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BLOOD VELOCITY MEASUREMENT IN HUMAN CONJUNCTIVAL VESSELS

Harvey N. Mayrovitz, Donald Larnard, and Gloria Duda
Miami Heart Institute, Miami Beach, Florida, 33140

The bulbar conjunctiva is one of the few areas in which blood flow in the peripheral vasculature can be directly and noninvasively observed in the human. Though an extensive literature exists describing morphological changes in this vasculature which correlate with a variety of systemic diseases, little quantitative data is available on hemodynamics either in normal or abnormal states. The limited hemodynamic data that is available mostly takes the form as subjective assessment of "low flow". Approaches to place the subjective assessment on more quantitative grounds have usually been based on photographic techniques which have intrinsic inadequacies. The objective of the work reported here was to develop a system capable of providing sequential blood velocity data potentially useful for providing quantitative information on blood flow and its change in the microvessels of the human conjunctiva. The method which has evolved uses a standard Zeiss slit-lamp to image a subject's conjunctival vessels using a one inch Newvicon TV camera having a 2X electronic magnification. The video image is simultaneously recorded on a video tape recorder (VTR) to an overall system magnification of approximately 4 um/raster line. The data aquisition phase requires approximately 5 minutes of patient time, whereas the actual determination of blood velocity in individual vessels is determined off-line using a modification of the dual-slit videodensimetric method. Two independently controllable video cursors are placed axially separated over the vessel image with the VTR in the still-frame mode. For each consecutive video field the position of two reference points on the vessel, and the position of each cursor relative to these and to each other, are encoded into a computer to track the moving image caused by normal eye movement. The computer then determines new cursor coordinates to assure that their position is constant within the vessel. The electrical signals obtained for each cursor site and for each video field are cross-correlated to yield the average blood velocity over the sampled time interval. The system has been calibrated in vitro from 0.2 to 2.5 mm/sec, evaluated in experimental animals, and used to measure blood velocity (0.3-1.5 mm/sec) in human conjunctival venules with diameters ranging from 20 to 50 μm At this writing blood velocity has been recorded over a period of about two months in the same vessel of several post myocardial infarction patients. It is thus felt that the method is suitable to follow and determine sequential changes in small vessel blood flow in patients over extended periods of time. This research supported by USPHS NIH Research Grant HL 23477.