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


SUMMARY

BACKGROUND
Patients with differentiated thyroid cancer (DTC) are usually treated with total thyroidectomy with radioactive iodine (131I) 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 131I, 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 131I therapy that is required. Although 123I 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 131I remnant ablation.

Patients and Methods
All patients with histologically proven DTC had a postoperative DxWBS using pertechnetate followed by subsequent treatment with 131I 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 131I administered via an oral capsule followed by an RxWBS scan 3 days after the administration of 131I. 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 131I 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 131I DxWBS to determine whether sites of uptake were concordant between the two scans. The RxWBS 131I 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 131I RRA. The study subjects were 13 men (19%) and 57...
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 $^{131}\text{I}$ 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 $^{131}\text{I}$ scan.
One patient (2%) had uptake at discrepant sites, even though
both $^{131}\text{I}$ 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 $^{131}\text{I}$ 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 $^{131}\text{I}$
RxWBS scans. $^{131}\text{I}$ 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 $^{131}\text{I}$ scan was negative
and equivocal uptake at another 21 sites, which showed no
uptake on $^{131}\text{I}$. 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.

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 $^{131}\text{I}$ therapy. Thus there are
several reasons why postoperative scanning may be indicated
in patients with DTC. Relatively low $^{131}\text{I}$ 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
$^{131}\text{I}$ often have low diagnostic sensitivity (3). There are several
limitations in this study; one is that pertechnetate was not
compared with low-dose $^{131}\text{I}$ scintigraphy and thus cannot be
compared with the relative accuracy of pertechnetate with that
of the wide use of smaller amounts of $^{123}\text{I}$. 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


