A Delay in the Processing of Blood for an ACT: Does it Really Matter?

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Introduction: Activated clotting time, typically referred to as ACT, has become a relatively easy, bedside clotting test to monitor heparin anticoagulation. Frequently, in an operating room setting, the actual processing of the blood sample may take place in another room and there could be a delay between collecting the blood and placing it into an ACT machine. Hence, this study focuses on processing ACT measurements at different time increments after withdrawal of blood from an arterial line to see whether the values differ significantly. If such statistical differences exist, there may need to be further standardization of ACT practices so clinical decision-making is not wrongfully affected.

Materials and Methods: Twenty-one patients, between the ages of 18 and 65, undergoing noncardiac surgery, were consented preoperatively. Inclusion criteria included arterial line placement by the anesthesiologist and normal coagulation studies (PT, PTT, INR) and platelet counts. Twenty milliliters of blood were taken from each patient through an arterial line, after withdrawing an initial ten milliliters to be returned to the patient. Immediately after the sample was drawn, one milliliter was placed into two cartridges each and the ACT calculations were started simultaneously on a Medtronic ACT II machine. Upon completion, the average of the two ACTs was taken for that time period. Another set of ACT calculations were then started in two, fresh cartridges, and the process was repeated ten times for each patient.

Each machine used to calculate the ACT measurements was liquid, quality controlled every seven days per the specific recommendations the perfusionists follow at Stanford University Medical Center. In addition, the machine was electronically, quality controlled every eight hours and the temperature validation was performed once a month.

Results: For each patient, ACT measurements were started at a different time point after the initial withdrawal of blood from the arterial line. This discrepancy was due to the location of the ACT machine outside the operating rooms and the time required to walk the sample into the room, place the blood into two cartridges, and start the machine. In order to determine if there was a statistical difference in the ACT measurement after a certain period of time, the first and last ACT average for each patient was grouped into two separate categories and a paired t-test was performed. The mean for the first ACT average for the twenty-one patients is 124 with a standard deviation of 21 and the mean for the last ACT average is 108 with a standard deviation of 20. Using the paired t-test, the p value is statistically significant at 0.0046.

Discussion: After first being described in 1966, ACT, or activated clotting time, has become the gold standard in measuring heparin anticoagulation. Machines, such as the Hemochron or Actalyke, derive an ACT number by rolling blood that has been placed into a cartridge with an activator of coagulation (celite or diatomaceous earth, kaolin, or glass particles) to form a fibrin clot. Once the clot forms, a magnet within the cartridge is pulled away from a detector and this signals the amount of time required for clot formation, or an ACT. The baseline reference range usually lies within 70 to 180 seconds.

As with the processing of any lab value, there exists the possibility of introducing error if there is no standardization in the derivation of lab values. Over the years, research has proven that the following variables can affect activated clotting times: lysed platelets, patient temperature extremes, decreased or increased urine output, hemodilution, clots in the circuit due to DIC, or transfusion of platelets, fresh frozen plasma, or cryoprecipitate. In addition, in terms of susceptibility to heparin anticoagulation, there exists individual variance due to inherited tendencies, acquired diseases, and the effects of drugs, such as nitroglycerine or aprotinin. Despite these findings, there has never been a study analyzing the effects of a delay in ACT calculation after blood is drawn from a patient. Such a delay is likely to occur if the ACT machine is stored outside the operating room and the anesthesiologist cannot access it readily. The blood sample may sit for several minutes before being placed in the cartridges and into the machine. If there is a discrepancy due to such a delay, this could influence clinical judgment, such as administrating too much or too little heparin or protamine.

Hence, by sampling twenty milliliters from twenty-one patients and consecutively processing twenty cartridges (two each time increment for a total of ten increments), this study aimed to see whether incrementally delaying ACT measurement significantly affected the final result. By using the paired t-test, there appears to be a statistical difference between the first and last ACT values for the twenty-one patients ($p = 0.0046$). Thus, further standardization may be required in the processing of activated clotting times and studies into the accuracy with time delays could be beneficial to doctors, nurses, and perfusionists. For now, as long as ACTs are calculated almost immediately and medical personnel continue to follow the strict practices of quality controlling their machines, activated clotting time will continue to be an easy, routine method of accurately assessing the anticoagulation effects of heparin.