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Comparison of ^{241}Am Organ Activity from Radiochemistry and Direct Measurements

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BUSINESS SENSITIVE

USTUR

- The mission of the USTUR is to study the uptake, translocation and retention (biokinetics) and tissue dosimetry of uranium, plutonium, americium, and other actinides in occupationally exposed humans (workers), ...and to serve as a national and international resource for testing and improving the application of excreta monitoring and other contemporary bioassay data to predict tissue dose rates measured at autopsy.

In Vivo Radiobioassay and Research Facility

- Provides facility, equipment, and technical expertise for direct radiobioassay measurements primarily in support of operations at the Department of Energy Hanford Site.
- Includes capability for measurement of plutonium, uranium, americium, and other actinides in the body
- Located in close proximity to USTUR facilities



Synergistic Collaboration

- Battelle and USTUR have long standing collaboration
- In vivo and post mortem organ measurement results to complement radiochemistry analytical results
- Unique opportunity to evaluate the real world accuracy of in vivo measurement results

Work in progress

- Four cases with radiochemistry results and direct measurement results
- All male subjects, lived into their 80's
- Inhalation and wound intakes
- Radiochemistry methods URL:
 - <http://www.ustur.wsu.edu/PolicyProcedures/RadChemProcedures.html>

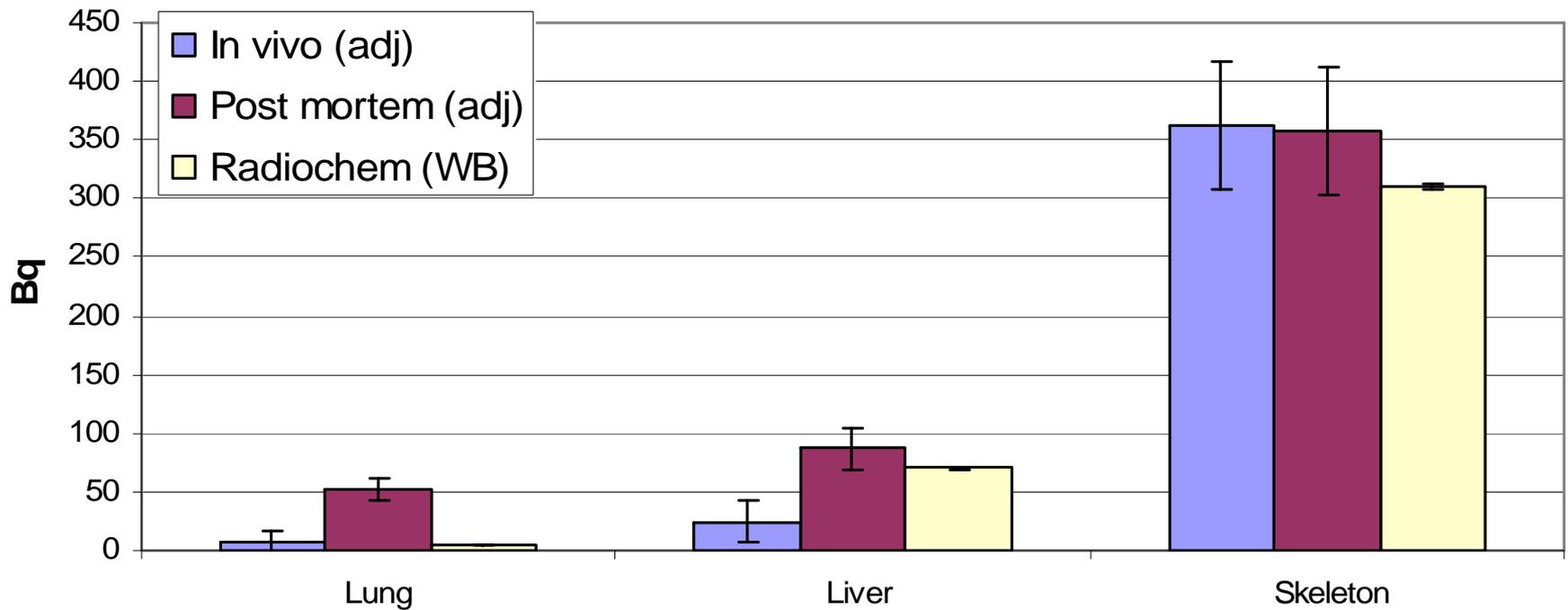
Estimating Organ Activities

- Direct measurements
 - Liver and lung Bq based on torso phantom calibration with uniform activity distribution
 - Skeletal Bq based on USTUR Case 0102 phantoms
 - Cross talk adjustments based on Case 0102 and torso phantom calibrations
- Radiochemistry
 - Total lung Bq from analysis of right lung
 - Skeletal Bq from analysis of half skeleton or patella
 - Total liver Bq from ~600 g sample

Case 0269

- Intake occurred in 1956
- Pu nitrate aerosol
- Received chelation therapy over 5 year period
- In vivo counts over years through 1987
- Died in December 1994
- Post mortem counts done in December 1994
- Radiochemistry done in January 1999

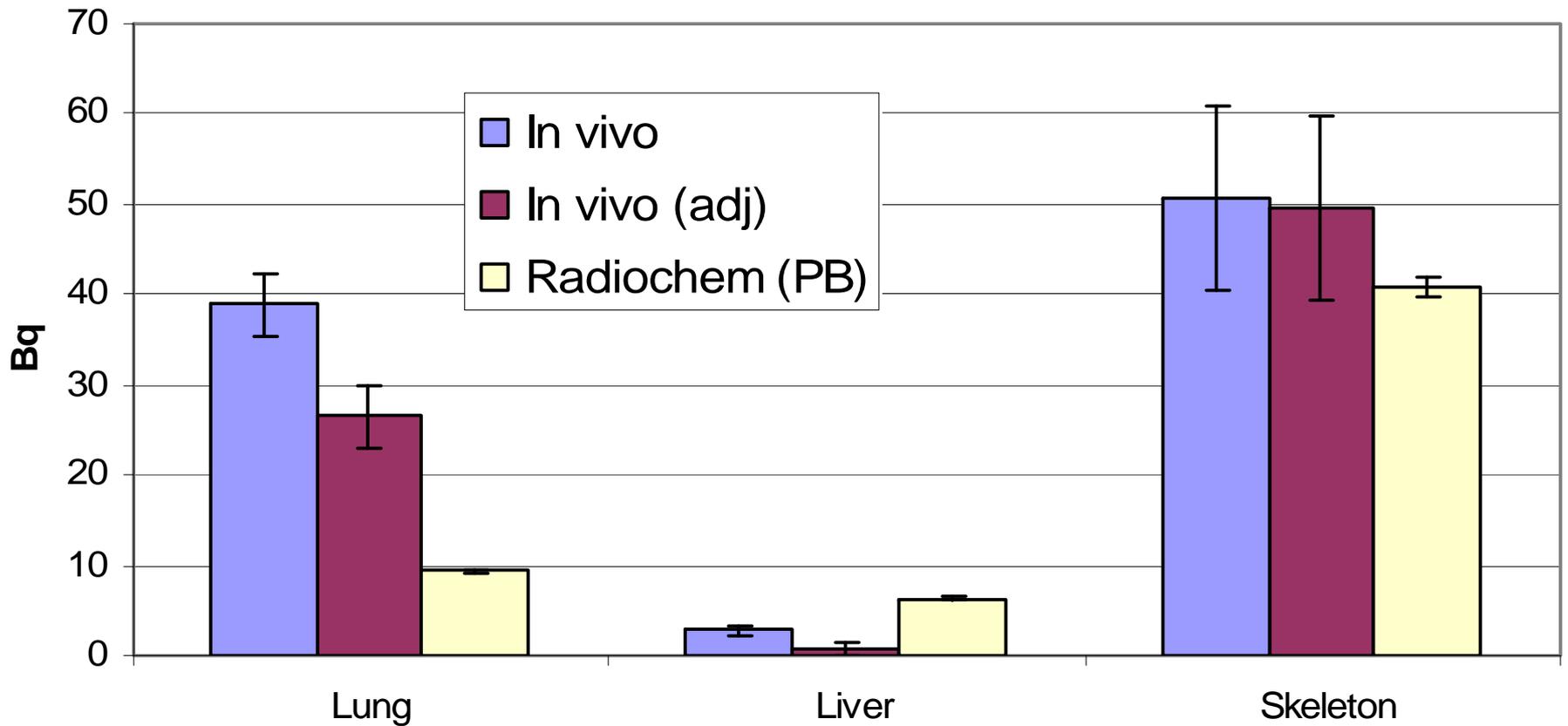
USTUR Case 269 ²⁴¹Am Organ Activity



USTUR Case 0271

- Puncture wound to left index finger in November 1967, other potential intakes from 1959-1967
- Pu oxide
- In vivo data from 1994-5
- Died in March 2002
- Radiochemistry in November 2003

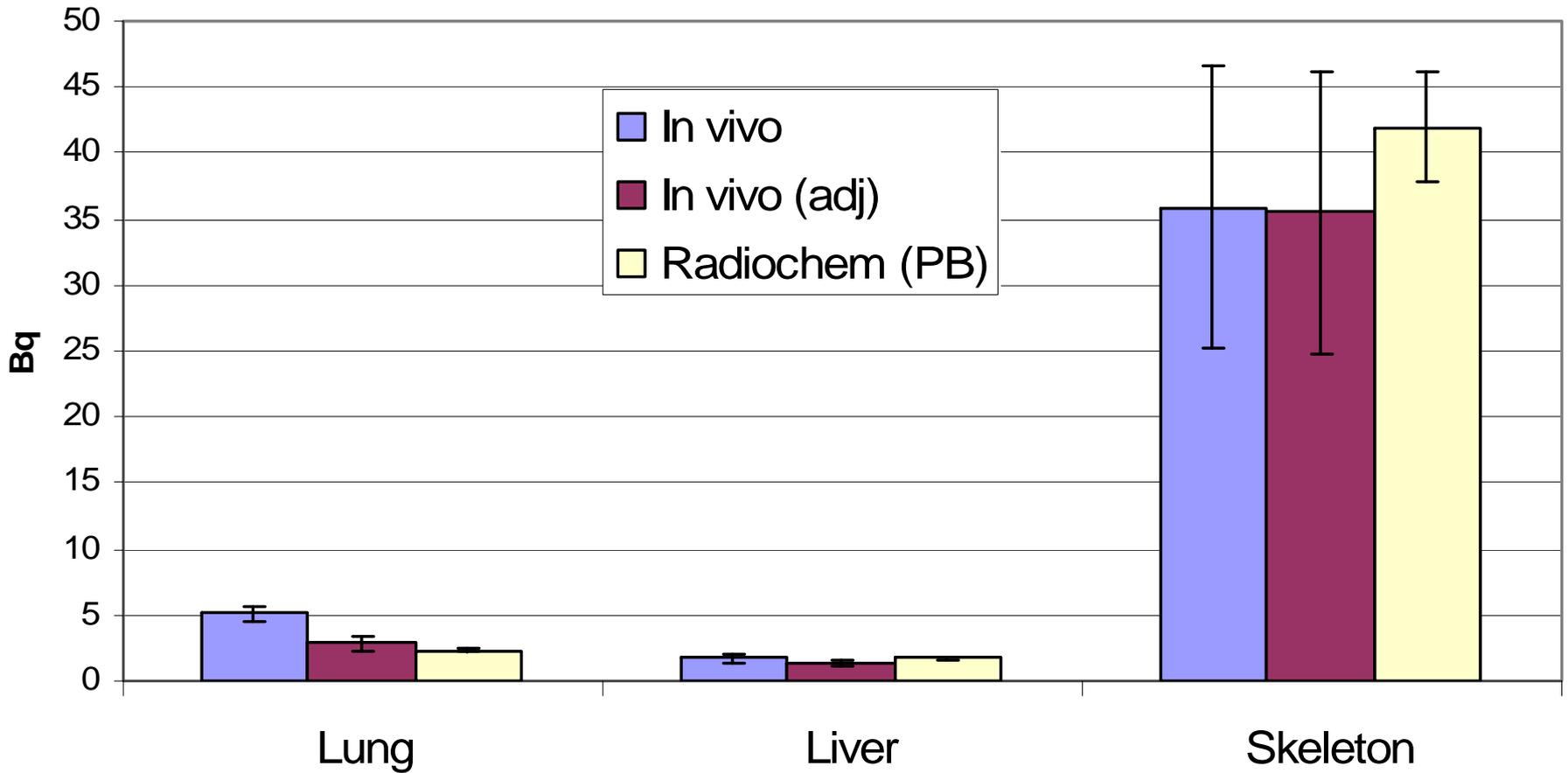
USTUR Case 0271 ²⁴¹Am Organ Activity



USTUR Case 0299 ^{241}Am Organ Activity

- 1948 systemic deposition of 167 Bq Pu based on urine sample
- Inhalation in June 1956; 18 Bq systemic deposition
- Other potential inhalation intakes in 1970 and 1972
- Inhalation in 1976, 22 Bq ^{241}Am systemic deposition
- In vivo measurements in September 1995
- Died in July 2000
- Radiochemistry in March 2002

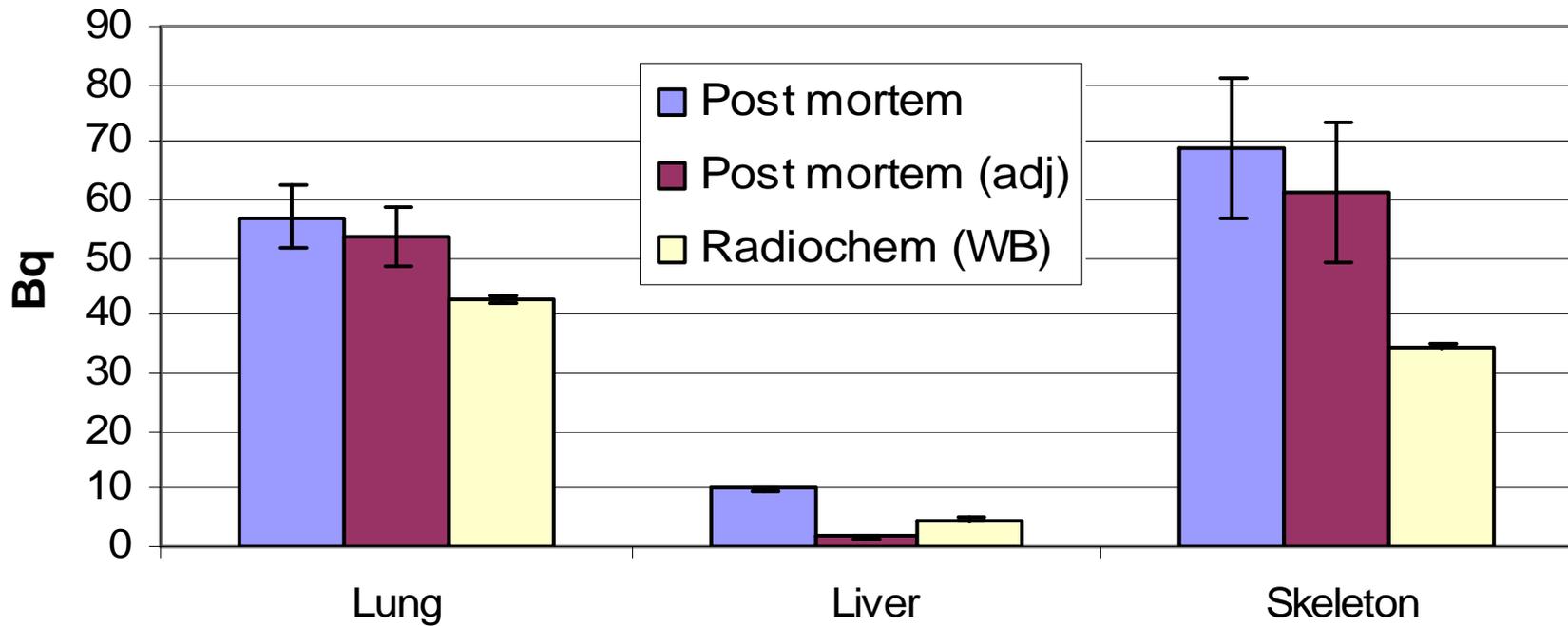
USTUR Case 0299 ²⁴¹Am Organ Activity



USTUR Case 0720 ^{241}Am Organ Activity

- Primary acute inhalation intake - August 1961, intakes via puncture wounds & inhalation - 1960s
- Died in February 2005
- Post mortem measurements February 2005
- Radiochemistry August 2007, lung activity includes TBLN

USTUR Case 0720 ^{241}Am Organ Activity



Ratio of Direct to Radiochemistry

Case 269

	<u>In vivo/rc</u>	<u>Post mortem/rc</u>	<u>Case 0271</u>	<u>Case 0299</u>	<u>Case 0720</u>
Lung	1.40	10.16	3.87	1.23	1.24
Liver	0.34	1.23	0.12	0.81	0.33
Skeleton	1.17	1.15	1.22	0.85	1.78

Observations

- Lung estimates from direct measurements generally greater than radiochemistry results; good agreement in 3 cases
- Skeletal estimates from direct measurements generally exceeded radiochemistry results but within 20%
- Direct measurement estimates of liver activity generally lower than radiochemistry results, good agreement in two cases
- Overall, good agreement for the low activity levels measured with some significant variability

Sources of uncertainty

- Activity distribution in organ vs. phantom
- Differences between phantom and subject (e.g. CWT, size, shape, composition)
- Accounting for cross talk from other organs & tissues
- Extrapolation from sample to organ activity
- Time between direct measurements and radiochemistry

Future work

- Publish comparison results
- Evaluation of results from several more cases
- Divide lung and liver into multiple samples to estimate activity distribution from radiochemical analyses
- Look at Pu data in addition to the Am data
- Best bone extrapolation