Gastrointestinal Haemorrhage Scintigraphy in Australia: Acquisition and Processing Parameters

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Geoffrey M. Currie, M MedRadSc, M AppMngt, CNMT
Lauren Moon, B AppSc
Janelle M. Wheat, B AppSc, M MedRadSc

School of Clinical Sciences, Charles Sturt University, Wagga Wagga, Australia.

Correspondence:
Geoff Currie
School of Clinical Sciences
Locked Bag 588
Charles Sturt University
Wagga Wagga 2678
Australia
Telephone: +61 2 6933 2822
Facsimile: +61 2 6933 2866
Email: gcurrie@csu.edu.au

Foot line: LGIH Scintigraphy in Australia

ABSTRACT

Introduction: Despite clear guidelines provided by the Society of Nuclear Medicine (SNM), there is no universally accepted consensus on acquisition and processing protocols for gastrointestinal haemorrhage scintigraphy. Moreover, there is anecdotal evidence to suggest strategies currently in use may be sub optimal, potentially contributing to decreased diagnostic utility of the procedure.

Methodology: The study was a self administered questionnaire of current protocol and procedures employed for scinitgraphic evaluation of acute LGIH across Australia. A structured questionnaire was employed in order to collect unambiguous answers for quantitative evaluation. The sampling frame included 136 Nuclear Medicine departments across Australia.Department identity remained anonymous.

Results: This survey indicated that in Australia only 38.5% (37/96) of departments satisfy the recommendations detailed by the SNM (95% CI: 28.5-48.5%) which represents only 45.3% (455/1005) of all studies performed (95% CI: 42.2-48.4%).

Conclusion: In Australia, less than 50% of studies evaluating LGIH in Nuclear Medicine are performed adequately. One might postulate that poor technique will decrease diagnostic utility and, thus, decrease demand for the procedure explaining, in part, the decreasing clinical utility of this excellent procedure.

Key words: *lower gastrointestinal haemorrhage, acquisition, processing, consensus, scintigraphy*

INTRODUCTION

Gastrointestinal haemorrhage can range from relatively benign to catastrophic.[1] While gastrointestinal haemorrhage can occur at any point along the gastrointestinal tract (GIT), it is generally characterised by its origin relative to the ligament of Treitz; superior being classified as upper gastrointestinal haemorrhage (UGIH) and inferior being classified as lower gastrointestinal haemorrhage (LGIH).[2] While the majority of gastrointestinal haemorrhage is of upper GIT origin, 20 per cent to 25 per cent of patients admitted with gastrointestinal haemorrhage are of lower GIT origin.[3,4]

There are currently three main options for detection and localisation of LGIH sites; colonoscopy, angiography and 99m-technetium (^{99m}Tc) scintigraphy.[2,3] There is no "gold standard" for assessment of LGIH due to the intermittent nature of the bleeding.[5] Scintigraphy is a safe, non invasive procedure with no associated morbidity.[6,7] Each year in Australia, approximately 350 and 400 ^{99m}Tc scintigraphy studies are performed for gastrointestinal haemorrhage.[8]

In Australia, only about 10 per cent of patients presenting with LGIH are investigated with Nuclear Medicine scintigraphy.[8,9] This is consistent with the 9.6 per cent of LGIH patients reported by Peter and Dougherty[10] to undergo ^{99m}Tc RBC scintigraphy. Improving this technique to provide earlier detection and more precise localisation of bleeding sites may facilitate

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its elevation to the "front line" diagnostic tool, filling the void left in the absence of a recognised "gold standard". Moreover, standardisation of the scintigraphic procedure may arrest the stagnant trend in annual procedure utilisation demonstrated per capita over the eight financial years up to June 2004 (zero per cent growth) which compares unfavourably with the 14.9 per cent increase in the utilisation of all Nuclear Medicine procedures for the same period.[8]

AIMS AND OBJECTIVES

Despite clear guidelines provided by the Society of Nuclear Medicine,[11] there is no universally accepted consensus on acquisition and processing protocols for gastrointestinal haemorrhage scintigraphy. Moreover, there is anecdotal evidence to suggest strategies currently in use may be sub-optimal, potentially contributing to decreased diagnostic utility of the procedure. This investigation may contribute to the collective knowledge of industry, providing justification or impetus to develop universal acquisition and processing strategies, reducing the non localisation rate and/or inaccurate localisation rate and decreasing potential cost, morbidity and mortality outcomes of inadequate diagnosis; extending advantage to patient and profession alike.

METHODOLOGY

The study was a survey of current protocol and procedures employed for scinitgraphic evaluation of acute LGIH across Australia. The study design utilised a self administered questionnaire to provide participant confidentiality. A structured questionnaire was employed in order to collect unambiguous answers for quantitative evaluation.

While non-response was considered from a number of perspectives, the impact of non-response in terms of the selected sampling frame on the external validity of the study was considered negligible because scintigraphic evaluation of acute LGIH is a specialised procedure infrequently performed in many Nuclear Medicine departments. The information being sought was less dependant on the raw compliance rate and more reliant on the representation of the total number of studies performed annually.

In August 2004, 136 questionnaires were sent to the Chief Technologists of each Nuclear Medicine department in the sampling frame. The sampling frame included all Australian departments accredited by the Australia and New Zealand Society of Nuclear Medicine (ANZSNM) in addition to those departments identified under a "nuclear medicine" search query of the online telephone directory. A reply paid envelope was included for the return of the completed questionnaire. Department identity remained anonymous since the questionnaire contained insufficient information to identify individual departments. Questionnaires were requested to be returned within four weeks of receipt.

The statistical significance was calculated using Chi square analysis for nominal data and Student's *t* test for continuous data. A Welch Anova *F* test was used for continuous data with unequal variances. The *F* test analysis of variances was used to determine statistically significant differences within grouped data. A *P* value less than 0.05 was considered significant. The difference between independent means and proportions was calculated with a 95 per cent confidence interval (CI). Confidence intervals without an overlap and/or those which did not include zero were considered to support a statistically significant difference while confidence intervals with an overlap and/or included zero represented differences for which chance could not be excluded as the cause.

RESULTS

At the completion of the four week data collection period 73 of the 136 questionnaires had been returned completed. Another two questionnaires were returned unopened with a postal notation that the addressee was unknown. Thus, a minimum compliance rate of 54.5 per cent (73/134) was determined. The 73 questionnaires represented the practices of 96 individual departments and, therefore, it is possible that compliance was as high as 71.6 per cent (96/134). Responder compliance of between 54.5 per cent to 71.6 per cent for a self administered postal questionnaire was considered an excellent response.

Demographic Data

Department demographics included 31.3 per cent (30/96) public hospitals, 27.1 per cent (26/96) private hospitals and 41.7 per cent (40/96) private clinics. The mean number of studies performed annually for the evaluation of LGIH was 10.5 per department with a range of 0 to 100 (95 per cent CI: 7.7 to 13.3). The mean number of studies performed annually in public hospitals was 18.1 (95 per cent CI: 13.4 to 22.8) with a range of 0 to 100. The mean number of studies performed annually in private hospitals was 8.8 (95 per cent CI: 3.7 to 13.8) with a range of 0 to 20. The mean number of studies performed annually in private clinics was 5.8 (95 per cent CI: 1.8 to 9.9) with a range of 0 to 30. Of all LGIH studies performed annually, 54.1 per cent (544/1005) were performed in a public hospital department (95 per cent CI: 40 per cent to 68.1 per cent), 22.7 per cent (228/1005) in a private hospital department (95 per cent CI: 9.6 per cent to 35.7 per cent) and 23.2 per cent (233/1005) in private clinics (95 per cent CI: 7.2 per cent to 39.4 per cent).

Radiopharmaceuticals

^{99}mTc RBCs were the radiopharmaceutical of choice in 99 per cent (91/95) of departments (95 per cent CI: 89.7 per cent to 98.4 per cent). The remaining 4.2 per cent (4/95) of departments indicated that they employed both ^{99}mTc RBC and ^{99}mTc sulphur colloid for performing LGIH scintigraphy. No departments indicated that ^{99}mTc sulphur colloid was their radiopharmaceutical of choice.

The most common method of performing RBC labelling was using the commercially available Ultratag kit (Tyco Health) with 48.9 per cent (45/92) of departments indicating Ultratag as the method of choice (95 per cent CI: 38.9 per cent to 59.0 per cent). The invivo method of RBC labelling was employed in 8.7 per cent (8/92) of departments (95 per cent CI: 4.5 per cent to

16.2 per cent), the invitro method in 8.7 per cent (8/92) of departments (95 per cent CI: 4.5 per cent to 16.2 per cent) and the invivtro method in 26.1 per cent of departments (95 per cent CI: 18.2 per cent to 35.9 per cent). The remaining 7.6 per cent of departments employ more than one RBC labelling method. It is worth noting that 58.7 per cent (54/92) of departments employ an invitro method of blood labelling (i.e. invitro or Ultratag).

No statistically significant difference was noted between RBC labelling methods with respect to the number of full time equivalent technologists (department size) ($P = 0.47$) or with respect to the number of studies performed annually ($P = 0.49$). There were, however, statistically significant differences noted between RBC labelling methods with respect to the type of department ($P < 0.01$). Increased use of the invivo and invivtro methods in the private sector was noted (table 1) as was greater use of invitro and Ultratag in the public sector (table 1).

Table 1: Contingency table of RBC labelling method by department type.

	Public Hospital	Private Hospital	Private Clinic	
Invivo	1 (1.2%)	0	7 (8.2%)	8 (9.4%)
Invitro	5 (5.9%)	1 (1.2%)	2 (2.4%)	8 (9.4%)
Invivtro	3 (3.5%)	7 (8.2%)	14 (16.5%)	24 (28.2%)
Ultratag	16 (18.8%)	17 (20.0%)	12 (14.1%)	45 (52.9%)
	25	25	35	85

Acquisition Protocols

Continuous dynamic sampling is undertaken by 96.8 per cent (92/95) of departments (95 per cent CI: 91.1 per cent to 98.9 per cent) while 3.2 per cent (3/95) of departments employ multiple static images (95 per cent CI: 1.1 per cent to 8.9 per cent). No statistically significant difference was noted in the use of acquisition methods between department types ($P = 0.96$). No statistically significant relationship was shown between acquisition method and department size ($P = 0.36$) or the number of studies performed annually ($P = 0.62$).

A sampling interval of 60 seconds was employed in 54.8 per cent (51/93) of departments (95 per cent CI: 44.7 per cent to 64.6 per cent). A number of other sampling intervals were also utilised, including; 2.2 per cent (2/93) for 20 seconds (95 per cent CI: 0.6 per cent to 7.5 per cent), 21.5 per cent (20/93) for 30 seconds (95 per cent CI: 14.4 per cent to 30.9 per cent), 8.6 per cent (8/93) for 120 seconds (95 per cent CI: 4.4 per cent to 16.1 per cent) and 12.9 per cent (12/93) for 300 seconds (95 per cent CI: 7.5 per cent to 21.2 per cent). A statistically significant increase in the representation of 60 seconds sampling interval was noted ($P < 0.01$). No statistically significant relationship was demonstrated between sampling interval and department type ($P = 0.07$) or between sampling interval and the number of studies performed annually ($P = 0.37$). There was, however, a statistically significant difference in the mean number of full time equivalent technologists comparing sampling intervals of 300 seconds with all other sampling intervals ($P = 0.01$) with mean technologist numbers of 6.0, 2.7, 3.8, 3.9 and 1.6 for 20 seconds, 30 seconds, 60 seconds, 120 seconds and 300 seconds respectively.

A 128x128 acquisition matrix is employed in 79.3 per cent (73/92) of departments (95 per cent CI: 70.0 per cent to 86.4 per cent). A 64x64 acquisition matrix is employed in 2.2 per cent (2/92) of departments (95 per cent CI: 0.6 per cent to 7.6 per cent) and a 256x256 acquisition matrix is employed in 18.5 per cent (17/92) of departments (95 per cent CI: 11.9 per cent to 27.6 per cent). A statistically significant increase in the representation of the 128x128 acquisition matrix was noted ($P < 0.01$). It is worth noting that the departments employing a 64x64 acquisition matrix represent the two departments that also employ a rapid sampling interval of 20 seconds. No statistical difference was noted between department types with respect to acquisition matrix ($P = 0.21$), full time equivalent technologists ($P = 0.31$) or the number of studies performed annually ($P = 0.34$).

An acquisition time of 60 minutes was employed in 70.2 per cent (66/94) of departments (95 per cent CI: 60.3 per cent to 78.5 per cent). Other acquisition durations included 15 minutes in 1.1 per cent (1/94) of departments (95 per cent CI: 0.2 per cent to 5.8 per cent), 30 minutes in 4.3 per cent (4/94) of departments (95 per cent CI: 1.7 per cent to 10.4 per cent), 45 minutes in 3.2 per cent (3/94) of departments (95 per cent CI: 1.1 per cent to 9.0 per cent), 90 minutes in 14.9 per cent (14/94) of departments (95 per cent CI: 9.1 per cent to 23.5 per cent), 120 minutes in 5.3 per cent (5/94) of departments (95 per cent CI: 2.3 per cent to 11.8 per cent) and 180 minutes in 1.1 per cent (1/94) of departments (95 per cent CI: 0.2 per cent to 5.8 per cent). A statistically significant difference was noted in the distribution comparing the 60 minute group to all other groups ($P < 0.01$). No statistically significant difference was noted for the acquisition duration with respect to department type ($P = 0.68$), full time equivalent technologists ($P = 0.87$) or the number of studies performed annually ($P = 0.96$).

Intervention is only employed by 10.5 per cent (10/95) of departments (95 per cent CI: 5.8 per cent to 18.3 per cent). Clearly, 89.5 per cent (85/95) of departments do not employ interventions to encourage bleeding in the LGIH patient (95 per cent CI: 81.7 per cent to 94.2 per cent). It should be noted, however, that an indication that intervention is used does not imply that intervention is employed for each patient; most likely intervention is reserved for those patients presenting difficulties in detection and localisation. All 10 (100 per cent) departments indicated that heparin was the agent of choice for encouraging bleeding in LGIH patients. No departments indicated that either glucagon or urokinase were employed. No statistically significant difference was noted in the mean number of technologist between intervention (4.5) and no intervention (3.2) ($P = 0.12$). No statistically significant difference was noted in the mean number of studies performed between intervention (11.2) and no intervention (10.5) ($P = 0.88$). No statistically significant difference was noted in the dis-

tribution of departments employing intervention for public hospitals (50 per cent), private hospitals (10 per cent) and private clinics (40 per cent) ($P = 0.27$).

Delayed imaging is used in the scintigraphic evaluation of LGIH by 86.2 per cent (81/94) of departments with only 13.8 per cent (13/94) of departments not employing delayed imaging (95 per cent CI: 8.3 per cent to 22.2 per cent) ($P < 0.01$). Delayed imaging at four to six hours is employed by 26.6 per cent (25/94) of departments (95 per cent CI: 18.7 per cent to 36.3 per cent), delayed imaging at 24 hours is employed by 20.2 per cent (19/94) of departments (95 per cent CI: 13.3 per cent to 29.4 per cent) and both four to six hour and 24 hour delayed imaging is performed in 39.4 per cent (37/94) of departments (95 per cent CI: 30.1 per cent to 49.5 per cent). No departments indicated that delayed imaging was performed after administration of a second dose. Once again, an indication that delayed imaging is used does not imply that delayed imaging is employed for each patient. No statistically significant difference was noted in the distribution between department types for those not employing delayed imaging ($P = 0.22$). There was a statistically significant difference in the mean number of full time equivalent technologists between departments employing delayed imaging (mean: 2.9) and those not employing delayed imaging (mean: 5.9) ($P < 0.01$) suggesting larger departments are less likely to employ delayed imaging. There was also a statistically significant difference in the mean studies performed annually between departments employing delayed imaging (mean: 8.8) and those not employing delayed imaging (mean: 22.2) ($P < 0.01$) suggesting those departments with more extensive experience with LGIH evaluation are less likely to employ delayed imaging.

Processing Methods

The results indicated that 81.1 per cent (77/95) of departments always review the cinematic display of the dynamic data (95 per cent CI: 72.0 per cent to 87.7 per cent). Only 1.1 per cent (1/95) of departments do not review the cinematic display (95 per cent CI: 0.2 per cent to 5.7 per cent) while another 17.9 per cent (17/95) indicated that the cinematic display was reviewed on occasion (95 per cent CI: 11.5 per cent to 26.8 per cent). No statistically significant relationships were noted between the review of cinematic display of dynamic data and department type ($P = 0.48$), the number of full time equivalent technologists ($P = 0.10$) or the number of studies performed annually ($P = 0.39$).

A 20 second display interval is employed by 2.2 per cent (2/93) of departments (95 per cent CI: 0.6 per cent to 7.5 per cent), 30 seconds in 12.9 per cent (12/93) of departments (95 per cent CI: 7.5 per cent to 21.2 per cent), 60 seconds in 30.1 per cent (28/93) of departments (95 per cent CI: 21.7 per cent to 40.1 per cent), 120 seconds in 10.8 per cent (10/93) of departments (95 per cent CI: 5.9 per cent to 18.7 per cent), 300 seconds in 41.9 per cent (39/93) of departments (95 per cent CI: 32.4 per cent to 52.1 per cent) and a variety of display intervals in 2.2 per cent (2/93) of departments (95 per cent CI: 0.6 per cent to 7.5 per cent). A statistically significant difference was noted between the proportion of departments using 60 second and 300 second display intervals compared to other display intervals ($P < 0.01$) although no statistical difference was noted between 60 second and 300 second groups ($P = 0.08$). No statistically significant relationship was noted for display intervals with respect to department type ($P = 0.08$).

Interestingly, only 12.9 per cent (12/93) of departments acquire studies at 300 second intervals which means a number of departments convert more rapid sampling for display. Only 57.0 per cent (53/93) of departments display the dynamic data in the same interval that it was sampled (95 per cent CI: 47 per cent to 67 per cent). Of those departments acquiring studies at a 30 second interval, 40 per cent (8/20) display the data at slower intervals. When departments acquire studies at a 60 second sampling interval, 56.9 per cent (29/51) display the data at slower intervals, most commonly at 300 seconds with 45.1 per cent (23/51) of 60 second acquisitions being displayed with a 300 second interval.

Only 1.1 per cent (1/95) of departments indicated that subtraction imaging is performed for scintigraphic evaluation of LGIH (95 per cent CI: 0.2 per cent to 5.7 per cent) while 98.9 per cent (94/95) do not use subtraction scintigraphy (95 per cent CI: 94.3 per cent to 99.8 per cent). The subtraction method of choice was using a normalised summed image. No departments indicated that either an initial frame (mask) or sequential subtraction scintigraphy were employed.

DISCUSSION

Compliance of individual departments was excellent for this self administered postal questionnaire with a compliance rate of between 54.5 per cent (73/134) and 71.6 per cent (96/134). The compliance range resulted from some respondents indicating that the returned questionnaire encapsulated more than one department. It is not known how many of the multiple departments included were included in the original sampling frame (mail database). In the case where each of the multiple departments were additional departments not included in the initial sampling frame, the compliance would be as low as 54.5 per cent while inclusion of all the multiple departments in the initial sampling frame would see the compliance increase to 71.6 per cent. The actual compliance clearly lies somewhere between these limits.

Of greater significance than raw compliance, however, is the representation of the actual studies performed annually. A compliance of 5 per cent encapsulating 90 per cent of patient studies would be of greater value than a 90 per cent compliance encapsulating just 50 per cent of studies performed. Volunteer bias was thought to be minimal since, 19.2 per cent (14/73) of returned questionnaires indicated that no studies were performed during a year and 26 per cent (19/73) performed one or less studies annually. The HIC (8) indicates that only approximately 400 studies are performed annually in Australia yet the questionnaire indicated that 1005 studies were performed annually (although the lower end of the 95 per cent CI is 643). While it might be easiest to explain this discrepancy in terms of bias such as obsequiousness or recall bias, the phenomenon might be somewhat more complicated. As such, these bias' were not anticipated for this information in the methodology because it was expected that respondents would simply run an enquiry on the patient billing database to provide a precise num-

ber of studies billed with the particular Medicare item number (61398 - bowel haemorrhage study).

The actual determination of the number of studies performed annually, however, seems to be a quick estimate based on perceived average numbers performed over a shorter period of time (e.g. extrapolating one per week to 52 annually). Clearly this provides an inaccurate estimate of actual studies performed, most notably due to a natural bias toward busy periods more easily recalled and not adequately weighting quiet periods where few studies are performed.

Other factors contributing to the apparent over estimation of actual studies performed include both obsequiousness bias and recall bias. Participants may over estimate the number of studies they perform annually because of a perceived desire of the investigator to have larger numbers, to give the impression the department is busier or more state of the art than it really is despite the anonymity of the questionnaire or because their recollection is that they are busier than reality. Understandably so, considering the natural bias toward recalling high impact events like a bowel haemorrhage study performed after hours in an emergency situation. Even those studies performed within normal hours are high impact because of the emergent nature and demand on resources (including time).

The magnitude of the over estimation in the number of studies performed annually may have been artificially elevated because the HIC[8] figures may not be representative of all studies performed. Firstly, the HIC figures do not include patients billed to the Department of Veteran Affairs (DVA). Secondly, the procedure is considered an emergency and, thus, non-Medicare card holders (e.g. tourists) presenting with acute LGIH would be required to pay for the procedure themselves, again being omitted from the HIC statistics. Finally, the emergent nature of the procedure results in it being performed frequently after hours which may allow patient billing to escape the attention of administrative staff while being a focal point for technical staff. It is clear that some over estimation of actual studies performed has occurred and this error is assumed to be random in nature. As such, expression of the percentage of studies performed with a specific protocol is considered to remain valid.

While there was no statistically significant difference between the respondents from public hospitals (31.3 per cent), private hospitals (27.1 per cent) and private clinics (41.7 per cent), it is worth noting that only 22.4 per cent (30/134) of the initial sampling frame were public hospitals. This suggests greater compliance from public hospitals which may be associated with a greater interest (volunteer bias) since public hospitals performed annually a statistically significant greater mean number of studies (18.1) compared to both private hospitals (8.8) and private clinics (5.8) ($P < 0.01$). This is not a surprising observation given the nature of acute LGIH with patients typically presenting to the Nuclear Medicine department as either an inpatient or via the emergency department.

The SNM[11] recommends the use of ^{99m}Tc RBCs as the radiopharmaceutical of choice for the scintigraphic evaluation of acute LGIH. Given the advantages of ^{99m}Tc RBCs over other radiopharmaceuticals, it is not surprising that 100 per cent of departments indicated that ^{99m}Tc RBCs were employed and 95.8 per cent (91/95) of those use ^{99m}Tc RBC exclusively. What was a little surprising was the high percentage of departments employing RBC labelling methods that yield poorer labelling efficiencies. A labelling efficiency of greater than 90 per cent is ideal to prevent false positive or false negative findings arising from the impact of structures accumulating unbound ^{99m}Tc pertechnetate (e.g. liver, spleen, kidneys, bladder, stomach).[12] The labelling efficiencies have been reported as 75-80 per cent, 85-90 per cent, greater than 98 per cent and greater than 98 per cent for invivo, invivtro, invitro and Ultratag methods respectively.[13] Only 58.7 per cent (54/92) of departments employ a method consistent with the recommendations of the SNM[11] (invitro or Ultratag). Thus, 41.3 per cent (39/92) employ labelling methods that may counteract the advantages offered by ^{99m}Tc RBC imaging due to poor labelling efficiency, radiolabel degradation over time and potential false positive and false negative findings. This is highlighted best, perhaps, by the 37.5 per cent (36/96) of departments that both employ sub optimal RBC labelling and perform delayed imaging.

The benefits, costs and demands of each labelling method may reflect its use with respect to department type. The invivo method is quick, simple and cheap and it is not surprising that this convenience is employed most frequently in private clinics (i.e. 87.5 per cent of invivo labels are performed in private clinics). The high labelling efficiency invitro method is time consuming and more complex leading to greater use in the public sector (62.5 per cent of invitro labels are performed in public hospitals). The invivtro method offers a compromise of time and complexity while maintaining cost effectiveness which sees 87.5 per cent of departments employing this method being in the private sector. Ultratag offers simple, quick and high efficiency labelling but is more expensive and is well represented in all department types, particularly public and private hospitals where it offers the most commonly used method.

While a continuous dynamic acquisition is performed for the scintigraphic evaluation of acute LGIH in 96.8 per cent (92/95) of departments, the sampling interval meets SNM recommendations[11] in only 78.5 per cent (73/93) of departments. It is an interesting observation that, despite acquiring patient data appropriately, 31 per cent (29/93) of departments then reframe the data to intervals slower than recommended by the SNM. Most commonly, this reformatting involves a 60 second sampling interval to a 300 second display interval. This practice is most commonly associated with departments performing fewer procedures annually. Slower sampling intervals (acquisition and display) inhibit the accuracy of bleed localisation, may delay detection and may increase the impact of retrograde and antegrade peristalsis of the extravasated blood.

The majority of departments employ a 128x128 acquisition matrix or greater with only 2.2 per cent (2/92) of departments utilising a 64x64 matrix. The high background activity associated with circulating ^{99m}Tc RBCs may make small, intermittent or slow bleeds difficult to detect. Intermittent bleeding and/or small, slow bleeds may also go undetected in the 5.4 per cent (5/94) of departments who do not routinely image beyond 30 minutes. Consistent with the sparse literature, intervention or provocative scintigraphy is performed infrequently with

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only 10.5 per cent (10/95) indicating that provocation is an option for LGIH patients. All departments offering provocation employed heparin.

Interestingly, while delayed imaging is employed in 86.2 per cent (81/94) of departments, these was a statistically significant difference noted in the mean number of studies performed annually between those performing delayed imaging (8.8) and those not using delayed imaging (22.2) ($P < 0.01$). There is significant debate in the literature regarding the usefulness of delayed imaging with Zuckier[7] and Ford et al.[11] suggesting delayed imaging is not useful in localising the bleeding site unless active bleeding occurs during delayed imaging. Despite this, there are strong advocates of the delayed procedure. These results suggest that departments with more extensive experience in performing and interpreting LGIH scinitigraphy are less inclined to utilise delayed imaging. Surprisingly, 81.1 per cent (77/95) of departments indicated that the cinematic display of dynamic data was always reviewed. This is counter intuitive based on anecdotal experience and may be evidence of obsequiousness bias. Despite the availability of SNM guidelines,[11] few of the responses in the questionnaire provide an obvious "best practice" alternative. In the case of cinematic review of dynamic data, always employing it would be the obvious "best practice" answer. This bias may be further substantiated by 100 per cent (3/3) of the departments indicating that multiple static images were employed rather than continuous dynamic data also indicating that the cinematic display was "always" reviewed. The low proportion of departments indicating that multiple static acquisitions are performed may also be a bias associated with an obvious "best practice" response.

CONCLUSION

The SNM[11] recommends the use of invitro labelled ^{99m}Tc RBC (which includes Ultratag) with a continuous dynamic acquisition of 10 to 60 seconds for a minimum of 60 minutes employing a minimum of a 128x128 matrix for the scintigraphic evaluation of LGIH. This survey, however, indicated that in Australia only 38.5 per cent (37/96) of departments satisfy these recommendations (95 per cent CI: 28.5 per cent to 48.5 per cent) which represents only 45.3 per cent (455/1005) of all studies performed (95 per cent CI: 42.2 per cent to 48.4 per cent). It should be noted, however, that this study makes no account of the skills and experience of the interpreting physician. Studies performed as per the SNM protocol may yield poor diagnostic efficacy in the hands of an inexperienced clinician while an experienced clinician may demonstrate excellent diagnostic efficacy with a discordant protocol.

Stratified by department type, 53.3 per cent (16/30) of public hospitals followed recommended minimum standards, 50 per cent (13/26) of private hospitals met the standard while only 20 per cent (8/40) of private clinics satisfied these standards. Larger department size (number of full time equivalent technologists) was found to be predictive of greater compliance with recommended procedures ($P = 0.02$). Surprisingly, expertise (number of studies performed annually) was not predictive of compliance with recommended procedures ($P = 0.19$) although the mean number of studies performed was higher for departments performing procedures adequately (12.3 versus 9.3). One might postulate that poor technique will decrease diagnostic utility and, thus, decrease demand for the procedure explaining, in part, the decreasing utility of this excellent procedure clinically.

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