Heparan Sulfate

THE FERRIER RESEARCH INSTITUTE AT VICTORIA UNIVERSITY

WHAT'S THE PROBLEM?

Bone fractures that heal slowly (or don't heal at all) are a major healthcare problem. Especially as we live more active-lives and live longer so sports and age related bone issues are on the rise. The usual treatment for these kinds of injuries is either to take bone from another part of the patients body (autograft) or bone from a cadaver (allograft) and place it at the site to provide a scaffold for new bone to grow.

Neither of these options are very efficient, and in the case of autograft treatment, can actually lead to worse complications.

WHAT'S A POSSIBLE SOLUTION?

Damaged bone produces bone morphogenetic proteins (BMP), which promote bone formation. However, they aren't always produced in high enough concentrations and degrade very quickly.

It is possible to add extra BMP to the site but they are very expensive to make, don't last long and it is quite possible to overdose the area, which leads to further problems. The ideal solution is to keep the naturally produced BMP around for longer while also giving it a scaffold on which to build.

FINDING THE RIGHT COMPOUND

Previous research has shown that a compound called 'heparin', is particularly good at promoting bone growth by binding to BMP and keeping it around for longer. Unfortunately it also acts as an osteoporotic (weakening bones) and as an anti-coagulant (increasing bleeding time).

HEPARAN SULFATE

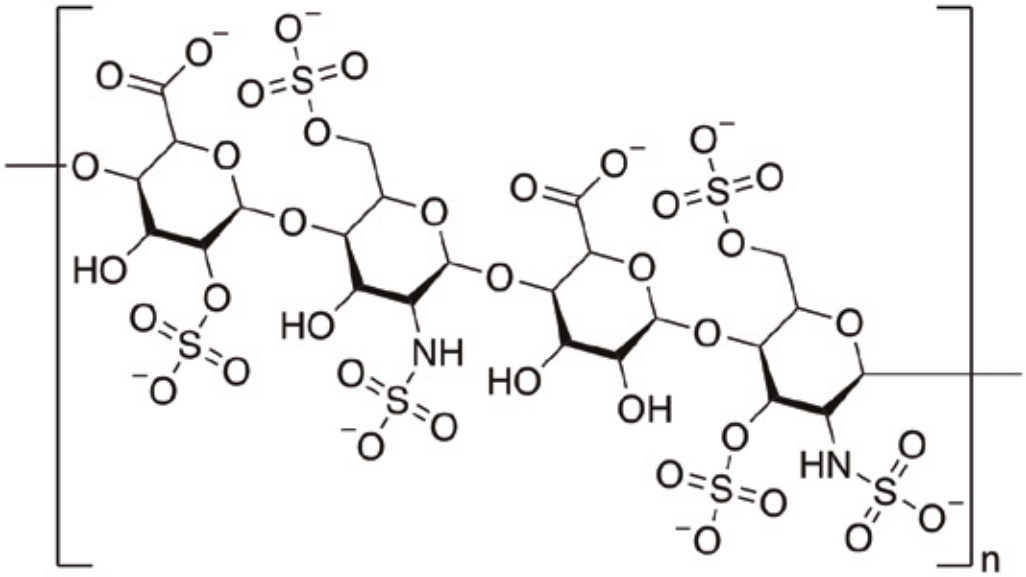
While the ability of heparin to promote bone growth is exciting, the side effects make it unusable. Researchers at the Ferrier Research Institute have been looking at the properties of heparin that make it bind to BMP, and looking for other types of compounds that can do the same thing. They didn't have to look far.

Heparin belongs to a group of glycosaminoglycans (GAGs), which are long unbranching polysaccharides – chains of sugar molecules. In the same group of GAGs is a molecule called heparan sulfate. After tweaking its chemical composition slightly to bind better with BMP, they were able to combine the heparan sulfate with a collagen implant and test it on damaged bone.

DID IT WORK?

Yes! In trials the heparan sulfate combined with the collagen was as effective at healing bone as injecting pure BMP, but without the side effects.

Examining Heparan Sulfate



1. FIND THE FOLLOWING FUNCTIONAL GROUPS IN THE ABOVE HEPARAN SULFATE COMPOUND:

- Alcohol
- Carboxylate salt
- Sulfate
- Ether
- Challenge: Sulfoamino group

2. THE HEPARAN SULFATE USED IN THIS RESEARCH CAME FROM PORCINE MUCUS (PIG SNOT). BECAUSE THERE ARE SO MANY VARIANTS OF HEPARAN SULFATE, THE RESEARCHERS NEEDED TO SEPARATE OUT THE MOLECULES THAT WOULD BIND BEST TO BMP.

- How do you think researchers separate out specific molecules?
- Why do you think the researchers get their heparan sulfate from pig snot rather than synthesising it themselves?

WANT TO KNOW MORE ?

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