During chemotherapy the body experiences adverse side effects, many of which appear in the fingernails. Chemotherapeutic drugs reach the fingernails by the vascular system and interfere with cell division as well as causing blood flow complications. Limited research has been investigated with respect to chemotherapy, fingernails and ultrasound so more insight could be provided on this topic.

**Abstract**

The aim of the present study was to quantitatively examine the fingernails of patients undergoing chemotherapeutic treatment by high-frequency ultrasound to investigate a possible correlation between cytotoxic drugs and their effect on the human body. Fingernails are suggested as a determinant of a person's general health and well-being presumably due to their direct connection to the vascular system [4, 5, 6]. By evaluating their conditions, more insight could be provided to the little known investigation of chemotherapeutic effects on fingernails using ultrasound [7, 8]. The potency of chemotherapy to the body extends to nails via the vascular system where they can cause blood complications such as hemorrhages or subungual hematomas [9, 10, 11]. Such complications induce changes in color, shape and integrity of the nail plate in the form of Mee's lines, Muehrcke's lines, Beau's lines and onycholysis (Fig.1 [8, 12, 10, 13]). It has been suggested that the severity of certain drugs can be determined by the extent of damage detected in the nails [14]. Qualitative information such as visual inspection or photographs reveals only visible imperfections and so other methods of investigation are still open to testing. The proposed model for detecting any nail defects with very little injury to the patient involves obtaining quantitative data through high-frequency ultrasound.

**Methods**

An acoustic microscope was equipped with a 50 MHz transducer with 7 mm focal length, connected to a desktop computer (Fig.7a) & Fig.7(b)). Using water as a coupling medium between the transducer tip and the patient’s fingernail, B-scans were taken on the ring and index fingers from both hands (Fig.5, Fig.7(c)). The nail plate was held steady by inserting the finger into a holder designed to limit its movement (Fig.7(a)). Data was then processed to determine the shape of the nail and its time-of-flight (TOF) from the nail bed to the nail plate surface (Fig.2, Fig.3, Fig.4). We tried investigating the use of infrared radiation (IR) for analysis combined with the ultrasound but it did not produce quantitative data (Fig.7(d)).

**Discussion & Results**

Upon initial trials conducted on normal fingernails, we noticed that the differences in B-scans and TOF for different subjects were not significant enough to clearly define useful variations. We realized the problem was that the machine moves in a straight line but nails have a natural curvature, and so the transducer was not constantly perpendicular to the nail surface as well as if that volunteer moved, the transducer did not move with it. A new configuration or new device is now required for more effective analysis (Fig.6). The device would preferably include a hand-held probe to rest against the nail plate and an internal transducer with a step-motor that moves inside the probe a distance of several millimeters. By limiting the distance of the B-scan, the curvature of the nail should ideally not affect the signal substantially.

**Conclusion & Future Plans**

In conclusion, further testing and trials must be conducted to create an effective, efficient machine that will accurately measure and investigate the fingernails of chemotherapy patients.

In the present stages of this product, we have the first prototype fabricated and functioning and are about to begin pilot studies on 5 chemotherapy patients at the Windsor Regional Cancer Center. After these preliminary trials, analysis of the results will be studied to determine if this machine setup is adequate and provides accurate results. If so, the machine or software may be redesigned or altered to a more useful configuration. Then, pivotal trials are to be conducted on about 50 patients to validate that the machine and software is successfully operational and user-friendly.

**Acknowledgements**

I would like to thank Dr. C. Hamm and Dr. R. Gr. Maev as well as the entire IDR team for their ongoing assistance and guidance.

**References**

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