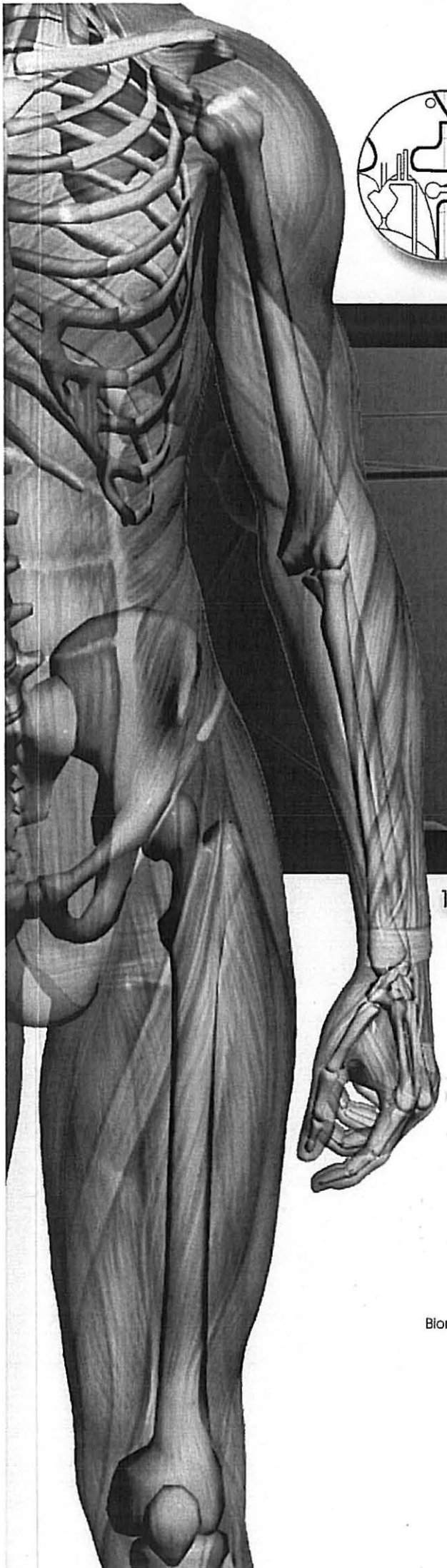

Congress Programme

6th World Congress of Biomechanics

In conjunction with

14th International Conference on Biomedical Engineering (ICBME)

&

5th Asian Pacific Conference on Biomechanics (APBiomech)

1 - 6 August 2010
Singapore Suntec Convention Centre

Jointly Organised by

BES SINGAPORE
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Flow of physiological fluids in microchannels: the sedimentation effect

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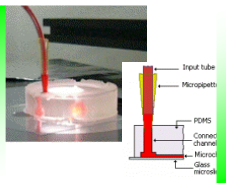
Introduction

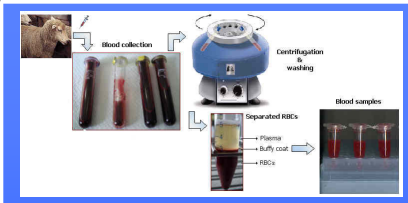
Currently, **biomedical microdevices** are becoming one of the most promising tools for the diagnostic and treatment of several diseases, such as diabetes, malaria and cancer. Hence, it is increasingly important to investigate the rheological behaviour of physiological fluids in microchannels in order to make use on the physics of microfluidics to either develop new lab-on-chip devices and to optimize the design of existent biomicrofluidics chips.



The **main objective** of this study is to **investigate the flow behaviour of two different physiological fluids frequently used in biomedical microdevices**. The working fluids used in this study were physiological saline (PS) and dextran 40 (Dx40) containing about 6% of sheep red blood cells (RBCs), respectively. By using a syringe pump and a camera it was possible to measure qualitatively the flow behaviour within a horizontal capillary.

Materials and methods

Blood samples preparation



The blood was collected from a healthy sheep, where heparin was added to prevent coagulation. The RBCs were separated and washed by centrifugation.

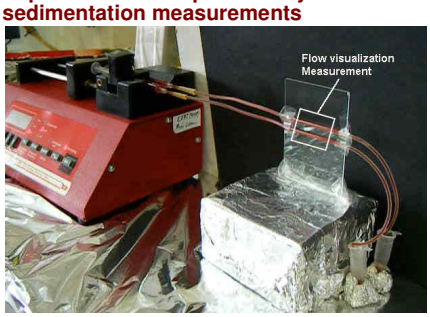
The washed RBCs where diluted with PS to make up the required RBCs concentration by volume.

The hematocrit (Hct) was about 6% (6Hct).

All blood samples were stored hermetical at 4ºC until the experiment was performed at room temperature (18 to 20ºC).

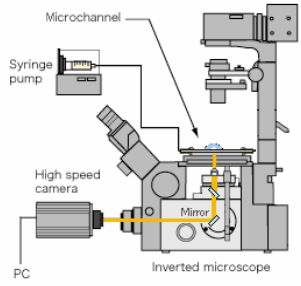
Experimental set-up

Experimental set-up for the dynamic sedimentation measurements



In this method the capillaries were placed horizontally on a slide glass and by using a syringe pump a pressure-driven flow was kept constant at 50 µl/min which corresponds to a Reynolds ~0.9(PS) ~0.3(Dx40).

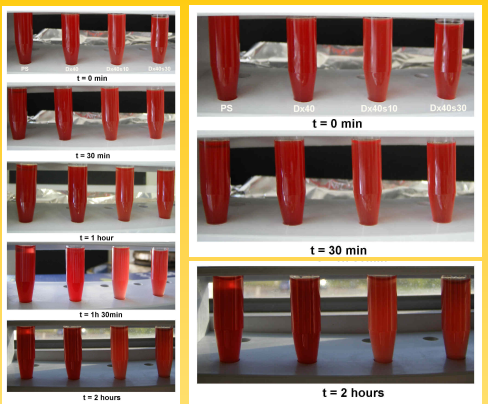
Experimental set-up for blood flow visualization in glass microchannels



Visualization of in vitro blood flow in glass microchannels by means of a high-speed video microscopy system.

Results and discussion

Static sedimentation measurements

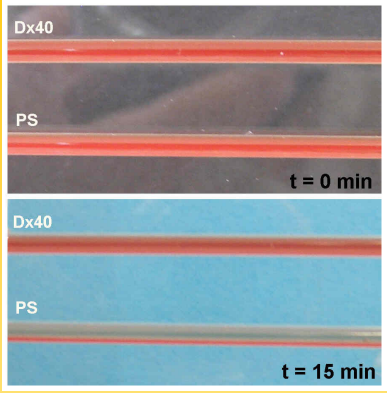


Four tubes containing PS with 10% of Dextran 40 (Dx40s10) and PS with 30% of Dextran 40 (Dx40s30) were used.

For a period of 30 minutes the RBC tend to settle down in the fluid with PS and the sedimentation tends to increase with the time. For a period of 1 hour and 30 minutes the interface between the high concentration of cells and the cell-free fluid is clear.

For a period superior to 1 hour little sedimentation was observed in the sample Dx40s10. For the case of Dx40 and Dx40s30 we did not observe any significant RBC sedimentation.

Dynamic sedimentation measurements

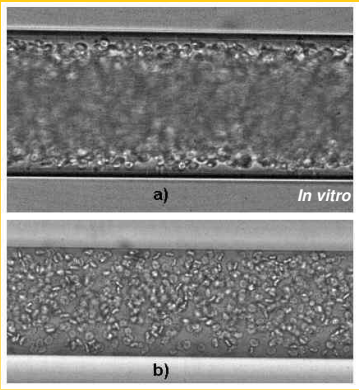


Flow rates for both physiological saline (PS) and dextran 40 (Dx40),containing about 6% of sheep RBCs, was 10µl/min.

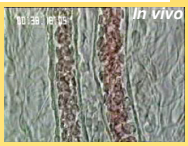
Flow qualitative visualizations measurements in glass capillaries with diameters ≈ 1.2 mm, for 15 minutes.

For a period of 15 minutes the RBCs tend to settle down in the fluid with PS whereas using Dx40 no RBC sedimentation was observed.

Flow visualization in glass microchannels



For the case of Dx40 there is formation of cell-free layer adjacent to the walls of microchannels. However, in the fluid with PS RBCs do not exhibit tendency to migrate into the microtube axis.



In vivo visualization shows a clear tendency for the formation of a plasma layer in microvessels. Hence, the present results indicate that *in vitro* blood containing Dx40 has a flow behaviour closer to the one observed in vivo microvessels.

Conclusion and future work

- Preliminary results indicate that *in vitro* blood containing Dx40 has a flow behaviour closer to the one observed *in vivo* microvesseles. The *in vitro* blood containing PS did not show a clear formation of cell-free layer which might be due to the fast sedimentation of the RBCs.
- In the near future we plan to vary the flow rate and diameter to study the influence of these effects on the RBC sedimentation.