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Transcriptomic Analysis of the Solute Carriers and ATP-binding Cassette Transporters in the Human Term Placenta: Regional Differences and Impact of Fetal Sex

Elijah Marsh Jung¹, Nicholas Ieronimakis^{2,3}, Bothaina Mousa¹, Emily D Shiekh², Sarah E Ligon²,
Joshua W Monson², Jennifer R Damicis³, Hilary J Kinsman³,
Lydia E Bettridge³, Samuel L.M. Arnold¹, Edward J. Kelly¹, Jashvant D Unadkat¹, Joanne Wang¹

¹ Department of Pharmaceutics, University of Washington, Seattle, WA

² Department of OB/GYN, Madigan Army Medical Center, Tacoma, WA

³ Department of Clinical Investigation, Madigan Army Medical Center, Tacoma, WA

Solute carriers (SLC) and ATP-binding cassette (ABC) transporters are essential for placental solute exchange and fetal protection, yet their transcriptomic profiles in the human placenta remain poorly characterized. Although fetal sex influences placental development and function, its impact on transporter expression is unclear. Using RNA sequencing, we profiled SLC and ABC expression in two anatomical regions of term human placentas (N=10) with balanced fetal sex distribution and controlled clinical features. In the intervillous region, 276 SLCs were detected, with 60% expressed at low levels (CPM < 25) and 110 (40%) expressed at higher levels (CPM 25–1650). Four transporters—SLC2A1 (GLUT1), SLC44A2 (CTL2), SLC38A2 (SNAT2), and SLC38A1 (SNAT1)—showed the highest expression (CPM > 500). Functional annotation of these 110 SLCs revealed that transporters for amino acids, metals, and inorganic ions each accounted for ~9%. Other well-represented SLCs included xenobiotic and vitamin transporters. Mitochondrial, lysosomal, and ER/Golgi transporters together accounted for ~37%, while 11% were orphan transporters. Thirty-seven ABC transcripts were detected, primarily associated with xenobiotic and lipid transport. Compared with the intervillous region, 1,676 genes—including 32 SLC and 2 ABC transporters—were differentially expressed in the decidua region. Although 117 genes in the intervillous region and 79 genes in the decidua region exhibited sexually dimorphic expression, none were SLCs. Notably, male placentas showed significantly higher expression of ABCB2 (P-gp), confirmed by qPCR and western blot. Our findings provide a transcriptomic map of placental transporters and highlight a potential sex-specific difference on ABCB2 expression and xenobiotic protection. This work is supported by NIH grant UC2HD113041.