The Pseudo Pelger-Huët Cell as a Retrospective Dosimeter: Analysis of a Radium Dial Painter Cohort

R. E. Goans (MJW Corporation)
R. E. Toohey (M.H. Chew and Associates)
C. J. Iddins (REAC/TS)
N. Daniak (REAC/TS)
S. L. McComish (USTUR)
S. Y. Tolmachev (USTUR)

“Learning from Plutonium and Uranium Workers”
Pelger-Huët Cell – Permanent Biodosimeter
Pelger-Huët Anomaly

• The Pelger-Huët anomaly (PHA) was first described by Karl Pelger in 1928, and defined as an autosomal dominant trait by G.J. Huët in 1931.

• The PH cell, mostly seen in neutrophils, is characterized by round, oval, bean–shaped or symmetric bilobed nuclei which are joined by a thin filament of chromatin or mitotic bridge.

• PHA is caused by a decreased amount of the lamin B receptor (LBR). The B-type lamins are the building blocks of the nuclear lamina (NL).

• The LBR gene is known to be located on the long arm of chromosome 1, 1q42.12.
Pelger-Huët Anomaly

- Recently the pseudo-Pelger Huët anomaly (PHA) in peripheral blood neutrophils was described as a new radiation-induced, stable biomarker (Goans et al. Health Phys 108(3), 2015).

- Using archival peripheral blood slides obtained from patients in the 1958 Y-12 criticality accident, we showed that the pseudo-Pelger Huët anomaly (PHA) in neutrophils is a new radiation-induced biomarker.

- From that work there is good evidence that PHA is a permanent biomarker (up to 17 years), making the cell potentially useful in retrospective dosimetry.
PHA in Y-12 patient A; 4.61 Gy-Eq; 17 June 1958, 19 h post accident
In this study, we have examined PHA in peripheral blood slides from a cohort of 166 former radium dial painters, 35 of whom had zero marrow dose.

The slides were made available in collaboration with the US Transuranium and Uranium Registry (USTUR).

Members of the radium dial painter cohort had ingestion of $^{226}\text{Ra}$ and $^{228}\text{Ra}$ at an early age (average age $20.6 \pm 5.4$ y; range 13-40 y) during the years 1914-1955.

Exposure duration ranged from 1-1820 weeks with marrow dose 1.5-6787 mGy. The peripheral blood slides were prepared 1960-1965 and 1970-1975 during medical follow-up.
RDP 09-064
Started 1916; exposed for 9 weeks
USTUR Radium Dial Cohort

$\text{Marrow Dose, mGy} \\
\text{Pelger Huet Percentage}

r^2 = 0.71

61st HPS Meeting - USTUR: Five Decade Follow-up of Plutonium and Uranium Workers
USTUR Radium Dial Painter Cohort
Sarcoma (n=5) and Nasal Carcinoma (n=1)

$r^2 = 0.77$
USTUR Radium Dial Painter Cohort
Sarcoma (n=5) and Nasal Carcinoma (n=1)

$\text{r}^2 = 0.91$

![Graph showing the relationship between Pelger Huet percentage and marrow dose. The graph includes data points with error bars and a trend line. The correlation coefficient is $\text{r}^2 = 0.91$.](image)
Fit to Sarcoma Data

Linear fit \( r^2 = 0.77 \)
Sigmoid fit \( r^2 = 0.91 \)

Evidence for a threshold effect
Bone sarcoma in Radium dial painters

Linear scale

Log scale

Bone sarcoma in Radium dial painters
Conclusion

• PHA from peripheral blood is therefore a reasonable dose surrogate to evaluate historic alpha dose to bone marrow.