Chapter 6

DISCUSSION

6.1 For the anatomical study of the Hyrtl’s anastomosis

- A literature search conducted on Hyrtl’s anastomosis determined that the anastomosis between the umbilical arteries had been investigated in the context of pregnancy-induced hypertension. Hence, we examined specimens from normotensive mothers and those with pregnancy-induced hypertension.

- We first studied historic data, regarding Hyrtl’s anastomotic pattern and noted that the anastomosis were found to be present in the umbilical arteries near the cord insertion (Hebenstreit, 1737; Hyrtl, 1870). These features were identifiable in the present study from the specimens that we examined in both normotensive and pregnancy-induced hypertension.

- Moreover, these previous studies demonstrated that the umbilical arteries are connected by a single connection and were essentially never connected by two or more anastomosis (Hyrtl, 1870; Shordania, 1929). A single report in the literature mentions a specimen in which there were two anastomoses (Priman, 1959). This is supported by the one case of double anastomosis in the present study.

- The important functional role of the Hyrtl’s anastomosis appears to equalize the blood pressure between the placental territories supplied by the umbilical arteries (Hyrtl, 1870). This probable role in regulating the distribution of the blood flow to the placenta has been supported by computer modelling studies (Gordon, 2006).
• Although numerous authors have described the anastomosis in the umbilical arteries, they have done so without differentiating whether they were associated only with normal subjects or with mothers with certain conditions like essential hypertension, pregnancy-induced hypertension, or diabetes.

• The present study focuses on the pattern of the anastomoses in pregnancy-induced hypertension. Since in pregnancy-induced hypertension there is an increase in the vascular resistance (Mitra, 2000), we hypothesized that there might be structural differences in umbilical cords and placentas derived from normotensive versus pregnancy-induced hypertensive mothers.

• In earlier investigations, different types of Hyrtl’s anastomoses (transverse, oblique, fused) have been characterized using the injection corrosion technique, Doppler method, and angiography (Priman, 1959; Arts, 1961; Ullberg). In the transverse type, in which the blood can flow in either direction, the area of the placenta perfused by the two arteries was found to be nearly equal (Priman, 1959). In the present study, the finding that a greater percentage of transverse anastomoses occurred in pregnancy-induced hypertension, supports the idea that the anastomosis aids in equalizing the pressure gradients in the umbilical arteries.

• Hemodynamic analysis of inclined (oblique) anastomoses, suggest that there is a drop in pressure between the two arteries which affects the flow pattern (Gordon, 2006). Further, a significant difference in the placental area served by the two vessels was observed in oblique type (Szpakowski, 1974).

• We observed a significant difference in the placental surface area in the oblique type anastomosis. In placenta from normotensive subjects the average placental surface area was found to be $217.26 \, \text{cm}^2$ while those from pregnancy-induced
hypertensive subjects averaged 168.96 cm$^2$. According to our current understanding, there is a disturbance in the flow of blood in the oblique anastomosis, suggesting a drop in the pressure. This may account for the observed change in the surface area of the placenta.

6.2 Microscopic study of Hyrtl’s anastomosis

- It has been demonstrated that the placental and vascular resistance associated with pregnancy induced hypertension has been linked to intrauterine growth restriction, Preterm births, low birth weight and perinatal mortality (Mitra, 2000).

- Various studies in uterine growth limitation which are characterized by narrow cord and reduction in Wharton’s jelly has been demonstrated by many authors. The reduction in the vascular layer is mostly accompanied by significant structural disorders which have an impact upon the tunica intima, media and fibrillary structures. In case of pregnancy induced hypertension significant modification in the morphology was noted.

- Often a reduction in the Wharton’s jelly considered as a factor for the reduction in the diameter of the vessels mainly in the diameter of the umbilical cord (Junek, 2000; Romanovicz, 2000).

- Several others were of the different opinion and reported the diminished smooth muscle layer due to the narrowing of the conjunctive tissue separating the muscular area (Dadak, 1984; Cetin, 2002).
• Several authors reported changes in tunica media and intima of the umbilical arteries in preeclamptic groups (Junek, 2000; Biagiotti, 1999; Dadak, 1984; Cetin, 2002; Morteza, 2011).

• Similar to our study, Barnwal et al in their study reported a significant increase in the wall thickness of umbilical arteries. \( p \leq 0.05 \) and in pre-eclamptic the thickness of the arteries increasing by 20% as compared to the control groups (Barnwal, 2012).

• The present study is similar to that of Barnwal; were an increase in the thickness of the muscular layer of the umbilical arteries and anastomosis was observed in pregnancy–induced hypertension when compared to the control.

• Studies have reported the blood vessels having low calibre have differences in the blood flow and greater resistance in their vessel walls (Predanic, 1998).

• The increase in wall thickness in the umbilical arteries and decrease in luminal radius as explained by Barnwal might probably be due to the intrinsic contractile response of the smooth muscle to stretch and further increase in pressure of the blood vessel stimulates the increase in the smooth muscle fibers (Barnwal, 2012).

• This study might probably explain the thickness in umbilical arteries and the Hyrtl’s anastomosis in pregnancy induced hypertension.

• Several descriptions in the arrangement of the muscle fibers in the umbilical arteries as spiral or snail like (Herzog, 1892; Von, 1935) are there but none for the Hyrtl’s anastomosis. Others described the arrangement as nearly circular, smooth muscle layers arranged in 50-60 layers (Spivack, 1946; Manuel, 2011; Gebrane, 1986).
• We observed a circular arrangement of the smooth cells in the umbilical arteries and except few areas where the layers were disrupted.

• Results from our study was similar to Ulla Ullberg (2003) who studied a transverse histological section of Hyrtl’s anastomosis comparing to the connected arteries revealed a thin layer of circularly arranged smooth muscle cells without any elastic tissue.

• The study reports the absence of adventitia, vasa vasorum, Internal elastic lamina in the umbilical arteries as well as in Hyrtl’s anastomosis. These finding were in agreement with previous workers (Gebrane,1986; Manuel , 2011).

• Consequently, the analysis of these vessels maybe useful in detecting hemodynamic status of the foetus.

6.3 Ultrastructural Study

• Ultrastructural changes observed in the present study of Hyrtl’s anastomosis in umbilical cords of pregnancy induced hypertensive and normotensive umbilical cords high lights the varied difference from that of the umbilical arteries.

• The result of the present study of Hyrtl’s anastomosis are in agreement with previous studies regarding the characteristics of the smooth muscle fibers of umbilical arteries( Weiss, 1977).

• Although there are many studies till date describing the ultrastructure of human umbilical vessels at term (Roach,1973; Takagi,1985; Asmussen,1980), but hardly any studies compare the ultrastructure of the Hyrtl’s anastomosis of
pregnancy induced hypertension and normotensive placentas. There has been various suggestions as to the orientation of the smooth muscle cells. Spivack suggested that two distinct layers existed: an internal longitudinal layer surrounded by an external circular layer (Spivack, 1946). Boyd and Hamilton suggested that the arrangement is mainly longitudinal with intermittent circular layers, whereas Gebrane-Younes et al proposed a predominant helicoidal layer in term umbilical vessels (Boyd, 1970; Gebrane, 1986). In the present study, it has been shown that in the Hyrtl’s anastomosis the circular layer was dominant in both the normotensive and the pregnancy induced hypertensive groups.

- Moving away from the lumen to the outer region of the vessel wall, fibroblast like cells were observed. These cells have been described in detail in umbilical artery by Takechi as myofibroblast cells of Wharton’s jelly, which acts as an adventitial layer around all three vessels of the umbilical cord (Takechi, 1993).

- Description in the arrangement of the endothelial lining of the fully patent umbilical artery is composed of longitudinally arranged, spindle shaped cells connected by cellular junctions (Rockelein, 1988).

- Our findings too revealed a uniform endothelial lining connected together by tight junctions in normal Hyrtl’s anastomosis. It has been demonstrated by Junek et al that in the pre-eclamptic groups the umbilical arteries were thicker than in normal pregnancies (Junek, 2000). These differences were observed in the tunica media and intima. Similar observations were noted from our study. In Hyrtl’s anastomosis of pregnancy induced hypertension the muscular layer
were thicker and the smooth muscle cells appeared to be more flat, thicker with short abrupt ends, whereas examination of the normal Hyrtl’s revealed the smooth muscle cells in few layers in comparison to that of pregnancy-induced hypertension. The smooth muscle cells arranged loosely with visible space and circularly arranged and the cells were slender, in shape.

- Throughout the whole of this investigation of the Hyrtl’s anastomosis neither nerves or vasa vasorum or elastic lamina were observed. These findings were in agreement with the findings of Manuel et al. who demonstrated in the umbilical arteries (Manuel, 2011).

- In summary, vessel wall of the Hyrtl’s anastomosis in normotensive and pregnancy induced hypertension were different in structure when related with the umbilical arteries. The effect of hypertension brought about structural changes in the blood vessel which might probably have an effect on the feto-placental circulation and therefore adversely affecting the fetal outcome.