Biomaterials: study of their biocompatibility

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1. INTRODUCTION

These biomaterials are used many years ago on medical devices that at one time come into contact with organism.
They have to be tested to know and to prevent all the immune responses that they can produce.

3. BIOCOMPATIBILITY

A biocompatible material acts with the interfaces of the biologics systems without generating a serious immunologic response.
It doesn't cause adverse reactions and it's accepted for the adjacent tissues.
Every biomaterial has a level of biological compatibility, when the lower immune response is more biocompatible the material is.

2. BIOMATERIALS USED IN IMPLANTS

Aesthetic field

Silicones: ideal immunogene that their surface texture is so important to reject or not the material.

Sometimes a *capsular contracture* is observed.

Hydrogels: Permeable membrane where there is incorporated a saturated salt solution by osmotic forces.

If this liquid escape can cause necrosis.

Orthopedics materials

BMG: Alloy of $Ti_{40}Cu_{38}Zr_{10}Pd_{12}$ that allows cell adhesion and differentiation with good corrosive and mechanic properties.

Dental implants: These materials have to be permeable to some substances but, in normal conditions, do not absorb the materials compounds or microorganisms.

Synthetic polymers

These polymers try to mimetize the natural compounds of the body.

4. POSSIBLE SOLUTIONS TO IMPROVE THE RESPONSE TO FOREIGN MATERIALS

The coatings produce a hydrophilic phase reducing the body reactions:

- **ADVANTAGE** → The materials are recognize by the biological environment.

- **DISADVANTAGE** → Generally, these natural polymers have decomposition or modifications.

The most used coatings

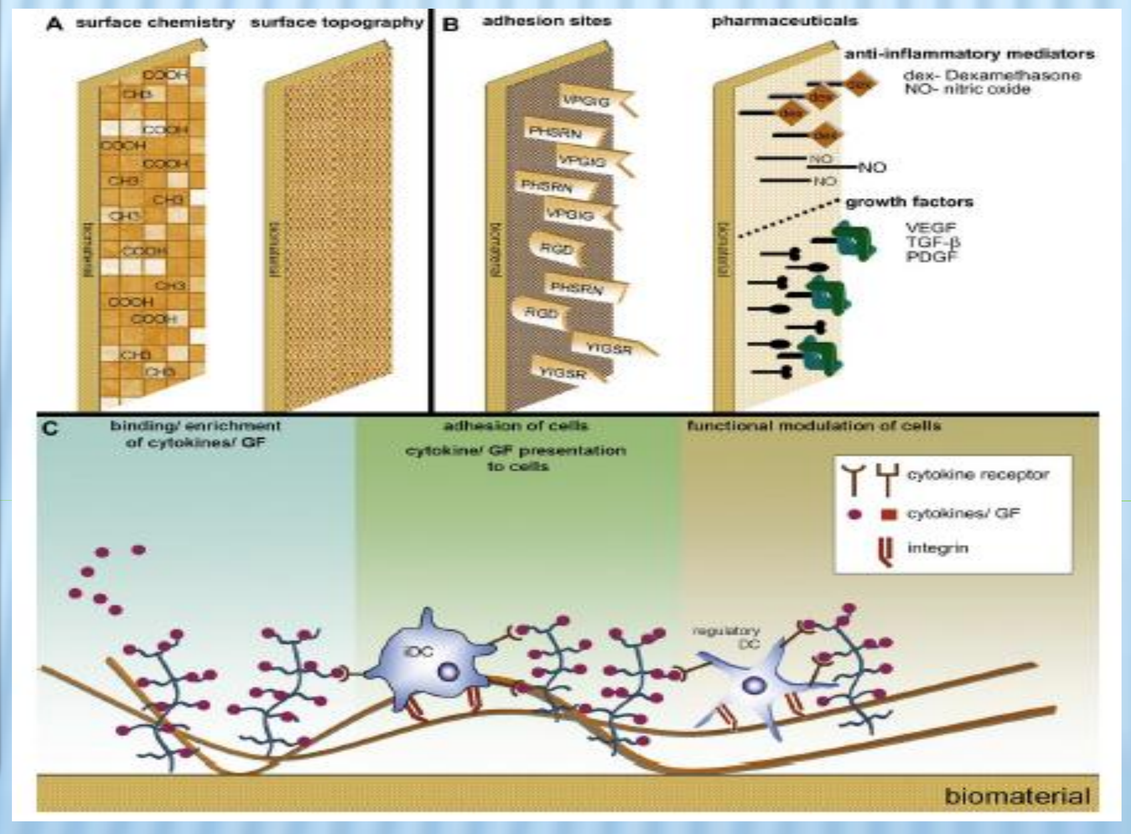

Fig.2A: Altering the roughness and topography.
Fig.2B: Using antiinflamatories and angiogenic drugs.
Fig.2C: Generating an artificial ECM

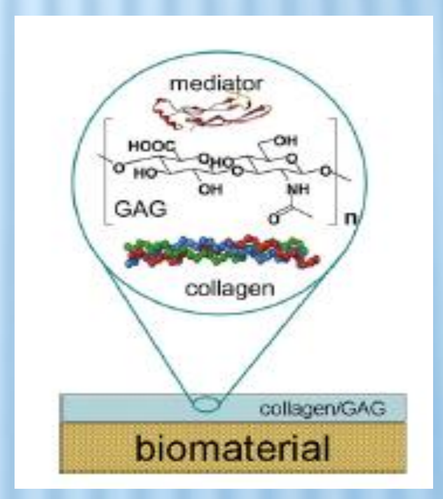

Fig.3: biomaterial covered with collagen using GAG to promote cell adhesion and proliferation.

Immune response

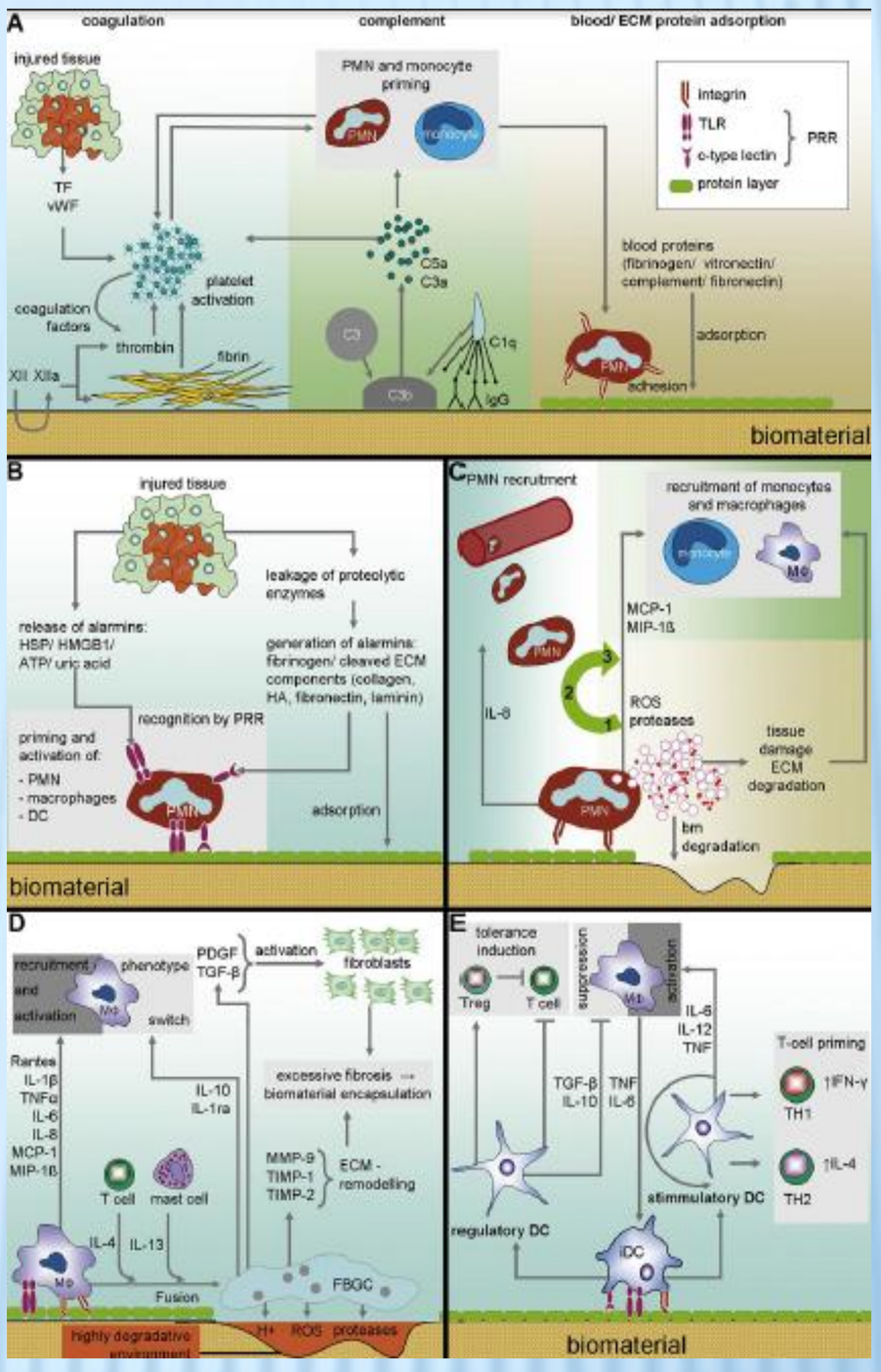

Fig.1: Immune response toward biomaterials

Biocompatibility assays

❖ Cell cultures allow the study of cell behavior before the contact between tissue and biomaterial.

❖**Biomaterials must allow**:
-Cell adhesion
-Cell proliferation
-Cell differentiation
-Formation of extracellular matrix.

Otherwise, there is cell death induced by the anchorage cell lose.

Cell viability	- MTT -Trypan Blue -Sulforhodamina B
Cell morphology	-Light microscopy -SEM + Energy dispersive X-ray spectroscopy analyses
Cell adhesion	- *Phalloidin* → actin filaments -*Ab agains vinculin* → focal contacts
Differentiation tests	- *MLR* → to measure the cell proliferation by 3H-Timidine in a co-culture with lymphocytes.
Mutagenic and/or carcinogenic tests	- Ag8 incubation with HAT medium to induce cell death.

5. CONCLUSION

The importance in **the biocompatibility study** of any material that comes into contact with tissue **is essential**, because it usually generates immune responses that can lead to implant rejection.

❖ **STEPS** to determine the biocompatibility of one material:
1. In vitro studies using cell cultures.
2. In vivo studies using animal models.
3. Introduce the device in the body.

❖ **SOLUTIONS** → Biotechnology is starting to develop materials able to avoid immune responses, by physicochemical changes in the surfaces to change target cell behavior.