Predictive value of SPECT/CT after radioiodine therapy in differentiated thyroid cancer

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Introduction

• The worldwide incidence of thyroid cancer has continuously increased.

• Patients with differentiated thyroid cancer (DTC) usually have a favourable prognosis with high cure rates; however, lifelong follow-up is required as potentially curable local recurrences and distant metastases may occur even decades later.

• Risk stratification systems help to categorize patients into different risk groups based on cancer related factors, clinical features, results of first WB after radioliodine therapy and serum thyroglobulin (Tg) level.

• planar whole-body scan (WBS) + single photon emission computed tomography/computed tomography (SPECT/CT)

Objectives

• Aim of this study was to evaluate the separate role of SPECT/CT after radioiodine treatment of patients with DTC

  ✓ in early risk classification

  ✓ in prediction of late prognosis

  ✓ in comparison to

  – ATA risk classification

  – ETA risk classification

  – predictive value of postoperative stimulated thyroglobulin level

Methods

• Characteristics of the patients

<table>
<thead>
<tr>
<th>Age group</th>
<th>Median range</th>
<th>%</th>
<th>Age group</th>
<th>Median range</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatric</td>
<td>10-14 yr</td>
<td>11</td>
<td>Adult</td>
<td>15-65 yr</td>
<td>86</td>
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<tr>
<td>&gt;66 yr</td>
<td>5</td>
<td>Total</td>
<td>100</td>
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  Gender: Male 59%, Female 41%

  TSH level: 0.3 μIU/mL - 4.0 μIU/mL

  Laboratory measures:

  • TSH (Elecys® TSH assay, Roche, measuring range: 0.005-100 μIU/mL)

  • Tg (Elecys® Tg II assay, Roche, measuring range of 0.04 - 500 ng/mL)

  • TgAb (Elecys® anti-Tg assay, Roche, measuring range of 0.100-4000 ng/mL).

  • SPECT/CT

    - SPECT: dual head, 50 sec/frame, 64 frames

    - CT: low dose, 64 slices spiral CT, 120 kV, 50 mAs

    - from the neck and chest 4-6 days after oral administration of 1100-1700 MBq radioiodine

    - additional SPECT scans of the abdomen and pelvis were acquired if suspicious isotope accumulations were detected on the whole body scan

  • Risk classification systems

    - American Thyroid Association (ATA) 2009

    - European Thyroid Association (ETA) 2016

  • Date analysis

    - Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, USA) version 22.0

Results

• SPECT/CT after the first 131I treatment

  - no evidence of tumor

  - residual tumor

  - Change in risk classification and clinical stage based on SPECT/CT

  Patients with detectable residual disease were upgraded based on SPECT/CT results: patients with lymph node metastases had intermediate risk for recurrence; incomplete tumor resection or distant metastases classified the cases to high risk category. Patients without RAI uptake outside the thyroid bed previously categorized having intermediate or high risk were downgraded to low risk category except aggressive histology.

  

  • AFA risk classification

    | low | intermediate | high | TOTAL |
    |-----|-------------|------|-------|
    | 61  | 27          | 3    | 101   |
    | 6   | 0           | 0    | 6     |
    | 2   | 0           | 0    | 2     |
    | 7   | 0           | 0    | 7     |

  • Change in risk classification at the end of follow-up

    Change in stage I (from I to III)

    Cohen’s kappa (0.450, p<0.001)

    Changes in clinical staging were not so profound, since the stage of young patients was not changed even if they had lymph node metastases.

    • Follow-up (N=173, median 55 months)

      • 9-12 months

        End of follow-up

        - No evidence of tumor

        - Recurrence biochemical response

        - Incomplete biochemical response

        • Diagnostic value of risk stratification systems. Tg and SPECT/CT

          The diagnostic value of stimulated Tg at the time of RAI treatment to predict residual tumor at the end of follow-up.

          • Sensitivity, specificity, positive (PPV) and negative predictive values (NPV) and diagnostic accuracy of risk classification systems, stimulated Tg before the radioiodine treatment at 2 ng/mL cut-off level and SPECT/CT based on follow-up data at 9-12 months.

          • Comparison of risk classification methods at one year

          Tg at 2 ng/mL cut-off level had the lowest specificity and diagnostic accuracy (59.5% and 0.63%). The best was the AFA classification with a specificity of 45.7%, significantly lower than the specificity of ETA risk classification or the ETA classification modified based on the SPECT/CT results (p <0.001). The results of SPECT/CT without any other data had the highest specificity (85.0%) and diagnostic accuracy (82.8%, p<0.001).

          The usefulness of risk classification systems and SPECT/CT to predict the presence of thyroid cancer at the end of follow-up.

          Reclassification of patients at one-year evaluation in excellent diagnostic accuracy (96.5%). The specificity and the diagnostic accuracy of SPECT/CT were also high, being significantly better than the values of risk stratification systems (83.3%, 82.1%; p<0.001) and did not differ significantly from the results of one-year recalculation.

Conclusions

• SPECT/CT after radioiodine treatment is useful in the early classification of patients.

• It influences the therapeutic strategy.

• ATA and ETA risk classification systems are sensitive and have high negative predictive values but not specific.

• Stimulated postoperative thyroglobulin<2 ng/mL is sensitive but the specificity is very low - its use is restricted by the high percentage of anti-Tg positivity.

• SPECT/CT results after the first radioiodine treatment have higher specificity and diagnostic accuracy than ATA and ETA classification.

• Reclassification of patients for risk of relapse is required at one-year follow-up.

References

• American Thyroid Association Guidelines Taskforce on Thyroid N, Differentiated Thyroid C, Cooper DS, DishBY WR, Haugen BR, Kloos RT, Lee SJ, Mandel SJ, Mazzaferri EL, Mikelakis E, Parada J, Schirner S, Shernan S, Sodor AD, Totto RM. Revised American Thyroid Association management guidelines for patients with thyroid nodules and differentiated thyroid cancer. Thyroid 2009 19:1537-1596.


• Haugen BR, Alexander EK, Bible KC, DishBY WR, Mandel SJ, Mazzaferri EL, Pecot I, Randolph OW, Saunders AM, Schirner S, Schuff KN, Shernan S, Sodor AD, Totto RM, Wartofsky L. 2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer: the American Thyroid Association Guidelines Task Force on Thyroid Nodules and Differentiated Thyroid Cancer. Thyroid 2016 26:1-131.