

The Battle of the MAG3s

A Smout¹, S Howell¹, P Hinton¹, A Fullbrook², J Hall²

1. Royal Surrey County Hospital, Guildford
2. Frimley Park Hospital, Camberley

Alexander Smout
Medical Physicist
a.smout@nhs.net

Royal Surrey County Hospital

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Introduction

- Historically, Mallinckrodt was the only supplier for MAG3 kits.



- In 2012, a QA failure on the vials led to a national shortage.
 - During this time, IEL were allowed to distribute a limited quantity of an alternative product (which is now fully available)

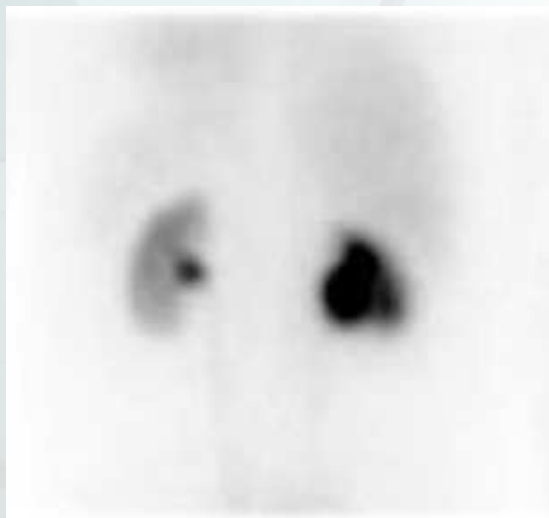
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Introduction

- We initially validated the radiopharmaceutical purity of the new MAG3 and accepted it as equivalent.
- However, after several hundred patients, one of our radiographers mentioned that liver visualisation seemed more common, which prompted a comparison of the two MAG3s.



MAG3 vs MAG3

TechneScan MAG3
manufactured by Mallinckrodt

VS

IEL-MAG3 (Previously NephroMAG)
manufactured by ROTOP

None of the authors have any conflicting interests.

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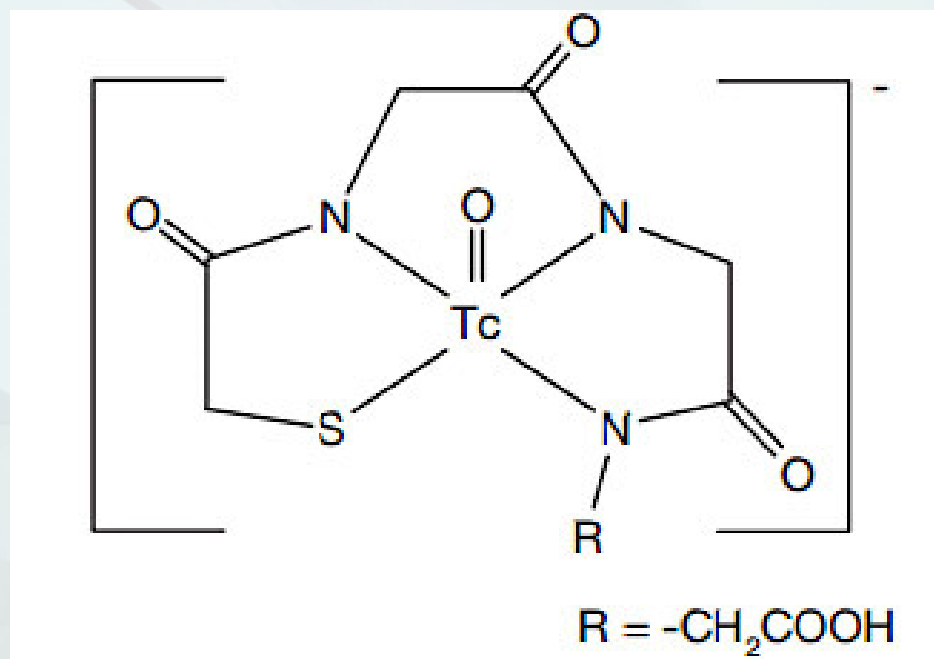
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Preliminary Observations

Technescan MAG3: $^{99\text{m}}\text{Tc}$ -**M**ercapto**A**cetyl**G**lycyl**G**lycyl**G**lycine

IEL-MAG3: $^{99\text{m}}\text{Tc}$ -**M**ercapto**A**cetyl**tri-G**lycine



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Preliminary Observations

- They may both be ^{99m}Tc -MAG3, but the kits and labelling techniques are markedly different
- There are obvious production and logistical differences:
 - One doesn't need boiling
 - One has a longer shelf time

TechneScan MAG3

- **Step 1 – Add ^{99m}Tc to cold kit**

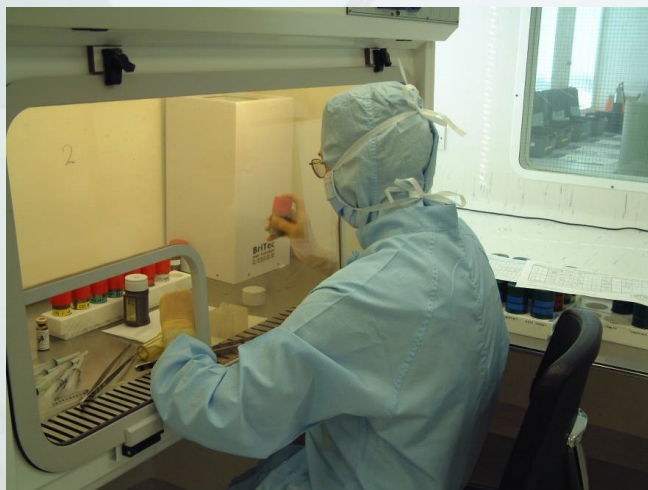
(At this point the ^{99m}Tc is not bound to the MAG3)

- **Step 2 – Boil the mixture for 10 minutes**

(The boiling process binds the ^{99m}Tc to the MAG3)

- **Step 3 – Cool the mixture for 10 minutes**

(To avoid injecting boiling hot liquid into patients)



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IEL-MAG3

- **Step 1 – Add ^{99m}Tc to alkaline kit**

(The alkalinity makes the ^{99m}Tc bind to the MAG3)

- **Step 2 – Add a second solution to neutralise the pH**

(To avoid injecting alkaline solution into patients)

- **Step 3 – pH test the final product**

(To avoid injecting alkaline solution into patients)



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Practicalities

Conventional (boil) TechneScan MAG3

- Boiling and cooling a product is time consuming in a busy radiopharmacy
- Short shelf life of 4 hours

These are conflicting things!

To prepare radiopharmaceuticals for delivery on time, the MAG3 had to be prepared first to allow time for boiling and cooling, which meant that the effective shelf life was further reduced.

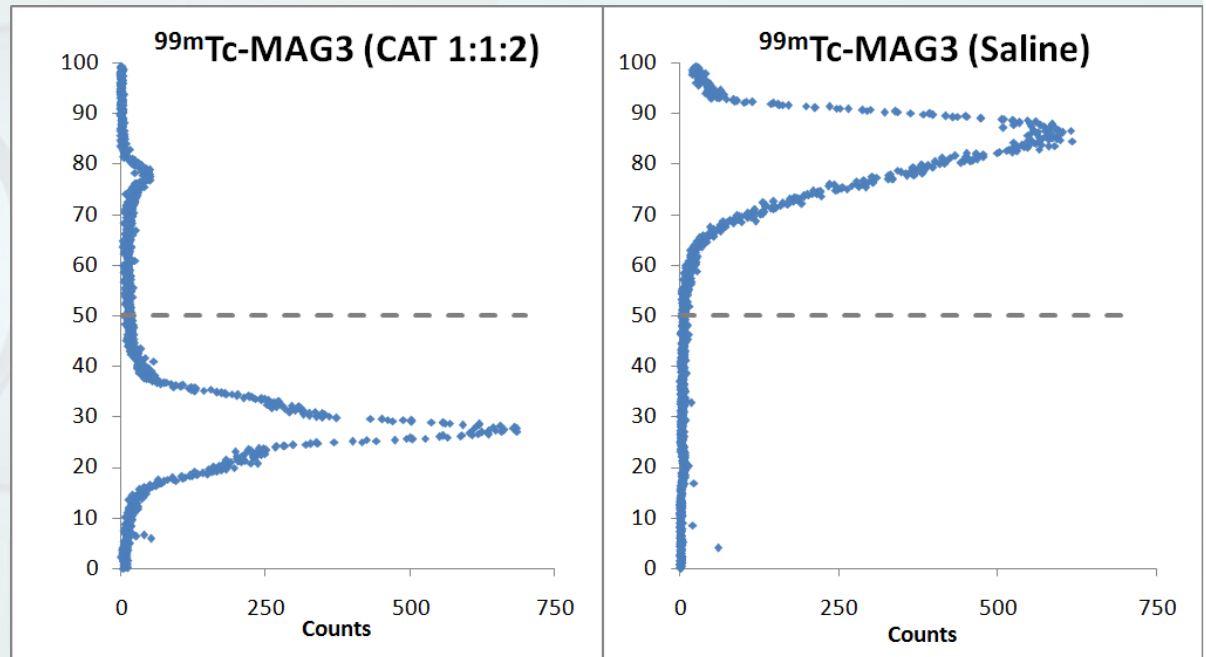
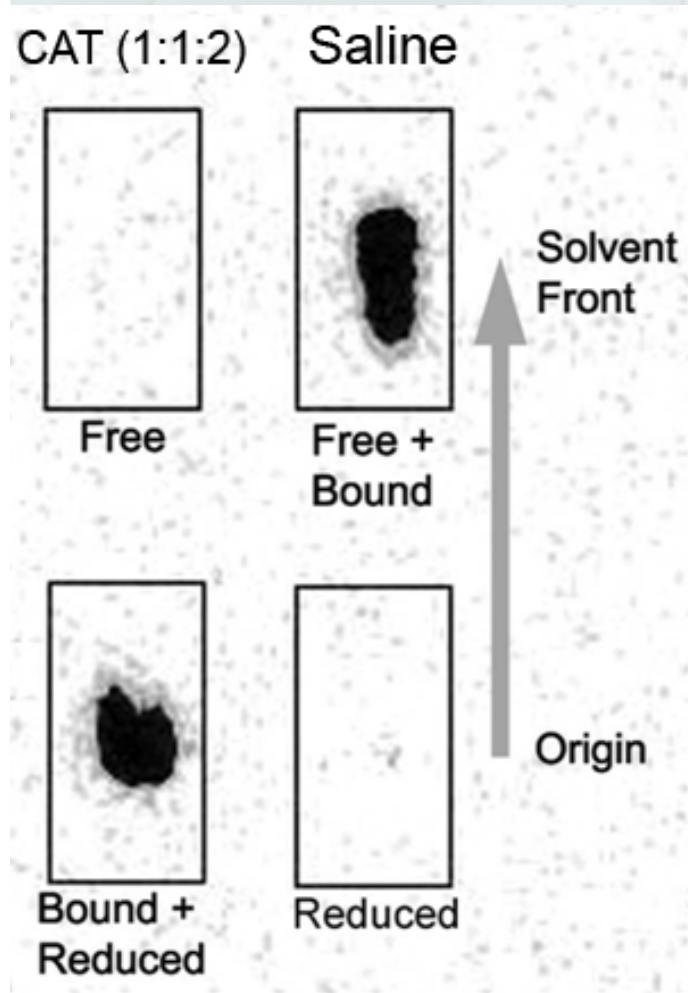
New (non-boil) IEL-MAG3

- Simpler to prepare
- Longer shelf life of 6 hours

This can be labelled later in the production run and takes less time so radiopharmaceuticals can be dispatched sooner

Radiopharmaceutical Purity Tests

Chromatography strips with CAT 1:1:2 and saline
(now quantified using an automatic scanner)



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Radiopharmaceutical Purity Tests

	TechnoScan MAG3	IEL-MAG3
# batches tested	10	7
Average Reduced Tc99m	0.5%	0.2%
Average Free Tc99m	1.1%	0.3%
Average Bound Tc99m	98.4%	99.5%

Statistical significance:

The two-tailed P value is 0.077

By conventional criteria, this difference is considered to be *not quite* statistically significant.

Clinical Comparison

Available data:

668 MAG3 scans at RSCH + Frimley Park Hospitals in 2011 to 2013

To reduce the effect of the many variables that are intrinsic to retrospective clinical comparisons:

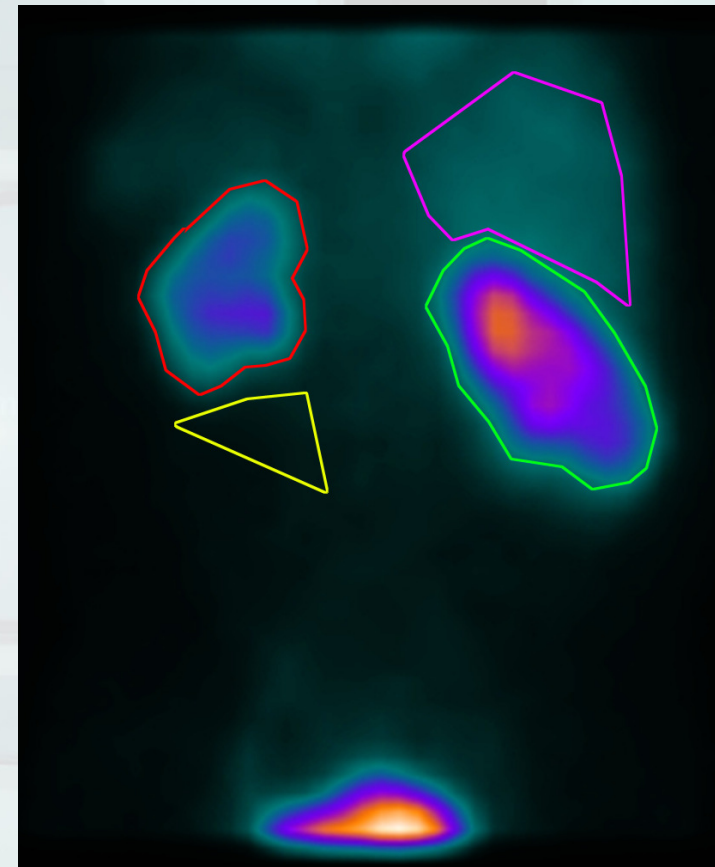
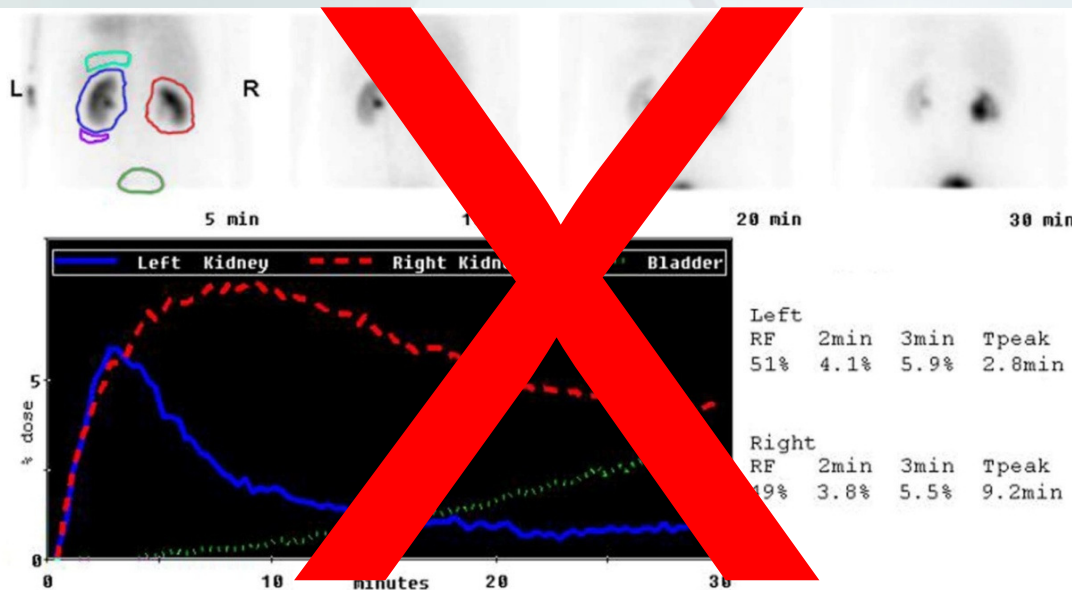
- Only patients that had scans with both MAG3s (in any order) within 12 months were included.
- Patients that had surgery between their scans were excluded

98 scans from 40 patients included in clinical comparison

Method in Clinical Audit

Too many variables when comparing renogram curves – needed a simple, consistent approach.

- Compared using ROI on post mict statics



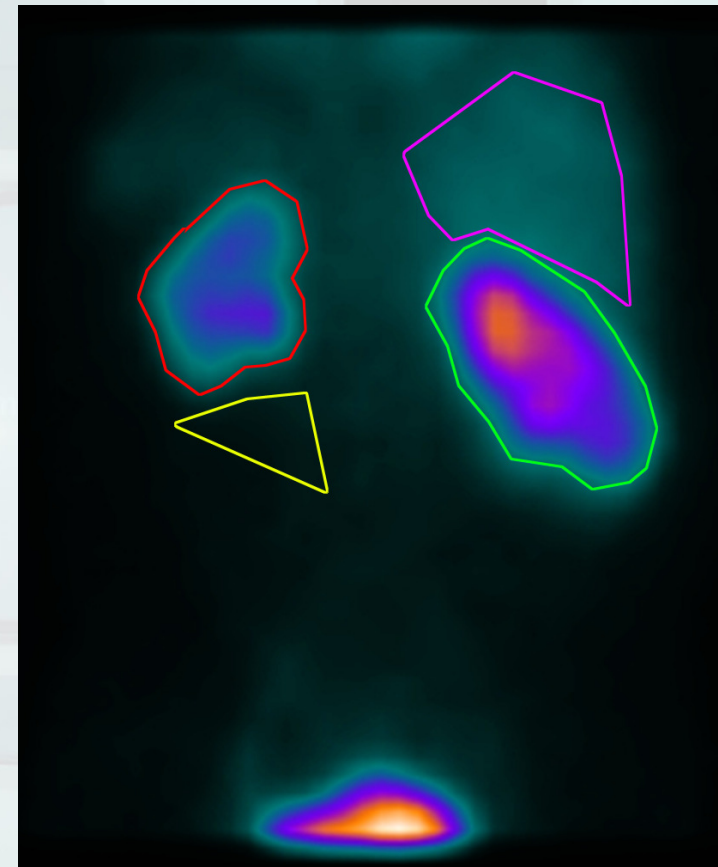
Method in Clinical Audit

Factors included

Kidney	}	retention after 1hr
Liver		
Tissue		
Left / Right differential function		

Not considered

Kidney uptake or clearance
Liver uptake or clearance
Furosemide usage
Clinical history (apart from surgery)
Administered activity



Clinical Audit

	TechneScan MAG3	IEL-MAG3
Absolute kidney retention	34.7 cts/px	33.5 cts/px
Absolute liver retention	10.4 cts/px	9.6 cts/px
Absolute BGD retention	4.9 cts/px	4.4 cts/px
Kidney to Background ratio	7.4 * BGD	7.6 * BGD
Liver to Background ratio	2.1 * BGD	2.1 * BGD

Statistical significance:

By conventional criteria, these differences are not statistically significant.

Conclusion

Both agents appear equivalent in terms of -

- Radiopharmaceutical purity
- Kidney, liver and background retention

Conventional (boil) MAG3

- Takes longer to prepare
- Short shelf life of 4 hours

IEL (non-boil) MAG3

- Much quicker to prepare
- Longer shelf life of 6 hours

