Robot-Aided Steerable Needle for Brain Blood Clot Removal

Aaron Gilmore, *Biomedical Engineering, University of Rhode Island*
BME 281 Presentation, November 4, 2015 <aaron_gilmore@my.uri.edu>

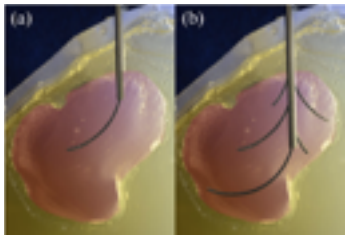
Abstract - Today's brain surgery methods still leave much to be desired for those in need of high risk surgeries. However, new robotic technologies are allowing more accurate blood clot surgeries in the brain to be performed by giving doctors more maneuverability while inside the brain to amend this type of deadly condition.

I. INTRODUCTION

Brain surgeries today are high risk and extremely expensive, and even still many don't bring the desired outcome to the patient needs. One out of every fifty people will get an intracerebral hemorrhage, or ICH, and also known as a blood clot, at some point in their lives, and with a 40% mortality rate within the first thirty days, this is a very pressing issue [1]. With the current equipment, large holes in the skull are needed to attempt to give the straight needle as much motion as possible to suck out a potentially-fatal blood clot. Fortunately, a new device that Vanderbilt engineers are calling the active cannula has been engineered to give doctors a greater range of motion to eliminate these dangerous developments, rather than the small range of linear motion provided by straight needles. .

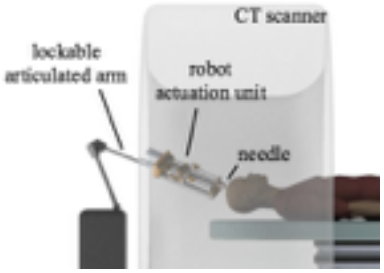
II. THE DEVICE

The active cannula consists of two concentric tubes, with the thinner one being flexible, curved and able to extend or retract, as well as rotate in relation to the larger, straight tube which is able to extend or retract from the stationary robot articulate arm located above the patient's head [2]. A much smaller hole in the skull is necessary than the one that would be needed for a typical blood clot evacuation surgery using today's methods. The active cannula's curved extending needle allows doctors to reach around parts of the brain to evacuate the blood that has clotted nearby, and suction is provided at the outside end of the inner tube to allow it to remove the hemorrhage [2].



III. THE PROCESS, RESULTS

Doctors begin the hemorrhage removal process by taking a CT scan of the patient, allowing them to map out the precise location of the clot in their brain [3]. This information is sent out to the robot, which rapidly maps out trajectories of both needles to effectively remove the majority of the clot. After a small hole is drilled in the skull of the patient, and the robotic arm is locked onto the skull, the two concentric needles will be inserted into the skull [1]. Using both inserting movements by both needles and rotational movement by the smaller needle, the blood clot is sucked out of the patient's skull, eliminating the pressure within the skull as well as the health risks associated with it [3]. This method has proved extremely effective, with the active cannula being able to successfully remove 92% of the gelatin used in laboratory tests, which, in reality, would save the patient from inevitable brain damage or even death which would occur if the procedure had not been performed [1].



REFERENCES

[1] Burgner, Jessica; Swaney, Philip J.; Lathrop, Ray A.; Weaver, Kyle D.; and Webster III, Robert J. "Debulking From Within: A Robotic Steerable Cannula for Intracerebral Hemorrhage Evacuation." *IEEE Xplore.* Vol. 60, No. 9. September 2013.

[2] Godage, Isuzu S.; Remirez, Andria A.; Wirz, Raul; Weaver, Kyle D.; Burgner-Kahrs, Jessica; and Webster III, Robert J. "Robotic Intracerebral Hemorrhage Evacuation: An In-Scanner Approach with Concentric Tube Robots." *IEEE/RSJ International Conference on Intelligent Robots and Systems*. 28 September - 2 October, 2015.

[3] Swaney, Philip J.; Lathrop, Ray; Burgner, Jessica; Weaver, Kyle; Gilbert, Hunter B.; Webster, Robert J.; and Comber, David B. "System, method, and apparatus for configuration, design, and operation of an active cannula robot." *Vanderbilt University.* 3 August, 2015.