**Title:** Proximal lower limb deep venous blood flow in cancer patients & volunteers without cancer. A pilot study.

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**Background:**

Development of a venous thromboembolism (a blood clot in the veins of the body) is four times more common in cancer patients than individuals without cancer. Blood clots are most often found in the legs, termed deep vein thrombosis (DVT) and in the lungs, termed pulmonary embolism (PE). These blood clots can be life threatening and are a major cause of death and disability in cancer patients worldwide.

Virchow's Triad states that three categories contribute to clot development:

- Blood hypercoaguability (a tendency of the blood to clot more rapidly than normal)
- Damage to the internal lining of the blood vessel
- Altered blood flow

The reason why patients with cancer have such a high risk of clot formation is complex and is probably due to many factors. We have noticed that some cancer patients have slow blood flow within the deep veins of the leg. The significance of this is unknown. To date, there is no published information on deep venous blood flow in cancer patients and how this might compare to people without cancer.

We found that there was no published method for measuring venous blood flow in the deep veins of the thigh.

**Aims:**

1. Develop and publish a reproducible ultrasound protocol for measuring blood flow in the deep veins of the thigh.
2. To detect if there is a difference in blood flow between cancer patients and individuals without cancer.

**Methods:**

We recruited 40 participants for the study; 20 with locally advanced or metastatic cancer and 20 age- and gender-matched volunteers without cancer to act as the comparison group.

Participants who agreed to be part of the study then took part in a brief 15 minute medical assessment. This was made up of a consultation and an examination.

Each participant then had an ultrasound scan of both legs to rule out a blood clot (DVT). These ultrasound scans were performed in the Ultrasound Department of Christchurch Hospital by experienced ultrasound technicians (sonographers). If a blood clot was seen, the participant would leave the study and be treated.
appropriately. If no blood clot was seen, blood flow was measured in the large deep vein of the thigh using the ultrasound protocol we created.

The recorded blood flow measurements were:

- How much blood was flowing through the vein per minute (Blood flow volume)
- The speed of the blood (Blood flow velocity)

These measurements were repeated approximately an hour later in a second scan to assess the amount of variation when the same sonographer repeats the scan (intra-observer variation).

In addition, each scan was performed by two different sonographers who were blinded to each other’s results. This allowed us to assess variation between different sonographers (inter-observer variation). Both the intra- and inter-observer variation assess how precise the ultrasound scan was at measuring blood flow.

Results:

The analysis of data is based on the male participants only; 9 males with cancer and 5 volunteers without cancer.

- Median **blood flow volume** on the right hand side in male participants with cancer is **0.194 L/min** compared to **0.336 L/min** in the volunteers without cancer. (P value <0.05 therefore results are statistically significant. Statistical significance means the results seen are unlikely to have occurred by chance).
- Median **blood flow volume** on the left hand side in male participants with cancer is **0.170 L/min** compared to **0.259 L/min** in the volunteers without cancer (P value < 0.05 therefore results are statistically significant).
- Median **blood flow velocity** in male participants with cancer was slower on both the right and left hand side in participants with cancer compared to the volunteers without cancer however these results were not statistically significant (P value > 0.05)

Conclusions:

Blood flow is slower in male participants with cancer compared to volunteers without cancer. This is an ongoing study and to date 20 participants have completed the study. We are awaiting results on female blood flow and when the study is complete we hope to publish both the observations of blood flow and the ultrasound protocol in a scientific journal.

Discussion:

There is significantly slower blood flow in the deep veins of the leg in cancer patients compared to individuals without cancer. We now know the range of venous blood flow velocities and volumes which can set a benchmark for future studies.
The next step in the research is to create a study that looks at blood flow and the subsequent risk of clot development over a period of time. We suspect that slow blood flow is an independent predictor of venous thromboembolism development.

If this is the case, ultrasound scanning may be able to identify cancer patients who have an increased risk of clot development. These high risk patients could then be targeted for close observation and/or blood-thinning medication (anti-coagulation) to prevent blood clot formation.

Ultrasound is a non-invasive, low risk, simple scan which may be able to be utilized to reduce the death and disability associated with venous thromboembolism in cancer patients.