Relationship between the structure and the velocity profile in the accompanying vein of the limb

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Abstract: *Deep vein thrombosis is known well as economy class syndrome. Deep vein thrombosis is produced in the accompanying vein of the limb,. There have been many studies about this disease. The chemical and mechanical research has shown the clear results. Especially, the result of the chemical aspect has shown the result, which would become an important role to reveal the mechanism of the thrombosis production. The flow velocity is still recognized as the important factor, but there is not a result connecting directly to the practical treatment. In this study, we considered the specific characteristics of the vein in the lower limb and examined the effect on the blood flow.*

I. Introduction

Deep vein thrombosis is known as economy class syndrome. “Deep vein” indicates an accompanying vein. Especially, in this disease, the vein means one in the lower limb. The cause of this disease has been thought as the increase of the blood viscosity and the decrease of the blood flow velocity [1]. The flow profile in the vein was estimated by the experiment and the computation [2]-[3]. These studies focused on the calf pump function and examined the efficiency., because the function could influence the flow in the accompanying vein well. In these studies, the effect of the valve was ignored. The compression from the outside of the limb did not have a good result [4]. On the other hand, Faghri et al [5] showed the efficiency of the calf pump by the muscle stimulation. But they used not only the muscle stimulation, but also the compression by the stocking.

In some studies, the velocity decrease in the neighborhood of the valve could be a factor to lead the thrombosis. But there are so many valves in the vein of the lower limb. If this opinion is correct, people have a lot of thrombosis in the lower limb.

In the chemical mechanism in the thrombosis production, the flow velocity is recognized as the important factor. The studies about the blood flow in the vein have been worked in for many years. Each study has a clear result but this result did not connect to the practical treatment. That may be because there were enough data about the blood flow in the vein. In addition, veins have the various types. Its structure is varied [6]. The attention for these characteristics seems not enough in these studies.

Veins are classified into accompanying veins and cutaneous veins. The name of the accompanying vein came from accompanying the artery. “cutaneous” means skin, and the cutaneous vein is in the near the skin. Cutaneous veins have more smooth muscle than the

accompanying veins. The reason has been thought that the cutaneous vein has to keep its shape on its own. On the other hand, the accompanying vein is supported by the surroundings. This is the reason that the calf pump has been thought to have an effect on the velocity in the accompanying vein. The power of the calf pump would dependent on the muscle quantity. Many studies have shown that the powerful calf pump could prevent the thrombosis Moreover only the vein in the upper and lower limb has the valve. Other veins have no valve. The lower limb has much more valves than the upper limb. The number of the valves in the accompanying vein is larger than the cutaneous vein. The interval in the accompanying vein is shorter than that in the cunateous vein.
In this study, we measured the velocity in the vein of the lower limb, investigated the effect of the calf pump and the flow difference of the vein type.

II. Experiment

In all the experiments, we used 1.5 T EXCELART MR SYSTEM (TOSHIBA Corporation, JAPAN). To measure the flow velocity in the vein, 2D TOF TR=30, TE=9) was used and all the images were around the knee. In this image, the intensity shows the relative velocity to the maximum one in all the image sequence. Hence, the image could show the tendency of the velocity/

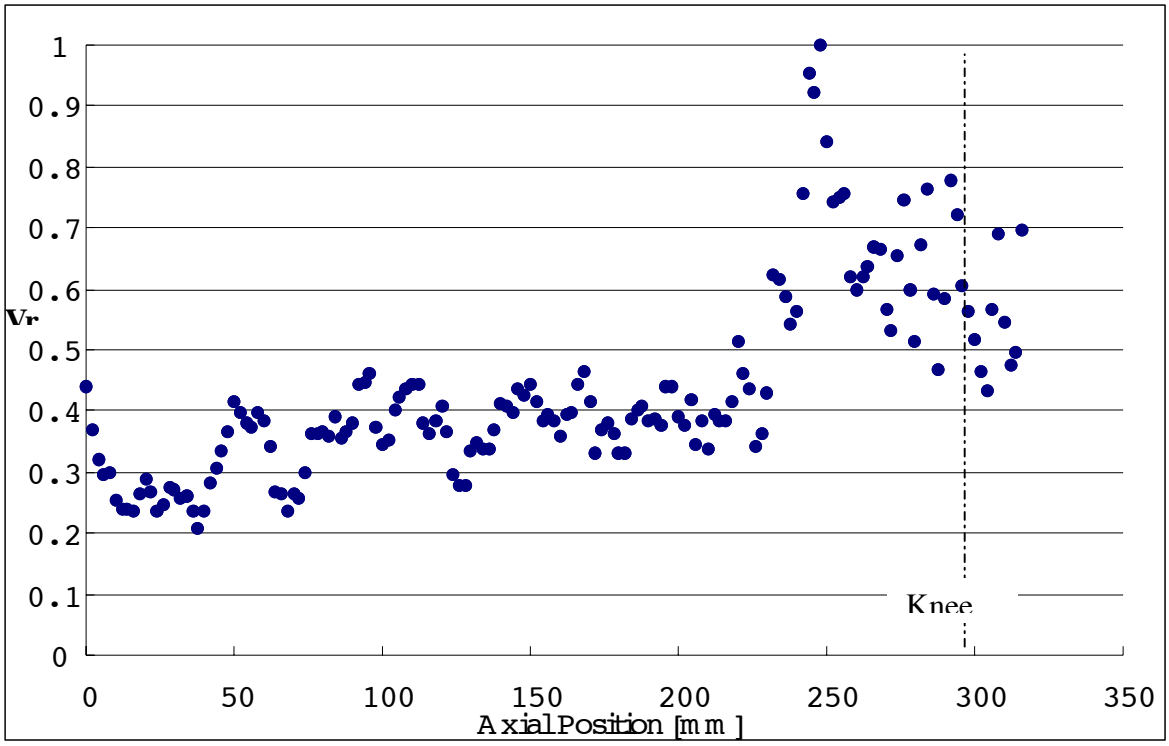
The TOF images of five volunteer were used for measure the velocity.. One of them had 1- hour walk. Before and after the walk, we took the image by the same way. The volunteer is called sample A.

III. Result and Discussion

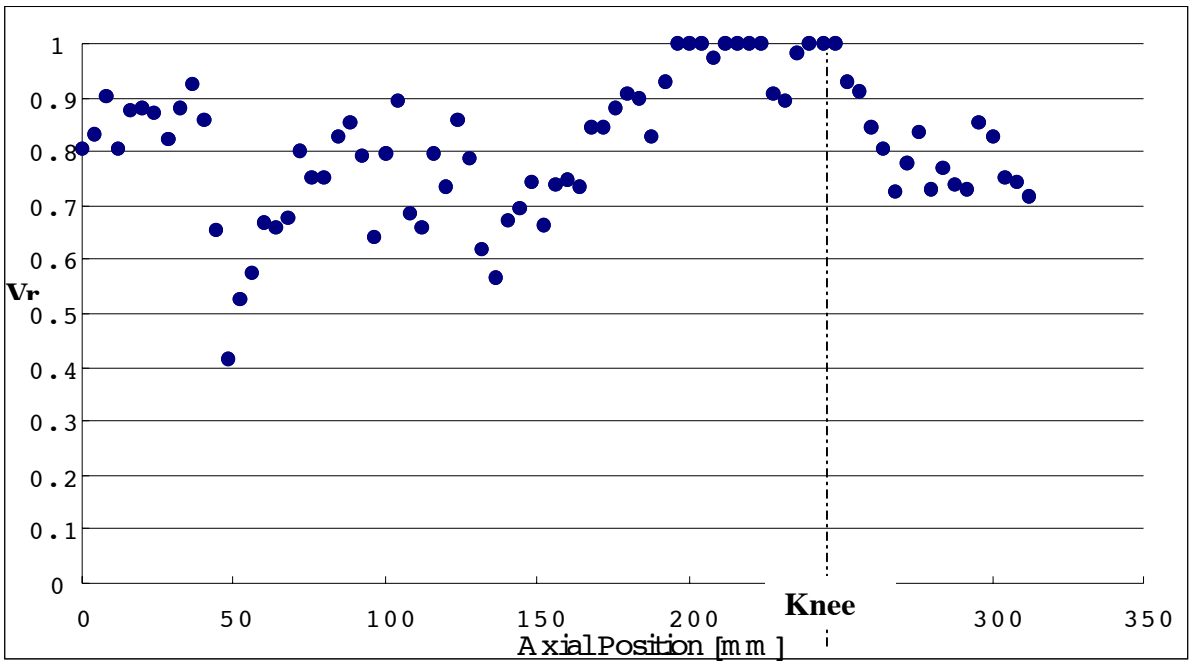
Except sample A, the maximum velocity was found in the accompanying vein of the knee. The cause of the difference may be that sample A was photographed just after the time of rising. From the result, the situation seemed that sample A did not achieve the degree of the activity in day- time. After the waling, sample A had the maximum value in the knee. About sample A, the average and the standard deviation is shown in Table 1.This result showed that the exercise could increase the velocity and put the same degree. And the maximum velocity in the calf near the ankle appeared in the cunateous vein. We will examined the point, in which the point of the maximum velocity moves from the cuntaneous vein to the accompanying vein.

Table 1 Effect of the exercise

	Average	SD
Before the walking	**0.456**	**0.154**
After the walking	**0.81**	**0.125**



(a) Before the walking



(b) After the walking

Fig. 1 Relationship between the axial position and the relative velocity. Vr, relative velocity to the maximum velocity. The axial direction is from foot to head.

Reference

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