Instrumentation

"Hotspot" Artifacts Produced by a Magnification/I.D. Control Module

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We recently discovered an artifact produced by a scintillation camera's magnification/I.D. control module that appears to be inherent to the design of the unit itself. A "hotspot" artifact was produced when a high activity source was imaged at the edges of the field of view. This artifact can take on different shapes, sizes, and locations and can be very misleading to the unaware clinician. Our discovery was made during a patient procedure and was not detected with routine quality assurance checks.

Recently, a patient was referred to nuclear medicine for an abdominal bleeding study as an emergency. The images in Fig. 1 show a hotspot in the midline, just below the left lobe of the liver. This appears to be proof positive for a bleeding site, and without further investigation, this patient would have undergone surgery needlessly. Fortunately, the study was left in question because "it just didn't look right." Simulation of this clinical situation proved that the hotspot was indeed artifactual.

Materials and Methods

We accumulate a 2-million count flood image each working day and review it for non-uniformities, size, shape, and focus. The pulse-height analyzer is calibrated for technetium at 140 keV with a 20% window. No irregularities were noted on the day of this study.

We are using Tc-99m sulfur colloid in a technique described by Alavi et al. (*1*) for localization of G.I. bleeding sites. The study should be performed when the patient's disease is active; it is an immediate and emergent procedure.

The patient is positioned under the detector of a General Electric large field of view camera-formatter system to include the area from the xyphoid to the symphysis pubis. A vascular sequence may be obtained by injecting

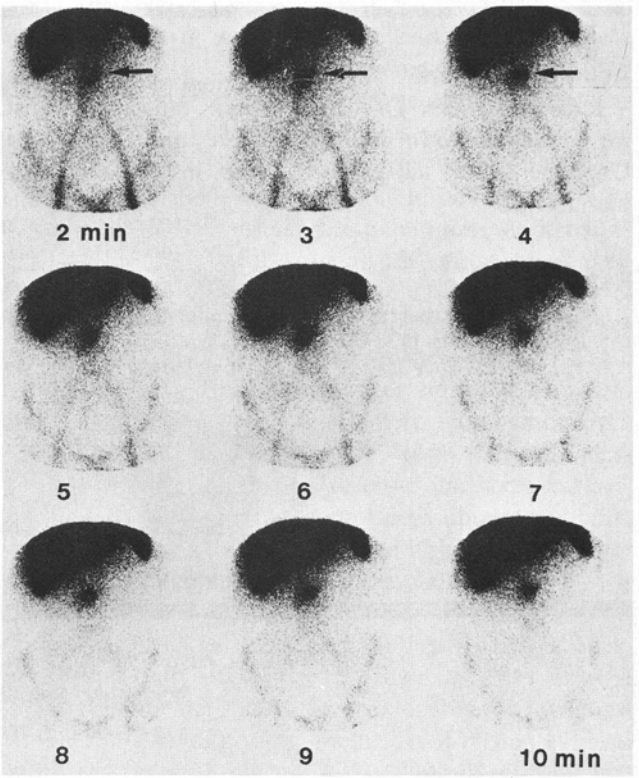

FIG. 1. G.I. bleeding study with artifactual midline activity.

8.0 mCi of the radiopharmaceutical, with static imaging begun at 1-min postinjection. Serial 1-min images are obtained for up to 15 min. One-minute exposures are then collected every other minute for another 15 min. A lateral view may be helpful when a positive focus is seen, and occasionally, delayed views will be necessary when the area just below the liver or spleen is involved. Intensities for this study are set very high to allow visualization of abdominal activity. With this technique, the liver and spleen may become totally black on the film. When this occurs, the G.E. nuclear medical systems display controller (model 99-205) produces a reflected image on film that can be misread as a hotspot.

This artifact has also been generated during first-pass

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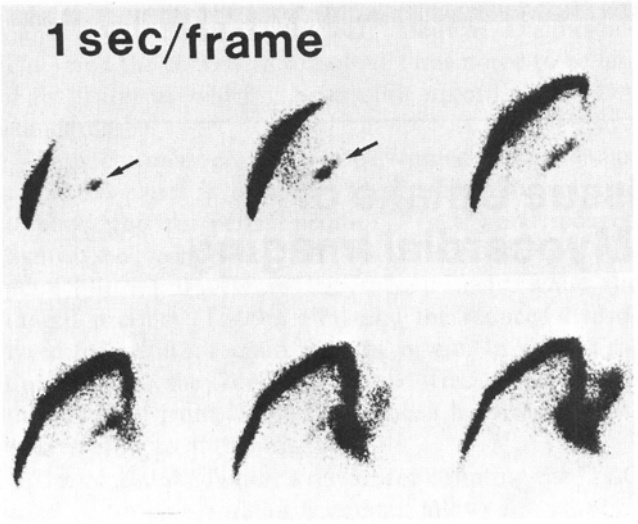

FIG. 2. First-pass study showing apparent collateral vein.

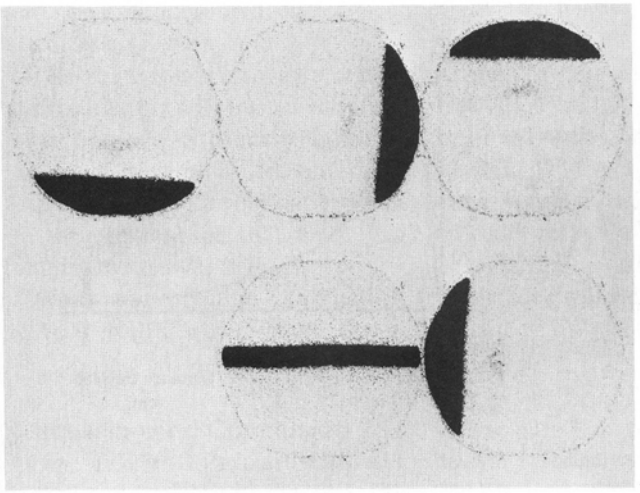

FIG. 3. High intensity image of flood source at edges produces artifact.

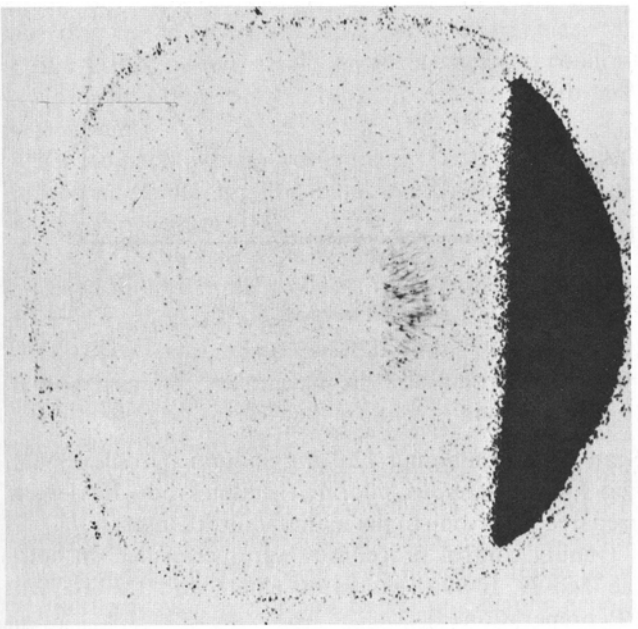

FIG. 4 Close-up of artifact showing streaking dots.

studies. Note the apparent activity in Fig. 2, which was thought to be some form of collateral circulation.

Results and Discussion

Figure 3 shows the artifact generated by using a source along the edges of the field. Notice the shape of the artifact, which appears to be a minified image of the blackened area. The dots in the artifact are not round but elongated (Fig. 4), giving the appearance of streaks. This phenomenon occurs at all times but is only visible when the field contains a very dark object out near the edge and a relatively clear central region.

To simulate the first-pass bolus, a plastic tube was filled with a solution of Tc-99m to give a counting rate approximating that of a first-pass study. A syringe was attached to the end of the tube to simulate a bolus in the vein. Note the secondary image next to the bolus (Fig. 5), which follows the tubing as it is pulled around the edges.

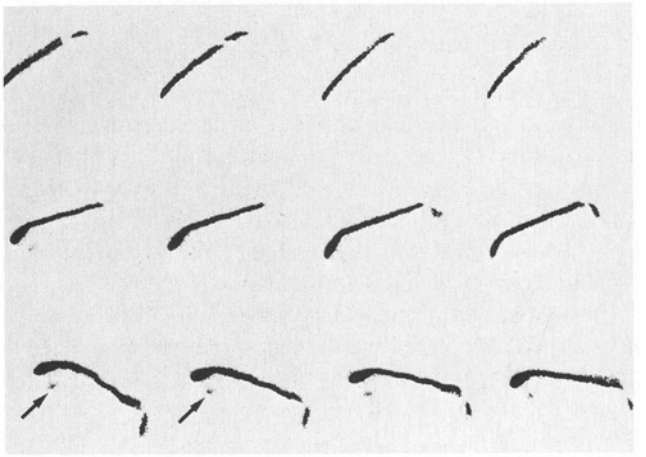

FIG. 5 Simulated first-pass study showing artifact at bolus of activity.

The hotspot artifact seems to be produced when either the intensity or count rate is at a relatively high level. This would be the case in any vascular study or the technique described for G.I. bleeding.

We contacted G.E. service for our area and reported the problem. A new module was installed that corrected 90% of the problem. The large artifact (Fig. 3) was no longer visible. However, the artifact shown in Fig. 5 was still present with the display controller installed in the system.

We would suggest that if this model or any model of a display controller unit is used, it should be checked in the manner we have described. We are not using this unit now (it has been disconnected from the imaging system). Turning the unit off, however, does not take it out of the system; it must be physically removed from the circuit to the formatter.

References

1. Alavi A, Dann RW, Baum S, et al. Scintigraphic detection of acute gastrointestinal bleeding. *Radiology* 1977;124:753–56.