Xu, 2014). Once activated, AMPK can turn on catabolic pathways that produce ATP such as glucose metabolism. When LKB1 is activated, it in turn activates AMPK by phosphorylating the Threonine 172 amino acid residue (Zhao, Xu, 2014). AMPK also is activated by low blood oxygen, as well as low blood glucose (Zhao, Xu, 2014). When AMPK is activated, it in turn activates LKB1 by phosphorylating the Thr-172 amino acid residue (Shaw, 2011). The above image A-B shows that the addition of Metformin to cells called human umbilical vein endothelial cells (HUVEC) results in LKB1 being shuttled from the nucleus to the cytoplasm. D shows that phosphorylation of LKB1 at serine 428 is increased when the cells are given Metformin (Xie et al., 2008).

**Functions of LKB1**

LKB1 works as a complex of three parts: LKB1, the pseudokinase STRAD, and MO25 (Zhan, Xu, 2014). When LKB1 is activated, it in turn activates AMPK by phosphorylating the Thrreonine 172 amino acid residue (Zhan, Xu, 2014). AMPK also is activated by low blood oxygen, as well as low blood glucose (Zhan, Xu, 2014). Once activated, AMPK can turn on catabolic pathways that produce ATP such as glucose metabolism and inhibit anabolic pathways such as cell growth and protein synthesis. Since defects in glucose metabolism can result in diabetes, it is not surprising that LKB1 dysfunction has been linked to diabetes. Human mutations in LKB1 causes the disease Peutz-Jeghers syndrome, which results in benign tumor-like growth called polyps in the intestine and a 50% chance of developing cancer by the age of 50. When cell energy, ATP, is low LKB1 will be activated. Active LKB1 regulates the activity of adenosine monophosphate-activated protein kinase (AMPK). LKB1 directly activates AMPK by adding a phosphate group to Thr-172. AMPK activity increases the production of ATP by activating glycolysis and fatty acid oxidation. AMPK also decrease the amount of energy needed by the cell by inhibiting protein synthesis and cell growth. Both of these processes play a role in cancer development. Drugs like Metformin, a successful diablic drug, are thought to activate LKB1. Through the activation of AMPK to cease cancerous growth, and with the whole cascade of proteins ceases cancerous growth.

**Metformin Activating ATM**

Metformin activates Ataxia Telangiectasia Mutated (ATM) which is a serine/threonine protein kinase responsible for the phosphorylation LKB1 (Shaw, 2011). The activation of ATM and the phosphorylation of LKB1 guides the LKB1 to move out of the nucleus and into the cytosol. AMNK is abundant in the cytosol and that is where LKB1 is able to phosphorylate AMPK and continue the cycle of the activation of the metabolism which will eventually lower the blood glucose.

**Conclusion**

Liver Kinase B1 has vital functions inside the cell. It is clear that the proper activation of LKB1 results in the control over the proliferation, cellular metabolism, and cellular integrity of the cell. As a kinase its sole purpose is to phosphorylate other proteins making it a stepping stone inside of an important cellular stress response. LKB1 acts as a check point or sensor for the cell. Without this check point the cell would be left helpless in managing its most important components such as energy. This would ultimately disrupt the overall homeostasis of the cell and most importantly, if not targeted by apoptosis, have the ability to turn cancerous.

**Citations**