Kresch (1977) presented the results of calculations which determined the cross-sectional shapes assumed by flexible, elastic tubes for varying transmural pressures. Extensions of these results are presented here in the form of graphs of the cross-sectional area as a function of the transmural pressure. Since the circumferential arc length, the X-axis intercept and the Y-axis intercept were necessarily computed, and are of interest, graphs of these are also presented.

Each graph is a composite of several curves. Each curve in the graph shows the behavior of the parameter as a function of the relative pressure (P) for a specific value of R, a parameter related to the wall thickness. The curves are shown for both positive and negative values of P. The most negative value of P shown is the point where the walls touch and the most positive value shown is the point where the equations fail to converge.

The cross sections were assumed to be elliptical when the transmural pressure was zero. Graphs for three of these initial shapes are shown: nearly circular, major-to-minor axis ratio equal to 2, and an intermediate case.

For the nearly circular case, the curves divide into two regimes: one where stretching clearly predominates and another where bending clearly predominates. For the more eccentric initial cross-sections, the distinction between the two regimes cannot be made in this simple manner.

A. Introduction. In 1969, Moreno et al. presented a curve showing the cross-sectional area of a vein as a function of the transmural pressure. This data was obtained experimentally using a segment of a vein mounted between two rigid supports, injecting fixed volumes of fluid into the vessel and measuring the transmural pressure. Moreno's curve is almost a step function and contains three distinct areas. The shape is nearly circular and the slope of the curve is essentially flat for positive transmural pressures, any changes in cross-section being due to stretching. The cross-section is collapsed into two disjoint channels, and the slope, again, is nearly flat for negative transmural pressures. When the transmural pressure is approximately zero, the slope is very high, indicating that large changes in cross-section occur for relatively small changes in transmural pressure. This is the region where the changes in shape occur, with little or no stretching.
Conrad (1969) presented similar data for penrose tubing. Additional data was published by Moreno et al. (1970) in which measurements on both veins and thin-walled latex tubes were compared with the results of computer calculations.

Theoretical calculations for inextensible flexible tubes have been published by Kresch (1968); Kresch and Noordergraaf (1972) and Flaherty et al. (1972). Recently (1977), Kresch presented results of a calculation for extensible tubes. In that paper, the shapes of the cross-sections were given; quantitative data for the behavior of the area and other parameters was not then available. By considering quantitative data, such as cross-sectional area or the $X$-semiaxis, it is possible to derive conclusions which cannot be clearly determined from a consideration of just the shapes alone. Here, as a result of additional calculations, four quantities are presented: cross-sectional area, arc-length, $X$-semiaxis and $Y$-semiaxis. These are presented as functions of the transmural pressure for different values of the stretching modulus ($R$) and the initial shape ($K$).

**B. Background.** The results presented here are based upon the following assumptions given recently by Kresch (1977):

(a) The cross-sectional shape of the tube is uniform axially.
(b) The wall thickness is small.
(c) The shape calculation is static.
(d) The cross-sectional shape is elliptical for zero transmural pressure (i.e. unstressed).
(e) The wall thickness is always constant.
(f) The wall is homogeneous, but not necessarily isotropic.
(g) The cross-sectional shape is symmetrical about both axes.
(h) The axial prestress is zero.
(i) The stress–strain relationship for the wall is linear; i.e. the Young's modulus is constant.

As per assumption (d), the initial shape (i.e. the shape for zero transmural pressure) was assumed to be elliptical. The eccentricity of the ellipse, $K$, was defined as the ratio of the major semiaxis to the minor semiaxis, and consequently is always greater than one.

In addition to $K$, there were two other input parameters: $P$ and $R$. These are defined as follows:

\[ P = \frac{6p}{EH^3} \]  
\[ Q = \frac{p}{EH} \]