Aortic stenosis affects many patients, especially those in the elderly population. Some of these patients are at high surgical risk and are ineligible for conventional aortic valve replacement. Transcatheter aortic valve implantation is an emerging procedure to treat symptomatic aortic stenosis in high risk patients. The surgery involves the percutaneous access and placement of a prosthetic aortic valve through the use of a catheter based system. Several devices and delivery systems are available, using different methods for insertion of the valve. Transcatheter aortic valve implantation has many advantages to conventional aortic valve surgery. Development of new prostheses and delivery catheters will increase the safety, efficacy, and eligibility of the surgery.

Transcatheter Aortic Valve Implantation

Transcatheter aortic valve implantation (TAVI) is a percutaneous surgical procedure for the implantation of a prosthetic aortic valve using a catheter based system that is expected to become promising for high-risk and inoperable patients with severe symptomatic aortic stenosis. Patient selection and pre-op assessment play pivotal roles in the delivery of safe and effective care. Assessment of the aortic annulus through the use of transesophageal echocardiography (TEE) or CT scan is required to determine if the size of the aortic annulus is suitable for one of the options for a prosthetic aortic valve. Patients must also undergo assessment of the aortic root angulation and the path of access (femoral, axillary, or transapical) to the aortic annulus.

The procedure for transcatheter aortic valve implantation involves a retrograde transaortic or antegrade transapical approach, depending on the valve prosthesis and product for transcatheter aortic valve implantation. The procedure begins with pre-procedure assessment and anticoagulation. The prosthetic valve is placed on the delivery system. Once the valve is on the catheter, the valve is deployed. Postoperative TEE and aortography are performed to assess proper placement and to detect any complications. Closure of the aorta is performed either surgically or using a percutaneous closure device. The patient then remains in an intensive care unit for at least 24 hour following surgery.

Discussion

Transcatheter aortic valve implantation has many advantages over traditional aortic valve replacement. TAVI eliminates the need for a median sternotomy, cardiopulmonary bypass, and cardiopulmonary bypass, all of which increase the surgical risk and complications associated with surgery. A recent study has shown that high risk surgical patient whom underwent TAVI had a much faster recovery rate at 1 month post-operation compared to traditional aortic valve replacement. This is expected and the predicted outcome from any minimally invasive surgery, the surgery can be performed with much smaller incisions, in this case a surgical incision in the thorax, instead of a sternotomy. This study also demonstrated that the access site for TAVI was correlated with patient outcomes. Patient who underwent TAVI by transapical access had improved outcomes at 1 month post-operation compared to patient whom underwent TAVI by transapical access, where 1 month outcomes were not significantly different from traditional aortic valve replacement. These results seem to indicate that with transapical access for TAVI, significant increased patient outcomes should be expected.

Future Work

Transcatheter Aortic Valve implementation is a promising treatment for patients with severe symptomatic aortic stenosis whom are deemed inoperable, as well as for all patients with severe aortic stenosis in the future. With advances in delivery systems and prosthetic valves, the risk involved in TAVI surgeries will be decreased, and a greater population of patients will be recommended for the surgeries. Innovative designs of prosthetic valves and delivery systems can be carried out as yearlong multidisciplinary undergraduate capstone projects aimed at achieving better patient outcomes. Research can also be carried out on optimizing the access path, improving the catheter delivery system, and valve mounting process.

Conclusion

In conclusion, the undergraduate research project investigated an innovative surgical procedure for aortic valve implantation. In comparison with highly risky open heart procedures, the reported results have been positive. Senior capstone projects can be carried out to optimize the prosthetic and delivery system, which will result in improved outcomes, fewer post-op mortalities, and an increased quality and length of life for patients.