Blood coagulation aggravates joint damage after an experimental hemorrhage in a canine knee

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Introduction

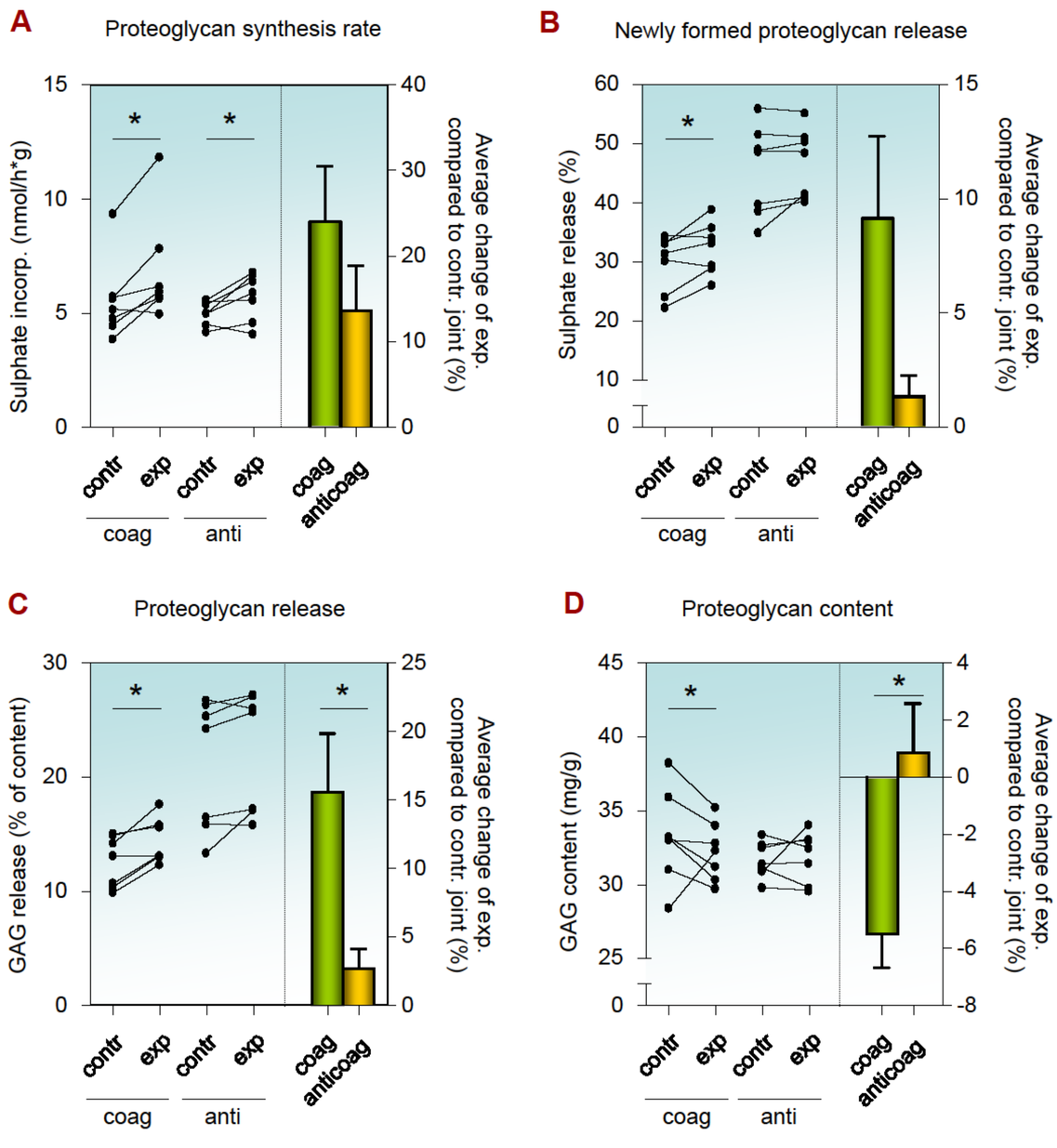
Joint bleeding due to trauma, major joint surgery, or hemophilia leads to joint damage. It is unclear if there are differences between coagulating blood and anticoagulated blood with respect to joint degeneration, especially in vivo. Therefore, we evaluated in a canine in vivo model whether intra-articular blood exposure is more destructive in case of coagulating blood compared to anticoagulated blood, and whether inflammation plays a role in the cartilage damaging process.

Methods

In 7 dogs left knees were injected with coagulating blood 4 times a week in week 1 and 4; right knees with saline. In 7 other dogs anticoagulated, heparinized blood was injected with heparinized saline as control. Ten weeks after the last injection, cartilage matrix turnover and synovial inflammation were analyzed. To study inflammation-independent cartilage damage, human cartilage explants were exposed in vitro to coagulating and anticoagulated blood, plasma, and serum for 4 days (n=6). Cartilage matrix turnover was determined at day 16.

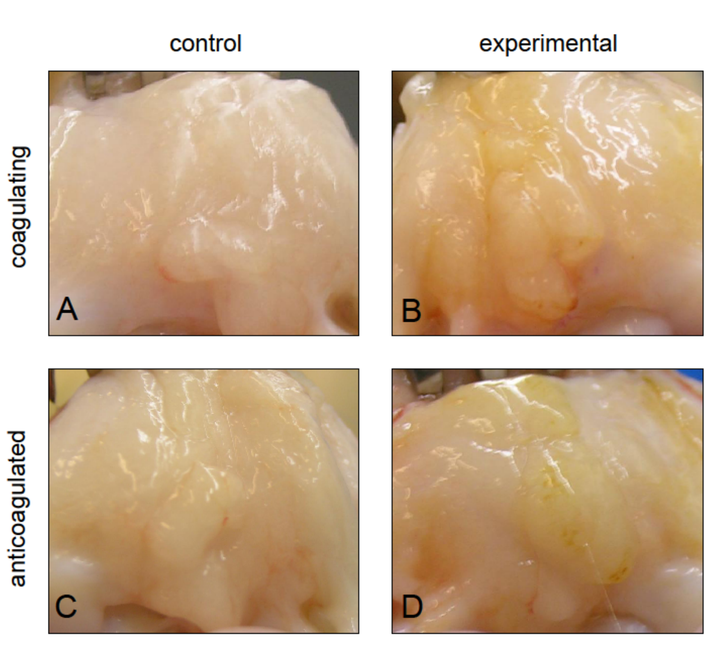
Results

Figure 1 Proteoglycan turnover of cartilage after exposure to blood



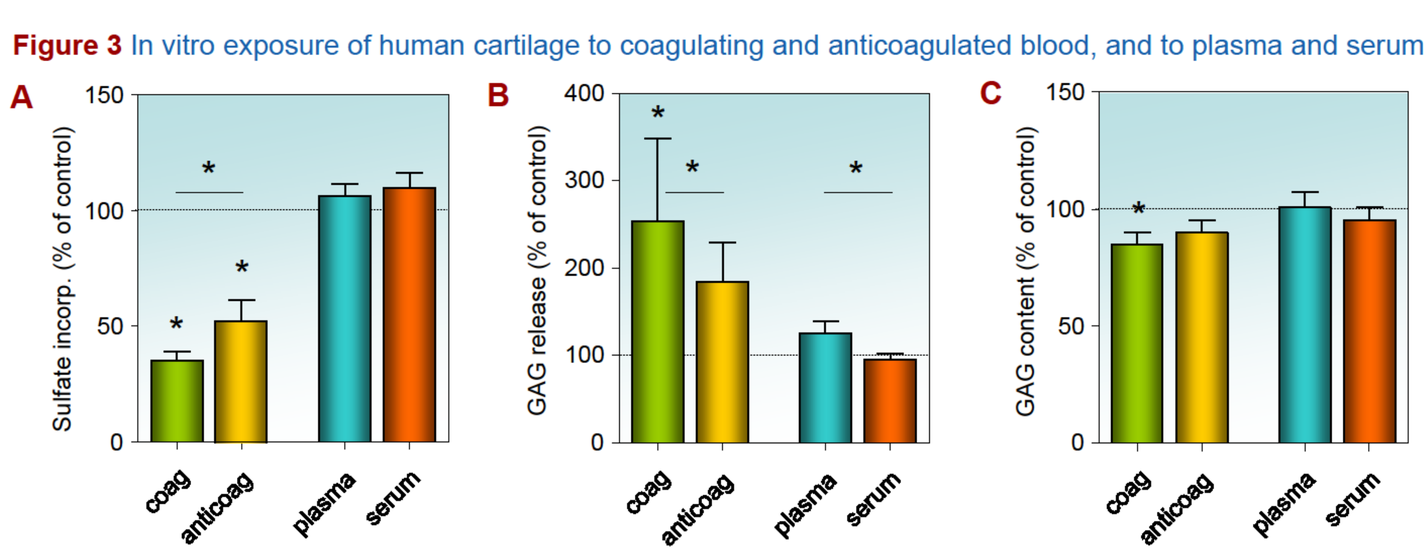
- Canine knees injected with coagulating blood showed a more disturbed proteoglycan turnover than knees injected with anticoagulated blood. Proteoglycan synthesis rate was increased in the experimental joints of both groups (24% in coagulating blood group; p=0.01 vs. 14% in anticoagulated blood group; p=0.04) as a characteristic of (ineffective) cartilage repair activity (fig. 1A). The newly formed proteoglycan release increased with 9% only after intra-articular injections with coagulating blood (p=0.04; fig. 1B), while total proteoglycan release was increased with 16% after exposure to coagulating blood (p=0.01; fig. 1C). Proteoglycan content was decreased only after injections with coagulating blood (6%; p=0.01; fig. 1D). The change between experimental and control joints was different for both groups (p=0.01; right panel of fig. 1D).

Figure 2 Macroscopic changes as a result of blood injections in the knee joint



- Macroscopically the synovial tissues showed no sign of inflammation due to the repeated injections with saline (fig. 2A) or heparinized saline (fig. 2C). Mean values are depicted in fig. 2E. Mild synovial inflammation was observed by injection of anticoagulated (fig. 2B) as well as coagulating blood (fig. 2D), but only statistically significant upon injections with coagulating blood (p<0.0001 compared to control leg).

Figure 3 In vitro exposure of human cartilage to coagulating and anticoagulated blood, and to plasma and serum



- Coagulation of blood in vitro resulted in more inhibition of proteoglycan synthesis rate (fig. 3A), a higher release of proteoglycans (fig. 3B), leading to a decreased total proteoglycan content (fig. 3C). Exposure to plasma and serum did not alter proteoglycan turnover of cartilage explants.

Conclusion

This study shows that coagulating blood causes more long-lasting in vivo joint damage than anticoagulated blood. Since coagulating and anticoagulated blood are both harmful to the joint, the best way to prevent damage would be aspiration of blood.

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