

# Radiochromated Erythrocytes in Gastrointestinal Tract

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# History

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- Successful labelling of red blood cells
  - Sterling and Gray in 1950
  - Using  $\text{Na}_2^{51}\text{CrO}_4$
- Demonstrated good binding of RBCs and little radioactive chromium in plasma

# THE TAGGING OF RED CELLS AND PLASMA PROTEINS WITH RADIOACTIVE CHROMIUM<sup>1</sup>

By SEYMOUR J. GRAY AND KENNETH STERLING<sup>2</sup>

J Clin Invest 1950

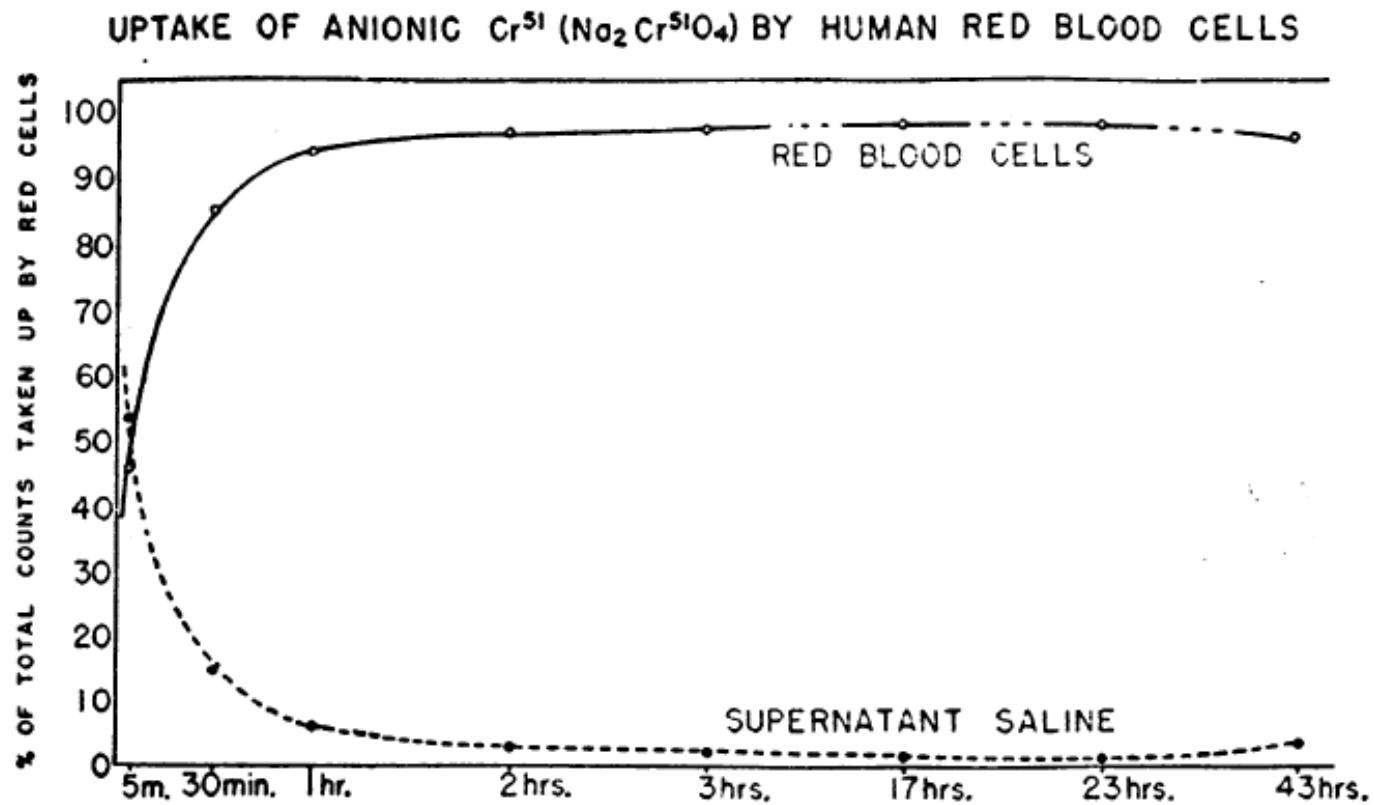


FIG. 1a

# History

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- Successful labelling of red blood cells
  - Sterling and Gray in 1950
  - Using  $\text{Na}_2^{51}\text{CrO}_4$
- Demonstrated good binding of RBCs and little radioactive chromium in plasma
- Several subsequent follow-up studies to
  - Improve techniques
  - Evaluate loss of chromium from RBCs

# Potential Problems

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- Collection of all stool samples
- Patients with long transit times
- Avoidance of interfering behaviours
- Separating stools from urine
- Suitable methods for measuring radioactivity in blood and urine

# GASTRO-INTESTINAL BLOOD LOSS MEASURED BY RADIOACTIVE CHROMIUM

BY

A. D. CAMERON

- Describe a simple, inexpensive, relatively odorless technique which is sensitive at low levels of faecal radioactivity

# GASTRO-INTESTINAL BLOOD LOSS MEASURED BY RADIOACTIVE CHROMIUM

BY

A. D. CAMERON

collected in successive numbered cartons. Each stool is passed onto a square of cellophane paper placed in a bed pan under a portable commode. The cellophane-wrapped stool is then transferred to a 20-oz. waxed screw-topped carton. In the laboratory a small faecal sample is removed for chemical occult blood estimation. The stool is then dried in an electric oven, thermostatically controlled at 170°F. so that spattering does not occur; drying takes about 15 hours. The odour is eliminated by housing the oven in a fume cupboard containing an extractor fan.

The dried stool is then placed in a glazed glass mortar, the cellophane ashed by ignition, and the whole ground to a fine powder. Thorough mixing occurs during the grinding process. The powdered stool is weighed and a 10 g. aliquot packed in glass test tubes and counted in a well-type scintillation crystal. The aliquot averages 20%

# GASTRO-INTESTINAL BLOOD LOSS MEASURED BY RADIOACTIVE CHROMIUM

BY

A. D. CAMERON

- Describe a simple, inexpensive, relatively odorless technique which is sensitive at low levels of faecal radioactivity
- Daily loss in normal group 0.3 – 1.3 ml
- Very low chromium levels in plasma weeks after labelling (0.28% first 24 h and 0.3% subsequent period)



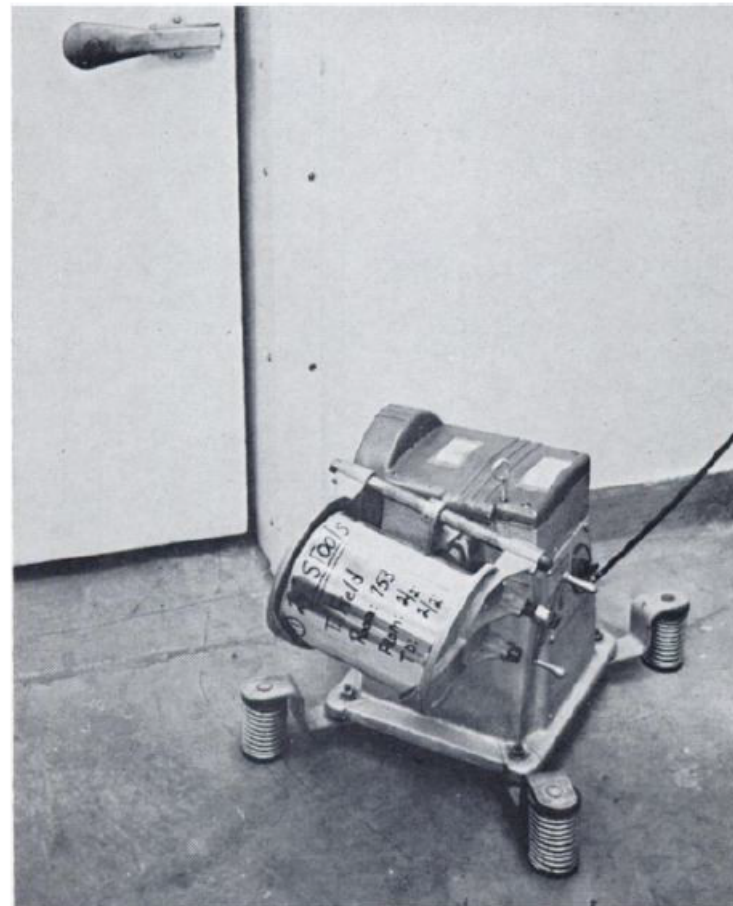
## Quantitation of Gastrointestinal Bleeding by Use of a Large Volume Scintillation Detector<sup>2,3</sup>

Earl T. Anderson, M.D.,<sup>1</sup> Mitchell Passovoy and Frank E. Trobaugh, Jr., M.D.<sup>2</sup>

JOURNAL OF NUCLEAR MEDICINE 7:612-619, 1966

chromium-51. There is general agreement that this method is the most reliable test for either detecting or quantitating gastrointestinal bleeding. However, none of these methods has enjoyed clinical acceptance. Most of the previously described methods have depended upon measuring the radioactivity of small weighed aliquots of stool homogenates in well-type scintillation counters. Elaborate manipulations and the troublesome and disagreeable tasks of handling stool specimens have made these techniques cumbersome, malodorous, and therefore unacceptable as standard diagnostic techniques. Other techniques utilized crystal scintillation detectors with unfavorable geometry which resulted in very low counting efficiency and/or poor counting reproducibility. This not only necessitated the use of complex calculations in correcting for geometric factors, but severely limited the sensitivity of the methods.

*Stool Collection and Assay:* All stools in a 24 hour period are passed directly into a new one gallon tin container positioned under the seat of a commode, taking care to exclude contamination with urine. To eliminate offensive odors and to avoid specimen loss, the containers are kept in a portable refrigerator



**Fig. 1.** Red Devil Paint Conditioner containing gallon tin container used for stool collection.

# **A Potential Error in the Quantitation of Fecal Blood Loss: Concise Communication**

Neil Chafetz, Andrew Taylor, Jr., Anne Schleif, John Verba, and C. W. Hooser

*Veterans Administration Hospital and University of California Medical Center,  
San Diego, California*

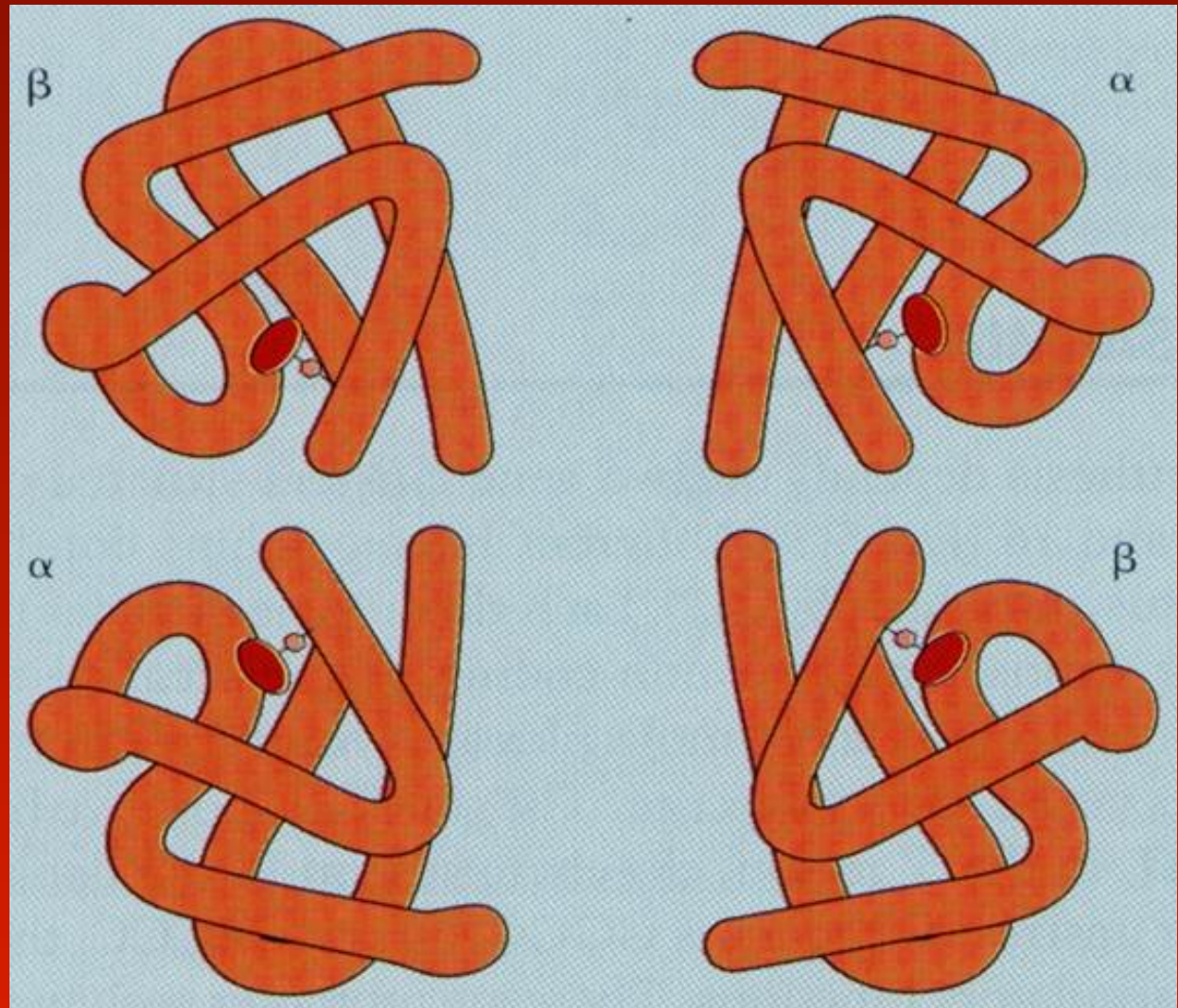
***Chromium-51-labeled red cells were used to quantitate fecal blood loss in a patient with chronic upper gastrointestinal hemorrhage. On Day 1, the stool guaiac was positive but the blood loss indicated by  $^{51}\text{Cr}$  was less than 1 cm<sup>3</sup>. Blood loss in the stool by  $^{51}\text{Cr}$  did not become significant until Day 3, when it measured 23 cm<sup>3</sup>. The failure to detect abnormal blood loss on Day 1, and probably on Day 2, appears to be due to a long intestinal transit time from a proximal bleeding site. The problem of slow intestinal transit is not uncommon and could lead to a false-negative study or falsely low estimates of fecal blood loss. This problem could be minimized by beginning stool collection on Day 3 or by delaying stool collection until the appearance in the stool of an oral nonabsorbable marker swallowed when the  $^{51}\text{Cr}$ -tagged red cells are injected.***

**J Nucl Med 17: 1053–1054, 1976**

# Labelling of RBC

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- Cr-51 linked to beta chain of globin portion of haemoglobin



# Labelled Red Blood Cells

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- Uses:
  - Blood volume determinations (red cell volume)
  - Red cell survival and -sequestration
  - Spleen scintigraphy
  - GIT blood loss

# Clinical Problem

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- Iron deficiency anaemia
- GI bleeding is the commonest cause of iron deficiency anaemia (men and post menopausal women)
- Often difficult to identify the cause
  - Stool testing may be negative
  - Endoscopy negative due to intermittent bleeding
  - Barium studies can overlook superficial lesions

# Clinical Problem

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- Use of radiochromated red cells as initial step to confirm blood loss is well established
  - More sensitive than chemical stool testing
  - Quantify blood loss
  - Low radiation dose

# Labelling RBC: Technique

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- Use ACD-A, not heparin – more rapid uptake in RBC
- Isolate RBC through centrifugation
- Mix Cr-51 carefully with RBC
- Stand for 30 min and mix frequently
- Wash with saline to remove plasma



# Labelled RBC for GIT bleeding

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- Initial studies: Stool collection for 4-5 days
- Up to 3 ml/day loss in stools accepted as normal
- Small spontaneous elution of chromium from RBC (~1%/day)
- This in form of chromic ion – cannot re-enter RBC
- Excreted in urine

# Adaption of technique

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- St John and co-workers: Investigated unexplained Fe-deficiency anaemia in 57 patients
- Stool collection for at least 10 days
- Occult GIT blood loss confirmed in 31 patients
- Further investigations lead to diagnosis in 17 of 31 patients

# Questions

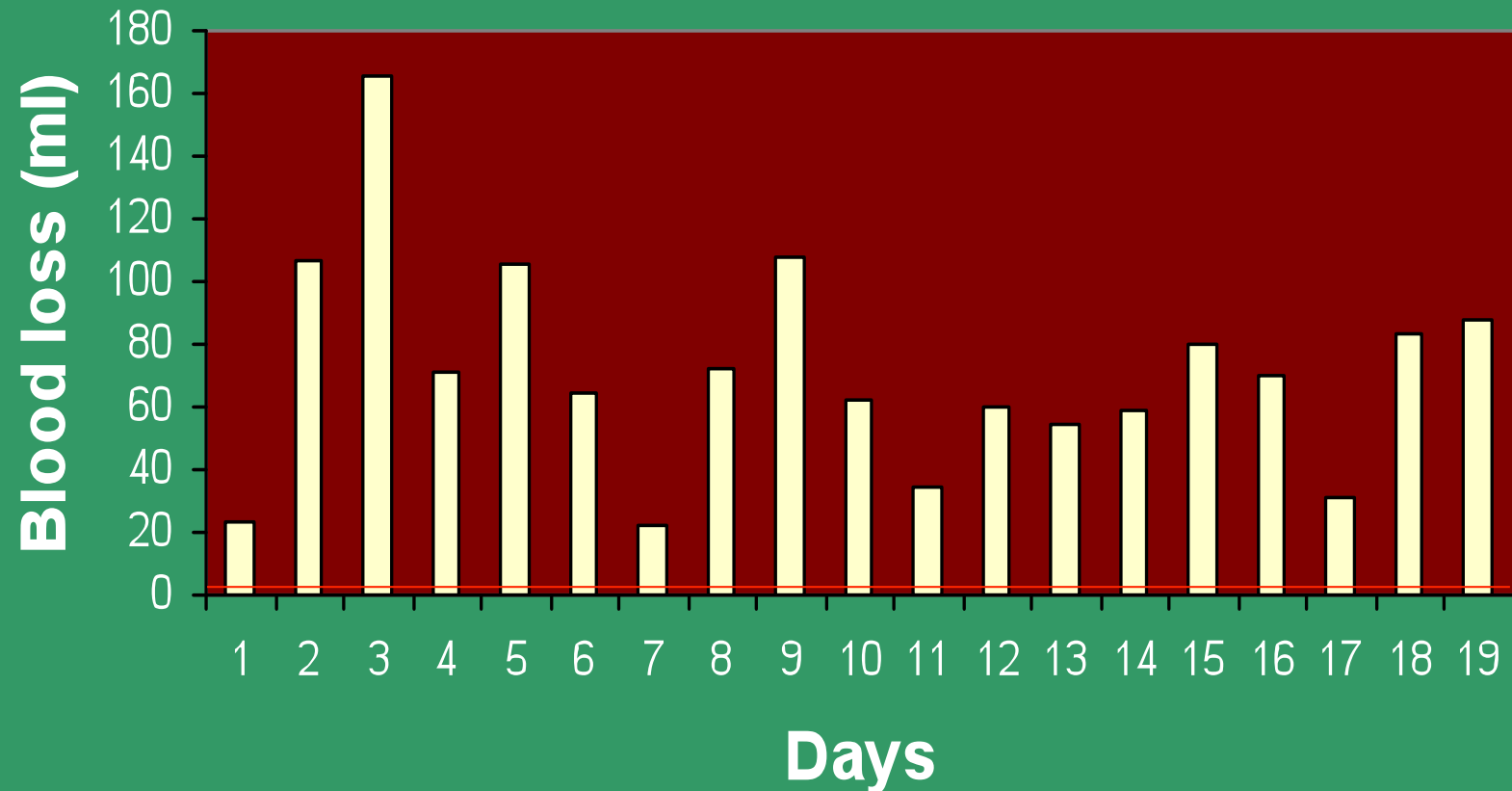
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- Use of extended Cr-51 RBC as quantitative tool to aid timing of bleeding study not well documented in literature
- If significant bleeding: Is there a place for use of Tc-99m RBC study to localise bleeding site?
- Can chromium labelled study be used to time Tc-99m RBC study?

# GIT Bleed

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## Cr-51 labelled red cell study



# Results

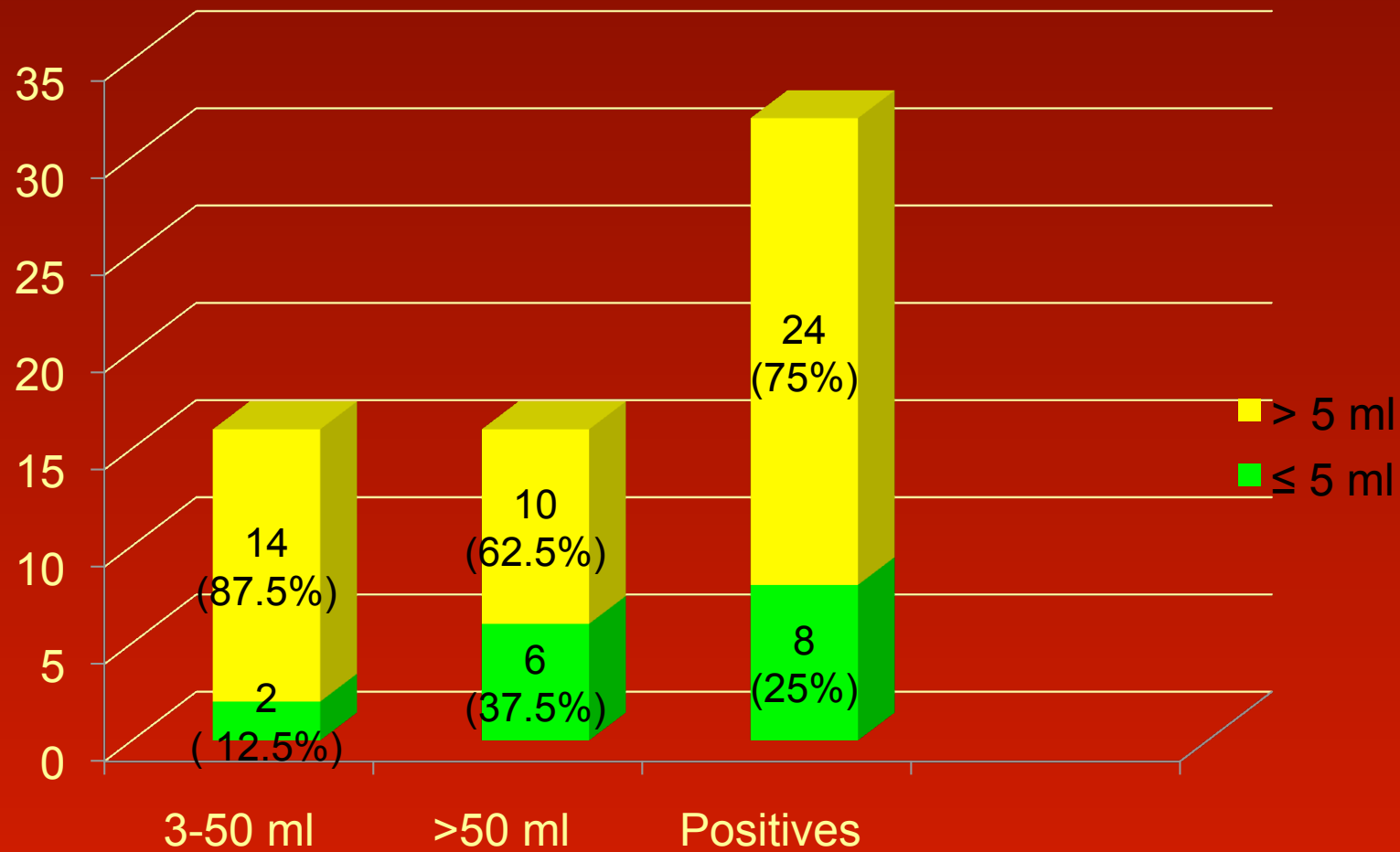
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Study	Result		
	Positive	Negative	Total
Cr-51 RBC	32 (54%)	27 (46%)	59

# Results

Cr-51 blood loss	3-50 ml		>50 ml	
	≤ 5 days	> 5 days	≤ 5 days	> 5 days
Number	2	14	6	10

# Extended Cr-51 RBC results



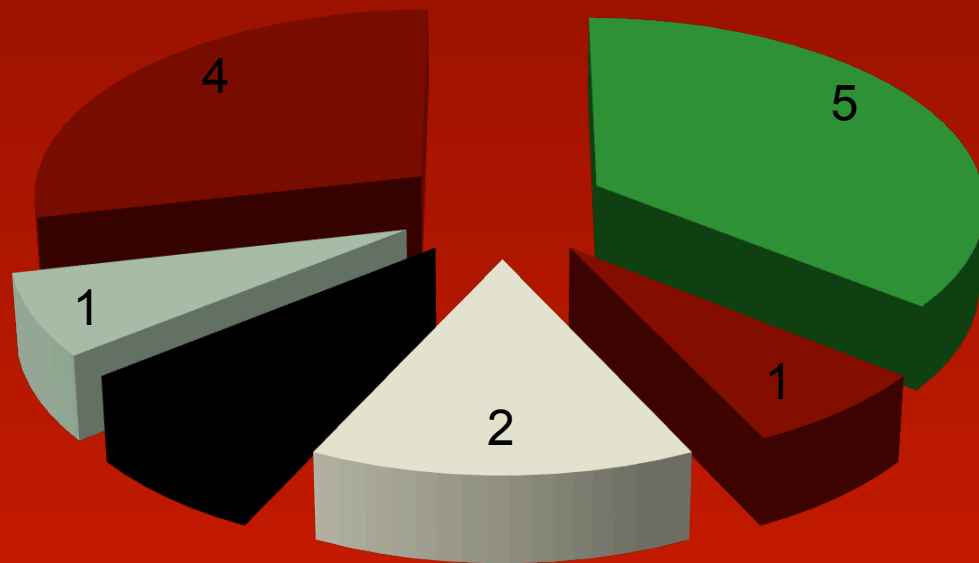
# Results

Blood loss	< 3ml (negative)	3 – 50ml	> 50ml
Cr -51 RBC	27 (46%)	16 (27%)	16 (27%)
Tc -99m RBC	Not performed	Performed in 3	Performed in 14
Positive	-	2	12
Negative	-	1	2
Localise	--	1	11



# Results

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- angiodysplasia 5 (50%)
- colorectal cancer 1 (10%)
- divericulitis 2 (20%)
- hiatus hernia 1 (10%)
- benign jejunal tumor 1 (10%)
- unknown

# Discussion

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- Use of extended Cr-51 RBC as a quantitative tool to aid timing of imaging bleeding study not documented in literature
- 54% of those tested had GIT bleeding
- By extending the period of Cr-51 RBC study, sensitivity of detecting GIT bleeding increased
- By using the cut-off of 50 ml, the likelihood of identifying and localizing a bleeding site was high.
- More research is needed to establish the value in bleeding < 50ml

# Acknowledgements

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- Radiographers performing the studies
- Dr Emmanuel Modebe