be non toxic.
2-Be surgically convenient to insert near the normal location of the heart.
3-Conform to the heart structure (the size and shape of prosthesis should not interfere with cardiac function
4-Show a minimum resistance to flow to prevent a significant pressure drop across the valve.
5-Have a minimal reverse flow which is necessary for valve closure, to keep the incompetence of the valve allow level
.6-Show long resistance to mechanical and structural wear– lasting for 25 years and maintain its normal functional performance (most not deteriorate over time)
7-Cause minimal trauma to blood elements and the endothelial tissue of the cardiac vascular structure surrounding. The valve should also allow probability for thromboembolic complications without the use of anticoagulants .
8-Be sufficiently quiet so do not disturb the patient
9-Minimize production of turbulence
10-Not induce regions of high shear stress
11-Contain no stagnation or separation regions in its flow field, especially adjacent to the valve super structure .

The fabric used in heart prostheses are formed by woven, knitted Gore- Tex, complex weave and nonwoven – knit. Procedures are designed to provide an open lattice structures through which fibrous connective tissues can grow

Nonwoven fabric used in heart prostheses are less porous than knitted fabrics, moreover nonwoven grafts are softer handle and durability . Knitted prostheses are usually

made of single jersey structure on weft knitting whereas Rachel structure is used in warp knitting .Velour structure has a rougher inner surface to encourage better adhesion of the thrombus layer. The roughened surface may be obtained by raising a nap, by knitting a looped pile or by using textured filament yarns . Knitted structures are too porous to be used in the machine state so they get compacted by chemical swelling agents or thermal processing. (2) Typical water permeability of knitted grafts is 1.000-2.000 cc/cm/min in order to prevent leakage, knitted grafts with internal and external velour surface have been developed, Warp knit grafts dilated less than the weft knit grafts

Most knitted and woven grafts are preclotted prior to transplantation . blood is intentionally soaked into the textile wall allowing clot formation to occur .The implantable material must meet mechanical requirements for the particular application biocompatibility ,for examples the biotextiles must interact, with the host in a controlled and predictable way. In addition to these, blood cells cause formation of destructive blood cloth. Application of textiles as implant include abdominal wall, artery, biohybrid organs, bone, heart valve and wall, vein, hip, joint, ligament, tendon, trachea …etc

The experimental Work

This study aimed to produce fabrics used in heart prostheses (patches and valves frames). One textile material employed in this research, polyester, and two kinds of construction techniques were used in producing all samples, nonwoven and knitted

Finishing treatment

The produced fabrics were undergoing special treatments before being used. These treatments include coating with Chitosan, and sterilization as following

Coating

The fabric samples were padded in an aqueous solution containing 12% Chitosan, solution then squeezed to a wet pick up 100 %.The fabric samples were dried at 85 0C for 5 min ,then thermofixed at 140 0C 90 sec .

Sterilization

The fabric samples were sterilized by ethylene oxide gas, where ethylene oxide gas is a colorless gas. It applied in special autoclaves under carefully controlled condition of temperature and humidity .The gas alters proteins, killing bacteria, fungi spores and viruses. A through cleaning cycle is required before sterilization and a gas removal cycle is needed before use.

Results &discussion

Through previous tables and figures, it was reached to the following results

1-It seen from the tables that the more weight the fabric gets, the lower air and water permeability the samples become. Because low weights means decreasing in fibers amounts per unit area which permit the air and water passage.

2-it seen from the table that the more weight the fabric gets, the higher thickness and bursting resistance the samples become. Because low weights means decreasing in fibers amounts per unit area, which increase of bursting resistance and thickness.

3-It seen from the figures that the random web has recorded the lowest rates of air and water permeability compared with cross-laid samples. I can state that the first process depends on distributing the fibers in the web evenly causing the fabric to be more compacted than the other process.

4-It seen from the diagrams that the random web has recorded the highest rates of thickness compared with cross-laid samples. This is for sake of the random of fibers in the web, which cause the web to be thicker.

5-All nonwoven samples produced with random and cross-laid web have achieved the excepted results for end uses and the samples produced with 400 g/m2 and random web has achieved the best results.

Through previous tables and figures, it was reached to the following results
1-It seen from the tables that the more denier the yarns get , the lower air and water permeability the samples become. I can state that yarns of more denier have thicker diameter than low denier, which have fabric more compacted ,so the spaces in the fabric will be decreased and so a little air and water will be passed.
thickness, and this is for sake of that 100 denier yarns are thicker than 50 and 70 denier .
2- it seen from the figures that samples produced of 100 denier have recorded the highest thickness, whereas samples produced of 50 denier have recorded the lowest 3-It seen from the diagrams that the more wales the samples get , the higher bursting resistance the samples become . I can state that the more courses and wales the more compacted, which cause increasing the bursting resistance

4-I can be also noticed from the diagrams that inverse relationship between thickness, weight and water permeability. I can state that increasing in thickness and weight means increasing in yarn diameter, number of wales per unit area, which cause an obstruction in water passage , causing decreasing in water permeability .

5-All warp knitted samples have achieved the excepted results for end uses, and the sample produced with polyester denier 100, 48 wales/inch and 36 courses/inch has achieved the best results. And also all weft knitted samples produced have achieved the excepted results for end uses, and the sample produced with polyester denier 100, 66 wales/inch and 32 courses/inch has achieved the best results

After treatment

It obvious from the results that all treated samples have prevented blood from passing through them,. And insignificant changes have occurred to the samples after being coated. Where the coating fill the spaces in fabrics. Also the bursting resistance of all samples increased about 2% where material of coating are used to aid the body to accept the foreign origin