Effects of Troponin Point-of-Care Testing on Emergency Department Overcrowding

Abstract

This review of several clinical trials and findings of experts from reputable organizations, such as the Mayo Clinic and the National Institute of Health, found Point-of-Care (POC) testing of the cardiac biomarker, troponin, in the Emergency Department (ED) was beneficial. A large number of visits to the ED are due to heart attacks and other cardiac related events, and regular laboratory troponin testing requires a substantial amount of time, which contributes to overcrowding of the ED. The advantages of POC testing are decreased time for patients to get results back, earlier decisions by the physician, and less risk of error in the proposed treatment plan. The disadvantages of POC testing are lack of sensitivity, standardization, separate training for personnel and cost. The impact of troponin POC testing varies in the amount of time and money saved among the different trials, but they all agree that troponin POC testing saves time, even though it costs more. Despite the disadvantages to troponin POC testing, the potential that it could offer as the technology improves will be beneficial to EDs in the future, especially to the cardiac workup protocol.

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Cardiovascular disease is one of the biggest healthcare issues in North America. It is the leading cause of death and one of the major costs of resources in the Emergency Department (ED). Chest pain is one of the indicative symptoms that a person might be having an acute myocardial infarction (MI), and 5% to 10% of 6 million ED visits annually consist of patients with presentation of chest pain (Than et al., 2013). There are many other conditions that also have the symptom of chest pain; so accurately diagnosing patients who have acute coronary syndrome (ACS) with a high risk of having an MI is crucial to provide the appropriate treatment plan that is both well timed and cost-effective. Assessment and laboratory diagnostics used to determine the difference between a person at high risk ACS from low risk ACS may take more than 6 hours, which can lead to long ED wait times and worse patient outcomes (Than et al., 2013).

A level 1 ED in an urban setting can see up to 120,000 patients annually (Dashevsky, Bernstein, Barsky, & Taylor, 2017), which equates to over 300 patients daily. A typical ED has very limited space, beds, and staff available. The lengthy amount of time it takes for safe discharge, limited available resources, and the high volume of patients often leads to ED overcrowding.

A potential solution for ED overcrowding is Point-of-Care (POC) Testing. The College of American Pathologists (CAP) defines POC testing as “tests designed to be used near the patient, will not take up a lot of space, and are performed by members outside the central or clinical laboratory (CL)”. A well-known example of POC testing is the glucometer, which can be purchased for at home use. For cardiac related events, troponin is the preferred biomarker when diagnosing acute MI; however, the recommended turnaround time (TAT) is approximately 60 minutes in the CL. Logistical and analytical steps for regular CL troponin testing include test

ordering, specimen collection and transportation, specimen analysis, and result reporting in the laboratory information system (LIS) (Hortin, 2005). Many CLs cannot meet the recommended TAT of 60 minutes as errors could happen in any of these steps, some of which may be outside of the laboratory's control (Singer et al, 2015). POC testing has the ability to eliminate a few steps, thus decreasing the amount of potential errors and satisfying a speedy TAT (Hortin, 2005). Troponin POC testing may be able to reduce the TAT, length of stay (LOS) of the patient, and improve patient management in the ED. The following review will examine and debate a few randomized clinical trials, systematic reviews, and expert opinions on troponin POC testing in the ED, with respect to physician acceptance, TAT, patient outcomes, length of stay, and costs.

Literature Review

Physician acceptance. In a review by Bingisser et al. (2012), randomized and controlled trials concluded that in order for troponin POC testing to be effective, it has to be able to deliver accurate results to rule out AMI from other complaints of chest pain. There is a lot of hesitation from ED physicians about the trustworthiness of the results from troponin POC tests because they are less sensitive than CL testing (Bingisser et al., 2012). More recent research conducted by Dashevsky, Bernstein, Barsky, & Taylor (2017) from Yale School of Medicine suggested that more current ED Troponin POC testing results are compatible with the results from the central laboratory, indicating that ordering both POC and CL testing is wasteful.

Turn around time. The turn-around-time for POC results are shorter than the central laboratory's. In a randomized controlled trial conducted by Asha et al. (2014), POC testing reduced the time for results by about 40 minutes, but this study was about general POC testing in the ED. The main advantage offered by troponin POC testing is that it reduces those logistical and analytical steps, from the ordering of the test, to the physician getting the results and making a decision (Hortin, 2005; Singer et al., 2015). With faster results, the patients are able to receive

treatment sooner. If patients are able to receive treatments earlier, there is increased chance of a better prognosis (Soremekun, 2012).

Patient Outcomes. A patient's prognosis is expedited when the decision for treatment based on clinically significant troponin concentration detected by POC tests. Reducing wait time for patients to receive treatment is advantageous because delay in the ED poses one of the greatest hazards in the hospital to the patient (Soremekun et al., 2012). One such study showed that more than 14 million patients who were admitted into the ED ran the risk of becoming worse if they stayed longer than six hours (Than et al., 2013). If a patient stayed more than six hours at the ED, it increased the risk of exposure to and contraction of infectious diseases from other patients, which may further exacerbate the strain on hospital resources.

Length of stay. There are mixed results when it comes to decreasing the length of stay of the patient when POC testing is used. Several research studies conclude that the impact of POC testing on the length of stay in the ED is highly dependent on the patient's POC troponin, ECG results, and the physician's decision to either start treatment, place the patient under observation, or discharge the patient (Asha et al., 2014; Bissinger et al., 2012; Singer et al., 2015; Than et al., 2013). A systematic review conducted by Bissinger et al. (2012) found that "10% more patients were discharged in less than eight hours when using Troponin POC testing but the differences overall were not statistically significant." indicating that the results of different lengths of stay between the clinical trials were highly variable.

Overall cost. The costs of POC testing versus CL testing are variable depending on the study and what component of tests that the study focused on. When strictly comparing the cost of supplies, such as POC reagent cartridges versus analyzer reagents, POC cartridges costs were significantly higher. Singer, et al. (2015) states that a one-time use POC cartridge could cost up to $12, whereas a bottle of reagent costing a similar amount could be used for several patient samples. In the cost analysis between POC testing and CL testing by Asha et al. (2014), there are

many other factors to be considered, such as wages, collection and transportation of specimen, equipment, and ED turnover. They calculated the direct cost difference between the two methods was approximately $24. However, the study by Bissenger et al. (2012) stated that the overall cost difference would be around $200 per patient when they included indirect costs such as wages. The general finding from most of the literature is that POC testing would cost more than CL testing when only accounting for direct costs.

Discussion

There are many benefits to troponin POC testing. It reduces the possible errors that may occur with regular CL testing by eliminating some pre-analytical steps, such as a phlebotomist going to the ED, prepping the patient for venipuncture, collecting the blood, aftercare of patients from phlebotomy, labeling the specimen, transporting the specimen to the main laboratory, and processing the specimen for analysis. Although these procedures overall do not take a lot of time, collecting a large volume of specimens poses a higher risk for errors (Hortin, 2005). With POC tests, the ED nurse would most likely be collecting and processing the specimen, which provides the results much faster for a decision on the subsequent treatment plan. By reducing the TAT, a physician will be able to execute the correct protocol sooner, which is beneficial for an ACS patient. Fast and accurate assessment allows the physician to direct the patient to the correct treatment facility, where they can receive time-efficient and improved cardiac care versus long, unproductive waiting in the ED. Increased length of stay in the ED increases negative prognosis for the patient (Than et al. 2013).

One of the largest issues for POC testing is standardization. Santrach (2018) from Mayo Clinic and Bingisser et al. (2012) both found that there are several methods, specimen requirements, and different POC instruments that can perform troponin testing, making it difficult to apply a standard to ensure accurate and reliable results. For POC testing to be standardized, the non-laboratory staff requires proper training, and proficiency tests on their

competency of the instrument, knowledge of reference ranges, quality control, proper documentation, and quality assurance (Santrach, 2018). There are many ED physicians who are not confident making a decision based only on POC troponin results. They often will order both POC and CL troponin tests, which is wasteful and drives up the cost for the hospital and the patient (Bingisser et al., 2012). For a hospital to implement POC testing into the their ED, the ED staff must be trained and assessed for quality control, reporting and documentation. Because Troponin POC testing is not a CLIA waived, the ED staff will be subject to stricter guidelines and regulations of CLIA and JCAHO because erroneous results could put the patient at great risk (Dashevsky et al., 2017; Santrach, 2018).

POC testing is an evolving and ever-improving technology. Current research findings concluded that POC testing in the ED does not have much of an impact on the overcrowding of the ED because there are so many other causative factors (Asha et al., 2013). Troponin POC testing can slightly improve the streamlining of treatment planning for cardiac patients in the ED (Than et al., 2013) but the results are variable (Bingisser et al., 2012). Future studies hope to deliver better quality patient care, resource management, and reduced overcrowding of the ED.

Conclusion

Troponin POC testing may be an answer to the large number of people who present in the ED with chest pain and other cardiac related symptoms. Troponin POC testing has the potential to alleviate the strain on the resources of the ED by shortening the TAT for troponin POC test results. In order for troponin POC testing to be effective, the ED staff must be competent in performing and interpreting the tests, which requires additional training and knowledge. The existing Troponin POC tests have had little impact on the overcrowding of the ED, but as technology advances daily, these valuable POC tests could eventually have a bigger influence on

streamlining cardiac workup protocols in the ED, hopefully yielding better patient outcomes with timely, cost-effective diagnostics and treatment plans.

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