The (Dr. Matthew) Walker Texas Rangers III

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Our objective is to develop a smart-shunt design for hydrocephalus treatment that detects and communicates intracranial pressure changes of 3-5 mmHg by measuring the pressure both inside the shunt and at the tip of the shunt inside the third ventricle.

Dr. Walker suggested working with piezoelectric circuits. However, we have identified that not only do these have high drift, but they also cannot detect pressure changes that occur over the span of days.

Dr. Feldman suggested working with fiber optics as they have little to no drift & FDA has approved fiber-optic devices before. If we are able to isolate the fiber-optic cables from the shunt, and make the reflective surface the only component directly in contact with the brain, we can overcome the debris risk. Moreover, we could program the system to take two readings a day instead of continuous monitoring in order to prevent excess heat production, which could be very dangerous. Dr. Feldman also proposed a miniature countercurrent heat exchange system running in parallel with the shunt tubing, allowing for heat exchange between the CSF and high specific heat fluid within the fiber optic cable. Dr. Baudenbacher proposed using strain gauges which are currently being explored, as they can be used to functionalize a small portion of the catheter wall, thereby serving as a means to measure the pressure differential between the ventricle and shunt tubing.

Keeping all this in mind, we are now looking at fiber optics and strain gauges as the potential mechanisms with which we could work. We have been unable to reach consensus on the pressure measuring mechanism to move forward with as different methods have their own pros and cons. If we decide to go with fiberoptics, we need to figure out how to overcome the issue of heat production. Dr. Feldman suggests fiberoptics may be best and we could mitigate the debris risk by making the reflective surface the only component directly in contact with the brain tissue. However, much of this is still hypothetical. For the strain gauges, finding the correct sizing commercially is a challenge that needs to be overcome. In order to figure this out, we need to know the exact sizing of the shunt and its tubing, for which we are awaiting Michael's response.

We have had some trouble scheduling a meeting with Dr. Miga (coordinating 6 people is tough) but are hoping to sit with him in the next couple of days to discuss our options and narrow down one mechanism to work with. Dr. Feldman is providing us with saline solution, albumin, and the shunt tubing, which are needed to develop our phantom of the system. We are awaiting information from Opsens Solutions on commercially available fiber-optic sensors, as well as small pressure sensors from Tekskan.