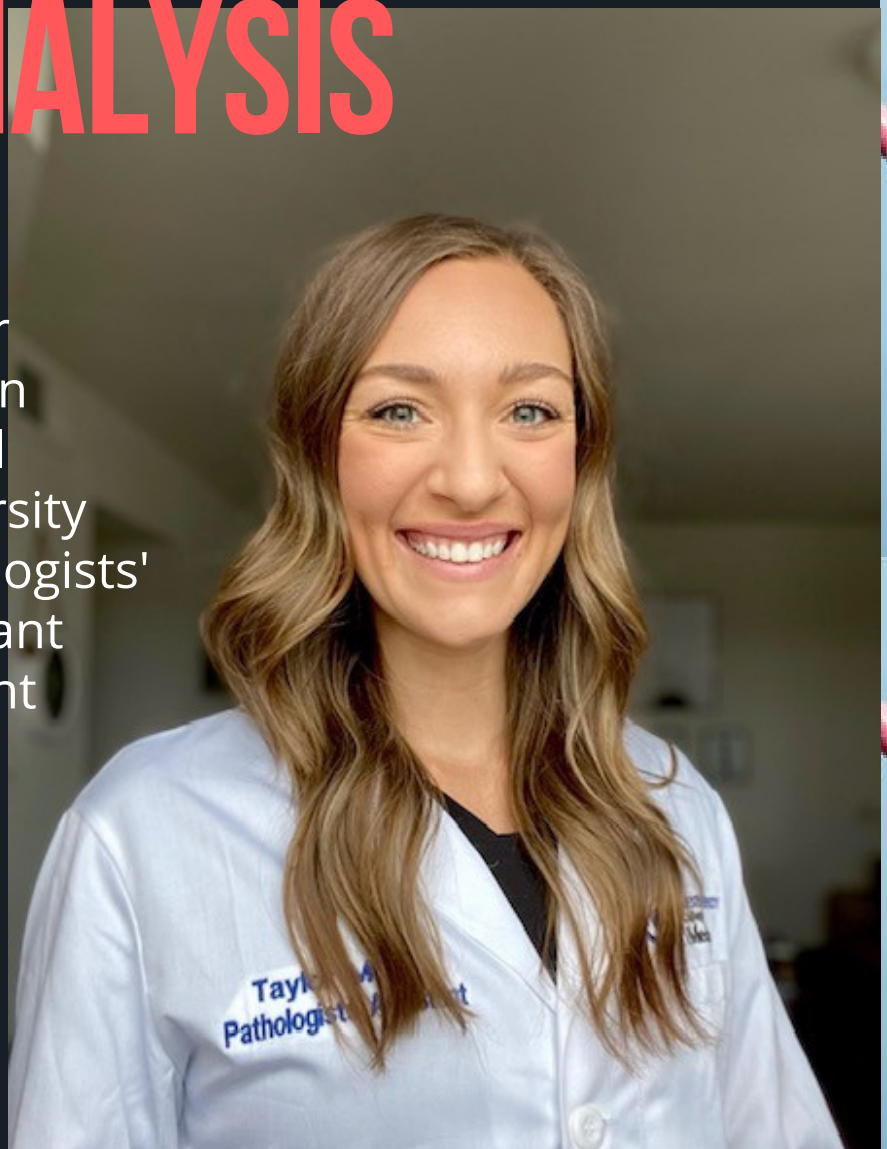
A BRIEF OVERVIEW OF ALTERNATIVE SOURCES FOR TOXICOLOGY ANALYSIS

By
Taylor Marvin
Drexel University
Pathologists' Assistant Student



While blood, urine, and vitreous humor are the most common and most studied sources used for postmortem toxicology analysis, there are instances in which it is not possible to obtain any of these, and I took a particular interest in exploring some alternative sources. This paper is a brief overview of the advantages and drawbacks of three alternative toxicology sources, skeletal muscle, hair, and insects.

The first of these three, skeletal muscle, is not an entirely uncommon option when others have been exhausted, as I saw firsthand a few cases in which skeletal muscle was necessary to be obtained for toxicology. In postmortem forensic toxicology analysis, the invasiveness of the procedure is of minimal concern, so while that is a drawback for other situations, it is not during a postmortem evaluation. When initially investigated as a source for evaluation, it was hoped that skeletal muscle could provide a comparable or better qualitative result of drug ingestion than blood; however, it has been found that there is no consistent pattern of drug distribution throughout the muscle, making it impossible to develop a standard to compare to. This lack of consistency could be due to the time lapse between drug ingestion and death or the volume of distribution, which varies by the drug, and this heterogeneity among muscle could significantly impact the calculation of minimal ingested dose simply based on where the muscle was sampled. Despite this relative downfall of using skeletal muscle, it is still thought that a low muscle to blood drug ratio may be indicative of a rapid death following ingestion. Ultimately, toxicology interpretations from skeletal muscle are

generally unreliable but can provide a qualitative corroboration with blood results.

Hair is an interesting source for analysis because drugs may be deposited into or onto hair by 3 different methods: via blood flow to the hair follicle, sebum deposition onto the hair follicle and shaft, and environmental exposure of the hair shaft to toxins. Additionally, use of hair is less invasive, can be obtained under close supervision, and perhaps most useful, can provide insight into drug use history through segmental analysis of the hair shaft. Despite these benefits, the fact that environmental exposure impacts toxins present on hair proves an issue, as there is no consensus on how to best clean the hair to avoid false interpretation of drug consumption. Additionally, it has been found that the race of the individual influences the rate at which drugs are incorporated into the hair, and perhaps there is a gender influence, as well. The intensity of drug use is difficult to conclude through the presence in hair and what is present may not be indicative of the ingested dose, so this proves minimally helpful in the goal of identifying a cause of death at a forensic autopsy, though there are interesting alternative applications, such as assessment of historical use, that can prove to be very useful given more research.

Finally, and perhaps most intriguing, is the idea of utilizing insects, usually flies in some life cycle stage, for toxicology analysis. Following death, it is common for flies to go to the body and use it as a source of food and site of reproduction. Scientists have studied the larvae found on bodies and determined that they

do indeed contain drugs that were present in the decedent. As with the previous sources discussed, it seems that insects only provide a qualitative measure of toxins, as there does not seem to be a correlation between the concentration of drugs between larvae and human tissues, with the exception of skeletal muscle. However, as previously discussed, skeletal muscle itself is a poor quantitative measure and may vary greatly, so to use that as a measure to compare larvae drug concentration would be unreliable.

Though there are interesting sources for postmortem forensic toxicology analysis beyond the standard blood, urine, and vitreous humor, it's largely concluded that these are subpar sources, as they generally provide minimal to no quantitative information, which is necessary in postmortem forensic evaluation in determining a cause of death. However, each source has unique aspects and advantages that may be expanded upon in studies for their use, and all serve as a complementary source in toxicological analysis.

Williams, K. & Pounder, D. Site to site variability of drug concentrations in skeletal muscle. American Journal of Forensic Medicine & Pathology. Sept 1997, 18 (3), pp. 246-250

Barroso, M., Gallardo, E., Vieira, DN., Lopez-Rivadulla, M., & Queiroz, JA. Hair: a complementary source of bio analytical information in forensic toxicology. Bioanalysis. 2011, 3(1), pp. 67-79.

Pounder, D. Forensic entomo-toxicology. Journal of the forensic science society. July 1991, 31, pp. 469-471.