external radiotherapy. Unfortunately, in published reports to date, most of the formulas for internal radiation dose calculation have been based on the presumed uniform distribution of the radionuclide in the target. Such was definitely not the case in our interstitial use of ^{90}Y-GMS. In fact, several formulas suggested by others had indeed been adopted in our early trials, but the outcome of those calculations was confusing. With the same amount of tracer, the dose determined by different formulas varied from thousands to millions of rads. In view of the spotty distribution of ^{90}Y-GMS, it seemed more appropriate to calculate the dose according to the distance from the source. In fact, irradiation of the entire volume is not as critical as the dose to the peripheral region of the tumor because in our experience, most tumor remnants and extra blood supply exist in that region. With these findings in mind, we adopted the formula of Valley et al. (*1*), which is not concerned with the distribution pattern but calculates the dose rate for an area geometrically related to the source. Thus, we determined the doses for the peripheral zone of the tumor and ignored the central part. We hypothesized that once the cells at the periphery died, the central portion would die as a result of even stronger radiation. We believe that this policy resulted in the positive outcome of our study.

Although the dose that we used to treat our patients might seem to be much higher than any previously reported, we believed that the exclusive, stable and restrictive localization of ^{90}Y-GMS would result in regionalized irradiation. Additionally, the sharp contrast between internal and external radiotherapy was considered (*3*). Furthermore, no side effects were reported by our patients who received the current ^{90}Y-GMS dosage.

One of the benefits of ^{90}Y-GMS is its painlessness, in contrast to alcohol injection. There were no abnormal blood count or serum biochemical test results for hepatic and renal function. However, in a few patients, low-level lung radioactivity was detected by Bremsstrahlung scintigraphy. Whether this might cause pulmonary fibrosis over the long run, because these patients now have a better chance for survival, remains to be seen. However, it was previously believed that lungs receiving ^{90}Y-GMS of less than 10 mCi had no risk of severe side effects (*8*), and none of our six patients received more than 0.5–2.0 mCi in the lungs. In our experience, slow, gentle injection is the key to reducing adverse events in the lungs.

Careful review of the patients who died during the follow-up period clearly showed that at least two were at the end stage of their disease at the time of the first ^{90}Y-GMS injection. Both died within weeks, before irradiation could have an effect. This finding had been reported in some pioneering reports from the 1950s (*7*). It was suggested that to gain the expected result, it was necessary to start treatment as early as possible. Three of our patients died of widespread tumor metastases or invasion, indicating patients with multiple-organ involvement or with an infiltrative type of tumor might not be suitable candidates for treatment. The last patient died of acute myocardial infarction; however, it was not clear whether this event had any relation to the ^{90}Y-GMS injections because no autopsy studies were performed in this patient.

CONCLUSION

The principle of interstitial injection of a radionuclide could be applied to any organ or tissue, provided that safe and accurate delivery of the dose and intense monitoring could be ensured. Nevertheless, we are still at the early stages of the clinical experience, and a solid understanding of the factors behind the modality is lacking. Further study is warranted to determine the indications, contraindications, dose calibration, influencing factors, alternative solutions and rationale for interstitial radionuclide treatment.

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EDITORIAL

New Treatment Approaches to Liver Tumors

Traditional management of liver tumors typically has been surgical (*1*) when resectable, and chemotherapeutic when not resectable (*2–4*). Radiological procedures such as embolization, radio- and/or chemoembolization have been used in selected groups of patients in the U.S. and abroad (*5–8*).

Recently, a series of image-guided techniques that offer equivalent and, in certain tumors, better response than conventional therapies at a fraction of the cost have been developed and are under study. These techniques include percutaneous ethanol injection [now extensively in Europe and Asia in the treatment of hepatocellular cancer (*9,10*)], radiofrequency tumor ablation (*11*), image-guided cryosurgery (*12*) and interstitial laser photocoagulation (*13*).

In this issue of *JNM*, Tian et al. report on the novel use of image-guided, ^{90}Y-glass microsphere interstitial radiotherapy in the treatment of hepatic malignancies. This new technique extends the envelope of percutaneous brachytherapy as used in the prostate (*14*) and pelvis (*15*). Their results are quite encouraging.

To be accepted by the medical community, these new developments should undergo the same litmus test as the more traditional treatments [i.e., randomized studies need to be performed (*16*)]. There is little doubt that healthcare delivery systems will take note of these relatively simple, cost-effective, outpatient procedures that result in low morbidity and mortality. Therefore all concerned that

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full validation of these results by time-proven protocols are advantageous.

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Lymphatic Drainage to Triangular Intermuscular Space Lymph Nodes in Melanoma on the Back

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Methods: Lymphoscintigraphy with ^{99m}Tc-antimony sulphide colloid was performed on patients with cutaneous melanoma of the back to define draining node fields and sentinel nodes before surgery. **Results:** One patient was found to have drainage from the back to sentinel lymph nodes in the triangular intermuscular spaces bilaterally, above and lateral to the scapula. Subsequently, drainage to this node field has been found in 26% of 42 consecutive patients who have had lymphoscintigraphy performed for melanoma on the back. **Conclusion:** When performing lymphoscintigraphy to locate draining node fields and sentinel nodes in patients with melanoma on the back, it is important to look for drainage to the triangular intermuscular space node field by obtaining posterior and lateral scans. Any sentinel lymph nodes found in this field should be marked prior to surgery in the same way as nodes in other node fields are delineated so that they may be removed at surgery.

Key Words: melanoma; lymphoscintigraphy; sentinel lymph nodes; triangular intermuscular space

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At the Sydney Melanoma Unit, lymphoscintigraphy has become an integral part of the presurgical diagnostic evaluation of patients with intermediate thickness cutaneous melanoma. Lymphoscintigraphy is used in conjunction with the blue dye method at surgery to allow accurate excision biopsy of the sentinel nodes in each draining node field. If the technique is to be successfully applied, all sentinel nodes must be identified. This article describes lymphatic drainage from the skin of the back to a new node field, the triangular intermuscular space. We also examine the incidence of drainage to this node field in a sequential group of patients with primary lesions on the back and describe the changes in the lymphoscintigraphy imaging technique required to ensure that all sentinel nodes in this node field are identified.

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METHODS

Patients

The patients described were referred for lymphoscintigraphy by the Sydney Melanoma Unit for lymphatic mapping and specifically to have the sentinel lymph nodes marked in each draining node field prior to surgery. Included in this report is the initial case showing drainage to the triangular intermuscular space and the following sequential 41 patients with back lesions, resulting in a total of 42 patients studied.

Lymphoscintigraphy

Lymphoscintigraphy was performed after excision biopsy of the primary lesion in most patients, although some patients still had the primary lesion in situ. The delay between excision biopsy and lymphoscintigraphy was usually 1–3 wk. Histologic diagnosis of malignant melanoma was present in each patient prior to lymphoscintigraphy. Surgery with wide local excision of the excision biopsy site and also in most patients sentinel node biopsy was performed the day after lymphoscintigraphy in almost all patients.

Technetium-99m-antimony tri-sulphide colloid was injected intradermally at multiple points immediately adjacent to the primary lesion or the excision biopsy site. This meant that the injections were given within 1–2 mm of the excision biopsy site or the primary lesion. Scanning was performed as previously described (*1*). Four to six small-volume (0.05 to 0.1 ml) injections were generally required, with each containing 5–7 MBq of tracer. Scanning began immediately and the major draining lymph channels were marked on the skin at this time, thus enabling an incontinuity dissection, including the lymph channels, to be per-