# Study of Sodium & Glucose levels in Cadaveric Synovial Fluid to Estimate Post-Mortem Interval

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**Abstract**

An indicator "Time of death" is very pertinent for the investigating agency to initiate the scrutiny regarding the death and ultimately to connect the criminal with crime. Estimation of sodium and glucose in synovial fluid obtained from knee joint of 123 cadavers revealed not significant changes in concentration of sodium and glucose with increase in time since death.

**Keywords**

Synovial fluid, Glucose, Sodium, Post-mortem interval.

**Introduction**

One of the most important questions at any forensic autopsy that until now has not been answered satisfactorily is the exact moment of death. To determine the exact moment of death in medico legal cases is not possible since post-mortem changes in the dead body are variable and often misjudged1, 8, 11.

Since many years, Forensic pathologists have tried hard to solve this problem by developing a method that would permit the determination of post-mortem interval with more precision. However the result of all these often vary, extensive studies shows clearly that moment of death can only be fixed within certain limits of probability. For example time since death, can be calculated from taking into consideration many factors like the classical triad (rigor mortis, PM lividity, and post-mortem cooling) changes in eyes, contents of stomach and bladder, greenish discoloration of right iliac fossa and modified form of decomposition like adipocere and mummification.

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No doubt, by these methods post-mortem interval can be measured in a scientific manner, but none of the parameters are either singly or collectively reliable in measuring exact post-mortem interval 9.

Various authors have studied different aspect of post-mortem chemistry with conflicting and inconclusive results. As synovial fluid is more protected and less prone to burns or atmospheric variations in comparison to other body fluids such as CSF and blood. It was thought that the post-mortem chemistry of synovial fluid might be helpful in estimating post-mortem interval with much desired accuracy 12, 14.

The aim of present study was to estimate post-mortem interval by sodium and glucose levels in joint fluid, to get hints for the reliability and to establish reference values for synovial fluid. Therefore in 123 cases with known post-mortem interval synovial fluid was taken and analyzed for sodium levels on flame photometer and analysis of glucose levels in synovial fluid by glucose oxidase method and the result showed not significant changes in sodium and glucose concentration with increase in post-mortem interval. Cause of death and age had insignificant effect on changes in sodium and glucose concentration in cadaveric synovial fluid 7, 13.

**Material & Method**

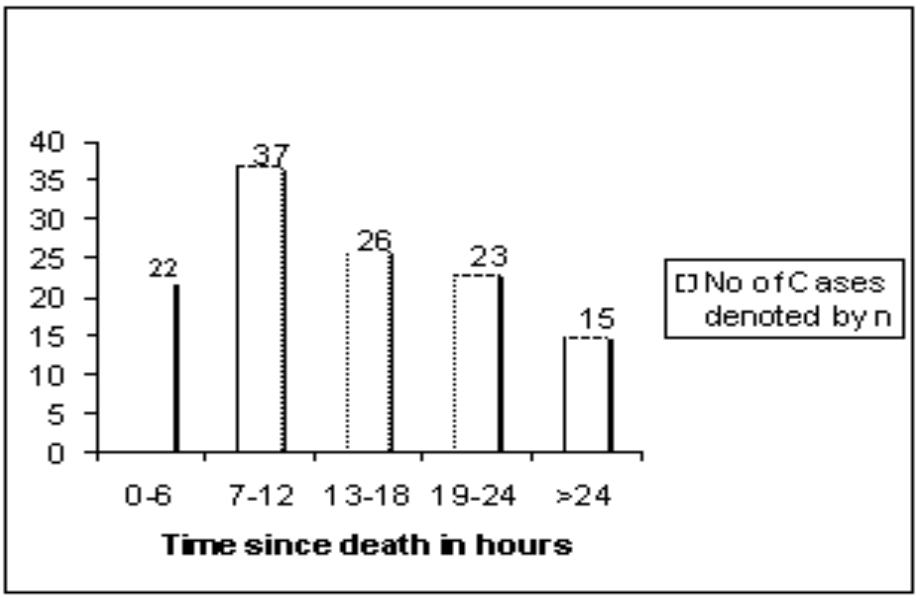
In the present study synovial fluid was aspirated from the knee joint by standard procedure as per adopted by D. J. U. Plesis 12 (1975) of 123 cases with known time since death who were subjected to medico legal autopsy in the mortuary of Department of Forensic Medicine and toxicology at Mahatma Gandhi Institute of Medical Sciences, Sevagram during the period of one year from Jan 2004–Dec 2004. Conditions for exclusion were, dead bodies, which were kept in cold storage, cases of injury to knee, infective conditions of joints (Rheumatism, arthritis etc.) and of unknown

time of death were discarded. Samples, in which synovial fluid was cloudy, bloody, yellow to greenish cloudy, turbid and hemorrhagic in nature were discarded. The synovial fluid was won by puncturing the Supra-patellar pouch. The viscosity of synovial fluid made aspiration some times complicated but mostly enough fluid could be obtained (approximately 1 ml per knee). If immediate analysis was not possible, the fluid were stored at 4 0 C for analysis on the very next working day. Prior to analysis, fluids were centrifuged for 10 minutes at 3500 rpm, samples of synovial fluid were analysed for sodium (Sodium ion by flame photometer in EEL flame photometer (model no ELCO26D) and glucose by glucose oxidase method using Erba glucose diagnostic kit Germany. The data so collected was analyzed statistically.

**Observation**

The post mortem interval ranged from 0 – 48 + hrs, the cases were classified according to the time interval since death (figure 1) firstly it can be stated that examination of parameters was possible with the collected material.

**Fig.1 absolute no. of cases are denoted by n; the x axis means the post-mortem interval or time since death**




Out of total 123 cases examined, 82 cases were males and 41 females. Age distribution varies from 6-76 years. Maximum no. of cases i.e. 27 were observed in the age group of 20-29, whereas only 2 cases were available in 1-9 years of age group. Detailed distribution of age, sex is shown in table 1.

**Table No 1: Age and Sex distribution.**

**Table 2: Distribution of cases regarding cause of death.**

| Sr. No | Cause of death | No. of cases. |
|---|---|---|
| 1 | Mechanical injuries | 48 |
| 2 | Poisoning | 23 |
| 3 | Natural causes | 25 |
| 4 | Asphyxia | 9 |
| 5 | Thermal injuries | 18 |
| | **TOTAL** | **123** |

As per table no 2, it is obvious that maximum no of cases i.e. 48 died due to mechanical injuries, 23 due to poisoning, 25 due to natural causes, 18 died due to thermal injuries, while minimum no of cases i.e. 9 died due to asphyxia.

**Table 3: The Descriptive statistical analysis of Variable (ANOVA) Sodium**

| ANOVA Sodium | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ***df*** | ***SS*** | ***MS*** | ***F*** | ***Significance F*** | | | |
| **Regression** | 1 | 280.89716 | 280.89716 | 2.4429313 | 0.1206671 | | | |
| **Residual** | 121 | 13913.022 | 114.98365 | | | | | |
| **Total** | 122 | 14193.919 | | | | | | |
| | ***Coefficients*** | ***Standard Error*** | ***t Stat*** | ***P-value*** | ***Lower 95%*** | ***Upper 95%*** | ***Lower 95.0 %*** | ***Upper 95.0%*** |
| **Intercept** | 11.441383 | 2.9938035 | 3.8216879 | 0.0002108 | 5.514359 | 17.368406 | 5.514359 | 17.36841 |
| **X Variable** | 0.0441633 | 0.0282557 | 1.5629879 | 0.1206671 | -0.0117763 | 0.1001029 | 0.0117763 | 0.100103 |

**Table 4: The descriptive statistical analysis of variable (ANOVA) Glucose.**

| ANOVA Glucose | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ***df*** | ***SS*** | ***MS*** | ***F*** | ***Significance F*** | | | |
| **Regression** | 1 | 306.9167 | 306.9167 | 2.674222 | 0.104584 | | | |
| **Residual** | 121 | 13887 | 114.7686 | | | | | |
| **Total** | 122 | 14193.92 | | | | | | |
| | **Coefficients** | **Standard Error** | **t Stat** | **P-value** | **Lower 95%** | **Upper 95%** | **Lower 95.0 %** | **Upper 95.0 %** |
| **Intercept** | 23.62829 | 4.841635 | 4.880229 | 3.27E-06 | 14.043 | 33.21358 | 14.043 | 33.21358 |
| **X Variable** | -0.1062 | 0.06494 | -1.6353 | 0.104584 | -0.23476 | 0.022369 | -0.23476 | 0.022369 |

**Fig. 2 Scatter diagram depicting the relationship in Sodium level and time since death (PMI).**

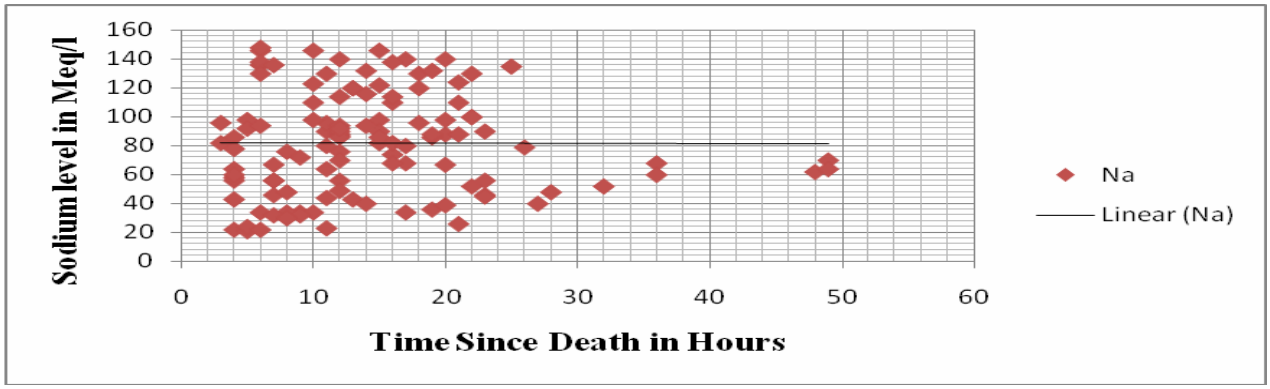



**Fig. 3. Scatter diagram depicting the relationship in Glucose level and time since death (PMI).**


As seen from the scatter diagram it is observed that there is no linear relationship exists between glucose, sodium and time since death. The attempt was made to look for any relationship present, in mathematical form by applying regression analysis. Sodium and Glucose do not have any positive correlation with time lapse and hence no definite formulae or equation could be evolved in relation to estimate time since death.

**Discussion**

In many medico legal cases, there is need to know the approximate time of death. Exact chronologies of post-mortem changes do not and cannot be expected to exist. Therefore, there is need for laboratory test, which is simple and yet can provide a dependable range of accuracy. There has been persistent endeavour to arrive at a conclusion with a reasonable accuracy by applying different method available at hand at different times 6.

While age-old conventional methods of changes, holds good for estimation of time of death during routine medico legal autopsies, newer methods are being explored until today. The post-mortem chemical examination of body fluid is restricted to compartment which are not as much exposed to autolysis and putrefaction as blood 3, 11. Another possible compartment is the joint cavity of the knee from which synovial fluid can be taken out in sufficient quantity by puncturing the joint.

The study of various parameters in synovial fluid by Moro D.S and Arryo M. C; 1985, like glucose, urea, nitrogen, uric acid, total protein, albumin, alkaline phosphatase, lactic acid dehydrogenase and GOT in relation to cause of death and observed that biochemical parameters of synovial fluid were modified although this modification is related more directly to the duration of pathological process that leads to death than with the nature of the process itself.

Burkahrd Madea et al (2001) studied both synovial fluid and vitreous humour, aim was to compare in both fluid. Potassium, natrium, chloride, calcium, creatinine, glucose, urea were analyzed, potassium concentration in synovial

fluid showed little bit higher than vitreous humour but both compartment fluid showed an increasing potassium concentration in a nearly parallel course.

Sahoo P.C; 1998 studied on 84 cases and showed synovial potassium a steady rise up to a maximum 48 hours of death.

We tried to study and correlate the effect of age, sex, cause of death over concentration of glucose and sodium in relation with time since death. We concluded that there is no effect of age, sex and cause of death over concentration of glucose and sodium ion with time since death ($P>0.06$, $P>0.05$)

**Conclusion**

The level of sodium and glucose in cadaveric synovial fluid has irregular change with increase in time since death and there is no significant correlation exist for sodium and glucose in relation to time since death and no definite equation could be evolved with no effect of age, sex and cause of death over concentration of glucose and sodium ion with time since death.

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