Pertechnetate scintigraphy is a low-cost and widely available option for patients who require postsurgery imaging that avoids thyroid stunning

Kueh SS, Roach PJ, Schembri GP. Role of tc-99m pertechnetate for remnant scintigraphy post-thyroidectomy. Clin Nucl Med 2010;35:671-4.

SUMMARY

BACKGROUND

Patients with differentiated thyroid cancer (DTC) are usually treated with total thyroidectomy with radioactive iodine (^{131}I) remnant ablation (RRA) followed within a few days by posttreatment whole-body uptake scans (RxWBS) to evaluate the efficacy of the initial therapy. Follow-up evaluations 8 to 12 months after the initial therapy require imaging studies, usually neck ultrasonography, and diagnostic whole-body scans (DxWBS) using small amounts of ^{131}I, although DxWBS has largely been abandoned because of the low sensitivity of this imaging study and the possibility of stunning producing a suboptimal response to any ^{131}I therapy that is required. Although ^{123}I can be used, it is expensive and often unavailable. This retrospective study investigated the efficacy of technetium-99m pertechnetate as a potential alternative for remnant scintigraphy (DxWBS) for follow-up after surgery and ^{131}I remnant ablation.

Patients and Methods

All patients with histologically proven DTC had a postoperative DxWBS using pertechnetate followed by subsequent treatment with ^{131}I for remnant ablation. Study patients were identified from a database in the Royal North Shore Hospital Department of Nuclear Medicine, Sydney, Australia, from 1995 through 2006. Pertechnetate scintigraphy was performed between 3 and 6 weeks after total thyroidectomy, and a subsequent RRA was performed within a week after the pertechnetate scan (range, 2 to 7 days). Prior to postoperative scintigraphy and RRA, patients were not treated with levothyroxine, and all patients were instructed to adhere to a low-iodine diet.

Pertechnetate scans were performed 10 minutes after an intravenous injection of 5.4 mCi (200 MBq) of pertechnetate, after which the patients drank a glass of water immediately before the pertechnetate imaging to eliminate esophageal uptake before the study.

Thyroid RRA was performed with 108 to 162 mCi (4000 to 6000 MBq) of ^{131}I administered via an oral capsule followed by an RxWBS scan 3 days after the administration of ^{131}I. Images of the thyroid-bed region were reviewed by two nuclear medicine physicians (reporters) who were aware of the clinical history, but were unaware of other imaging results. A hard-copy film of the pertechnetate scan was viewed first on a viewing box by both reporters concurrently, who classified the scan as either positive, negative, or equivocal. The reporters then viewed the DxWBS ^{131}I hard-copy scan and classified it as positive, negative, for thyroid remnant or equivocal for remnant ablation, with individual foci labeled only as positive. A direct comparison was then made of the pertechnetate and ^{131}I DxWBS to determine whether sites of uptake were concordant between the two scans. The RxWBS ^{131}I scan was regarded as the standard against which the pertechnetate scan was compared. The patient results were analyzed on both a per-patient and a per-site basis.

RESULTS

Per-Patient Results (Figures 1 and 2)

The study group comprised 70 consecutive patients with DTC who had both postoperative pertechnetate scintigraphy followed by ^{131}I RRA. The study subjects were 13 men (19%) and 57

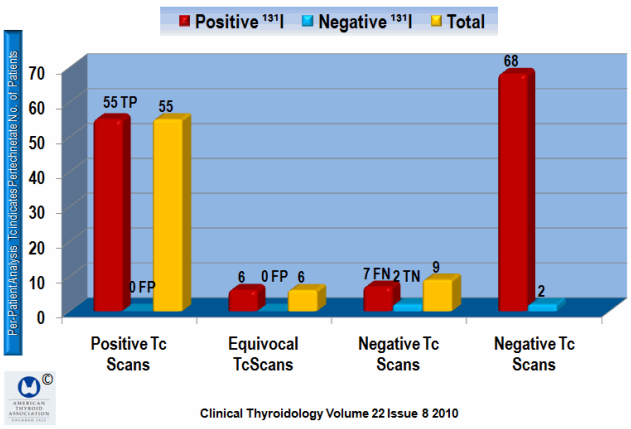

Figure 1. This figure shows the result of per-patient analysis. Tc = pertechnetate; TP = true positive; FN = false negative; FP = false positive; TN = true negative. Data for this figure are derived from Table 1 of Kueh et al.

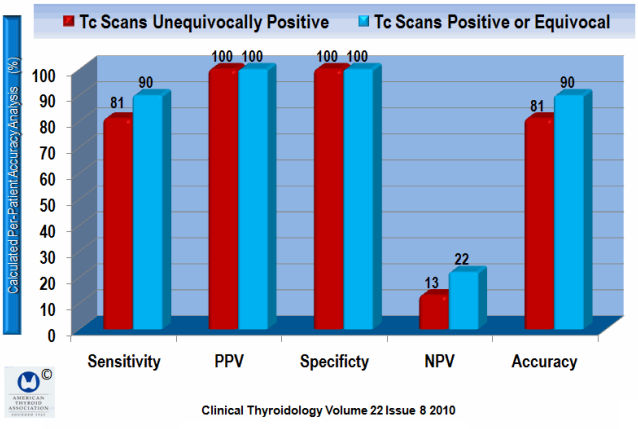

Figure 2. This figure shows the calculated per-patient analysis. NPV = negative predictive value; PPV = positive predictive result. Accuracy is the total accuracy of the per-site analysis.

women (81%) who ranged in age from 11 to 85 years. For the per-patient analysis, pertechnetate scans were considered positive if they had any definite sites of uptake. Of the 70 patients, 2 (3%) had negative ^{131}I scans (DxWBS); both of these patients also had negative pertechnetate scans *(Figure 1)*. Among the remaining 68 patients, 55 (81%) were positive for at least one site on the pertechnetate scan, 6 (9%) had equivocal uptake, and 7 (10%) were negative. However, 54 of the 55 positive pertechnetate scans (98%) showed pertechnetate uptake that correlated with at least one site on the postablation ^{131}I scan. One patient (2%) had uptake at discrepant sites, even though both ^{131}I RxWBS and pertechnetate scans were positive. All six equivocal pertechnetate scans were also positive on the RxWBS scan; however, in 2 (33%) of the equivocal scans, discrepant sites of ^{131}I uptake were again noted. The per-patient analysis revealed a sensitivity for pertechnetate scintigraphy of 81% when the pertechnetate scan was unequivocally positive *(Figure 2)*. If the scan was either positive or equivocal, the sensitivity was 90%. The positive predictive value (PPV) of pertechnetate was 100% for both analyses.

Per-Site Analysis (Figures 3 and 4)

The pertechnetate sites were considered to be accurate on the per-site analysis if they showed concordant uptake at sites that correlated precisely with those seen on the postablation ^{131}I RxWBS scans. ^{131}I RxWBS scans showed a total of 166 positive foci. Of this group, 101 foci (61%) were unequivocally positive on pertechnetate scans, 12 (7%) had equivocal uptake, and 53 (32%) were not detected. Also, the pertechnetate scans showed definite uptake at five sites where the ^{131}I scan was negative and equivocal uptake at another 21 sites, which showed no uptake on ^{131}I. The per-site analysis revealed a sensitivity of 61% if pertechnetate foci were unequivocally positive *(Figure 3)* and a PPV of 95% if pertechnetate foci were either positive or equivocal; the sensitivity was 68% and PPV 81% *(Figure 4)*.

CONCLUSION

Pertechnetate scintigraphy is a low-cost and widely available option for patients who require postsurgery imaging, which avoids thyroid stunning.

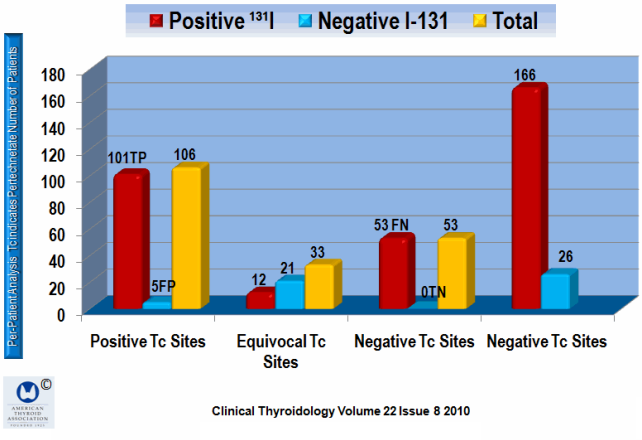

Figure 3. This figure shows the result of per-site analysis (see the definitions for PPV and NPV in Figure 2).

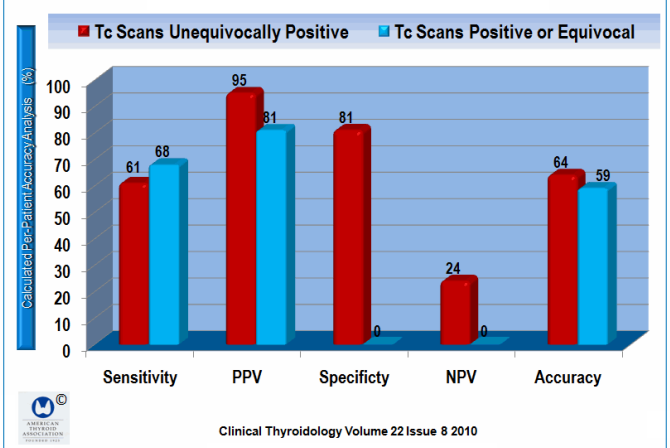

Figure 4. This figure shows the calculated result per-image analysis (%).

COMMENTARY

Patients with DTC often require posttherapy imaging to assess the efficacy of the initial therapy and to assess the therapy during follow-up in patients with evidence of residual or resistant disease. This is particularly true for patients with high-risk disease who require further ^{131}I therapy. Thus there are several reasons why postoperative scanning may be indicated in patients with DTC. Relatively low ^{131}I activities of 1 to 5 mCi [37 to 187 MBq]) often have a low sensitivity for identifying residual disease, which, in addition, also may be associated with stunning (1;2). Moreover, images with small amounts of ^{131}I often have low diagnostic sensitivity (3). There are several limitations in this study; one is that pertechnetate was not compared with low-dose ^{131}I scintigraphy and thus cannot be compared with the relative accuracy of pertechnetate with that of the wide use of smaller amounts of ^{123}I. Some authors (4) have suggested that pertechnetate has a low sensitivity in detecting extrathyroidal and metastatic disease, thus leaving some question about its use. Nonetheless, pertechnetate scans correlated well with postablation scans (the standard), and they are inexpensive, avoids stunning, and according to the data in this study, are highly accurate, with a sensitivity that is 80% with a high PPV (>95%), indicating that pertechnetate scans have a place in the follow-up of patients with DTC, especially those with high-risk tumors.

— Ernest L. Mazzaferri, MD, MACP

Reference List

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