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BAD CENTRIFUGING EFFECTS ON AUTOMATED CHEMISTRY ANALYZER

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Abstract:
Introduction: Blood chemistry analysis is one of the diagnostic methods used to assess patient's health status. In this test, serum extracted from the blood using a centrifuge is analyzed to identify the concentration of chemical ingredients. The centrifuge separates serum from the blood using centrifugal force which depends on the density of particles in blood. The automated chemistry analyzer aspirates serum through a thin probe to perform the requested tests.
Method: While using the centrifuge to prepare the blood samples to the automated chemistry analysis, the chemistry analyzer couldn't aspirate the separated serum and a clog appeared in the thin sample probe of the analyzer. In most analyzers and in this case particularly the analyzer will stop working unless the clog is removed. This problem happened regularly in short time without any knowledge of the cause. Every time the probe is clogged, a biomedical engineer removes the clog and the analyzer keeps clogging the probe after several samples. Replacing the probe with a new one solution was tried with no positive result.
Results: After doing some research and inspections in the same laboratory, it was noted that the fresh centrifuged samples was very hot after removing them from the centrifuge. The temperatures of the samples were compared with samples centrifuged by another centrifuge. It is shown from the analysis of different equipment in the laboratory that the prolonged load and the age of some centrifuges led to a higher temperature of the samples after performing the centrifuging. This consequently melt the gel in chemistry tubes which used to separate the blood from serum, the melted gel particles travels with the serum inside the sample probe which clog the sample probe.
After detecting the cause of the repeated problem a recommendation was to use another centrifuge or use this centrifuge alongside another centrifuge to avoid heating while centrifuging, this recommendation led to eliminate the problem. This solution helped to reduce the downtime of the analyzer, helped to reduce the number of replaced sample probes.
Conclusion: In every laboratory, a periodic check on the temperature of centrifuges while centrifuging must be done, to avoid problems in the aspirating of samples and to reduce the downtime of the automated chemistry analyzer and to avoid additional service solutions like replacing parts in the analyzer which does not require replacement.

Keywords: Blood chemistry analyzer, Centrifuge, Blood clot, Sample probe.
Note: this research is done in King Hussein Medical City in the emergency laboratory of Queen Rania Hospital.

Introduction:

Automated chemistry analysis depends on the principle of spectrophotometry, where a light beam crosses a solution with particular ingredients dissolved in it, when the light crosses the solution the wavelength of this light will alter depending on the ingredients because they absorb light. The output wavelength will determine the value of the selected parameter through measuring the quantity of the absorbed light.

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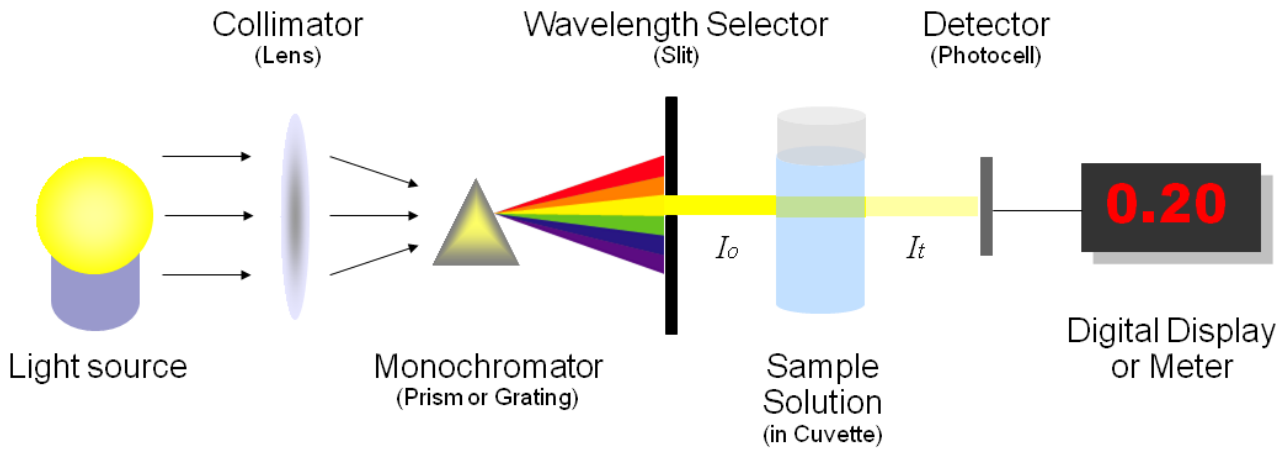

Figure 1: The principle of spectrophotometry

The sample solution which in the cuvette (in the figure above) is just a serum and not a whole blood sample, the serum is the solution which contains the blood chemical ingredients. People sometimes misunderstand the difference between serum and plasma, the serum is the plasma itself but without the coagulation factors, that's why the serum is selected for chemistry analysis so it can be stored for more time for other tests without getting clotted.
The coagulation factors and other blood components like white blood cells, red blood cells, hemoglobin and platelets are separated from the serum using the centrifugal force through a centrifuge device, the centrifugal force is defined as a force, arising from the body's inertia, which appears to act on a body moving in a circular path and is directed away from the center around which the body is moving. In this way, the particles will move outside the center depending on their density, and through science it was revealed that on 4000 rotations per minute and for 3 to 6 minutes the blood components will separate from the serum.

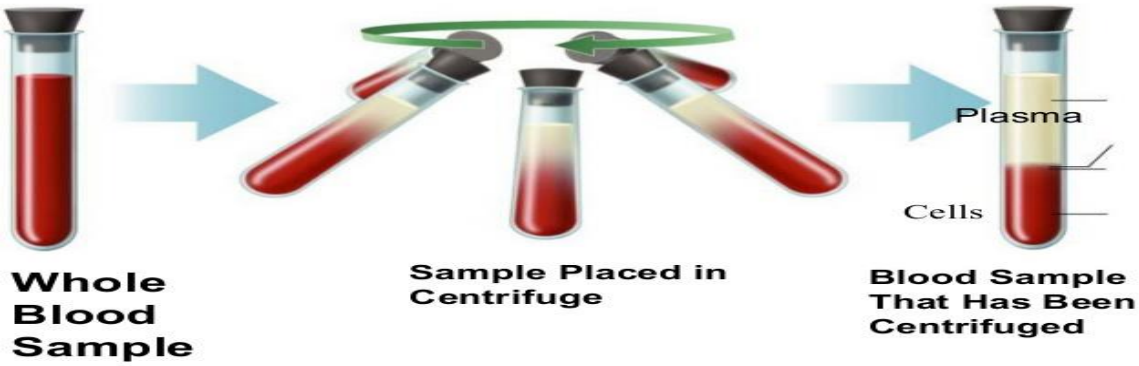

Figure 2: Blood sample centrifugation

Method:
The aspiration of serum in automated chemistry analyzers is done through a thin probe with a diameter of 0.478 mm. any particles with size over this diameter will clog the probe, and this will take additional procedures, time and costs to remove this clog. the case in this research is about automated chemistry analyzer from Roche Diagnostics – Cobas C311, the first time a clog in the sample probe was found an alarm titled "Abnormal Probe Sucking" is triggered, explained that a clog is resided inside the sample probe. There are maintenance orders programmed inside the analyzers used to help in these situations, such as "Sample probe wash" and "Air purge" was ordered but with no avail.

The biomedical team intervened with using a clog removal tool; which is a stainless wire with a diameter less than 0.478 mm to insert inside the sample probe and push the clog outside the probe. This method has succeeded with the

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elimination of the problem, but after a short period and after running a few samples the problem came back. The same steps mentioned earlier were repeated to make sure it was not a coincidence, but the problem kept on coming back.
The biomedical team decided to replace the sample probe thinking that's its malfunctioning; the probe was replaced but also with no avail. The biomedical team started to inspect the automated chemistry analyzer and the laboratory for the reasons of this problem. After a period of inspection, the biomedical team realized that the fresh-centrifugated samples were unusually hot, and this led them to check the temperature of the centrifuge itself to realize that it is also heating up dramatically, the reason for heating up was the continuous load on a certain centrifuge in an emergency lab 24 hours a day, concluding that the reason of this problem (probe clogging) is the melted gel inside the chemistry tube which used to separate the serum from other blood components, and these melted gel particles is cooled inside the sample probe because the speed of aspiration and this leads to make them stuck inside the probe.

Figure 3: Sample probe

After detecting the cause of the problem, the centrifuge which was used earlier replaced with a new one and the problem disappeared.

Results:

After replacing the centrifuge and the disappearance of the problem, the automated chemistry analyzer continued its operation with no problems regarding the aspiration of serum. This problem caused a replacement of the sample probe which costs 300$, caused hours of downtime and this is bead especially when this problem occurred in an emergency lab. These costs would have been avoided if the centrifuge was checked periodically and the problem was detected earlier.

Conclusion:

A recommendation was to use another centrifuge or use this centrifuge alongside another centrifuge to avoid heating while centrifuging and Performing planned preventive maintenance as recommended by the manufacturer of centrifuge equipment is of important value to keep the medical device in appropriate conditions, reduce the downtime of the device, prevent any serious and sudden damage to the device itself and other equipments related to it like the automated chemistry analyzer in this case.

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