RESULTS: The average differences using heterogeneity correction and inheterogeneity correction were 1.5-2.9% for patients with lung cancer, 2.1-3.4% for patients with breast cancer.

CONCLUSIONS: The results indicated that the difference between using heterogeneity correction is not significant in calculation dose for 3D-CRT plans.

Key words: Tissue heterogeneity corrections, treatment planning, 3D-CRT

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INTRODUCTION

Radiation therapy technique is one of possible approaches to treat cancer at most of hospitals all over the world. In external radiation therapy gamma rays often produced by medical linear accelerators (LINAC) to radiate into cancer tumors. The various energies of gamma rays can be earned to use in three types of techniques: 3D-CRT, intensity modulated radiation therapy (IMRT) and volumetric modulated arc therapy (VMAT). 3D-CRT is one of the most commonly used in the treatment of cancer, in which radiotherapy treatment planning is one of the most important steps in the radiotherapy. Dose calculation in radiotherapy is done using the algorithms used in treatment planning system (TPS). A uniform treatment plan, the algorithm assumes that patients have homogeneous tissue density; on the other hand, in a heterogeneous planning the algorithms will be added to the different densities of tissue called a correction factor\(^1\). This correction factor was generated from the electron density of the matrix which was derived from a matrix of CT values because it is the linear relationship.
between electron density and CT values obtained. To make a correction factor, this study using an algorithm with heterogeneity correction is available in treatment planning system Prowess Panther (Prowess, Chico, CA). A hypothesis was suggested that the dose between 2 groups were different.

**MATERIALS AND METHODS**

**Patients**

25 plan of patients with lung cancer and 11 patients with breast cancer were treated in the Dong Nai General Hospital by a Linear Accelerator Primus 5497 using two photon energy levels: 6 MV and 15 MV with radiotherapy technique 3D-CRT. All plans of patients were randomly selected for this study.

**Dose calculation algorithm**

There are many models of dose calculation algorithm, for photons, Prowess panther v4.6 has two models: (1) Conventional Calculations; (2) Convolution Calculations.

In this study, a model of conventional calculation was used to calculation dose distribution in patients. It is integrated in the software treatment planning Prowess Panther. This model has two algorithms: Fast Photon and Fast Photon Effective.

**Treatment Planning**

The CT images of all patients were taken on Siemens SOMATOM (Siemens Medical System, Germany) with slice thickness of 3 mm for the planning purpose. All CT images were transferred to the treatment planning system Prowess Panther. Each patient was performed two treatment plans with two different algorithms, but the same in physical parameters: beams, energy, etc… The treatment goals for these plans meet plan acceptance criteria for critical structures according to the RTOG-0225 protocol. Total of dose is 60 Gy with lung cancer and 50 Gy with breast cancer; fraction dose of 2 Gy.

![Figure 1 Models of dose calculation algorithm.](image1)

![Figure 2 Isodose line between two plans: Fast photon and Fast photon Effective.](image2)

![Figure 3 DVH of plan 1 (solid) and plan 2 (dashed).](image3)

![Figure 4 Compare between Fast photon and Fast photon Effective.](image4)
RESULTS AND DISCUSSIONS

Dose calculation algorithm is one of the main steps in the radiotherapy procedure\(^{(6,7)}\). This study was to compare the accuracy of different inhomogeneity correction algorithms for external photon beam dose calculations. For this purpose, two plans of each patient have been calculated with two different algorithms. In plan 1 was calculated using the Fast Photon Effective with the identity of the tissues; in plan 2 were calculated using the Fast Photon without the identity of the tissue. The results of the two algorithms in dose calculation are shown in Table 1, 2 and Figure 2, 3, 4, and 5. Figure 3, 5 shows the isodose line between two algorithms in PTV, but small isodose (< 20%) there are differences between the two algorithms. Figure 2, 4 shows the curve DVH between the two algorithms are not difference, but there is small different at the maximum and minimum dose values.

Table 1 and table 2: The average difference between the two algorithms is 1.5-2.9% for patients with lung cancer and 2.1-3.4% for patients with breast cancer.
Table 1 Percentage difference between the two plans lung cancer radiotherapy.

<table>
<thead>
<tr>
<th>Plan</th>
<th>V95 (%)</th>
<th>Min Dose (%)</th>
<th>Max Dose (%)</th>
<th>Mean Dose (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan 1 vs Plan 2</td>
<td>2.57 ± 0.82</td>
<td>2.98 ± 0.95</td>
<td>2.18 ± 0.68</td>
<td>1.56 ± 0.45</td>
</tr>
</tbody>
</table>

Table 2 Percentage difference between the two plans for breast cancer radiotherapy.

<table>
<thead>
<tr>
<th>Plan</th>
<th>V95 (%)</th>
<th>Min Dose (%)</th>
<th>Max Dose (%)</th>
<th>Mean Dose (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan 1 vs Plan 2</td>
<td>2.88 ± 0.79</td>
<td>3.48 ± 0.65</td>
<td>2.61 ± 0.58</td>
<td>2.14 ± 0.57</td>
</tr>
</tbody>
</table>

Case 1: Lung cancer
20% Isodose line between Fast photon and Fast photon Effective clearly different, Fast photon Effective dose to healthy lung tissue receiving more than Fast photon.

There is small difference between the two algorithms
The average difference between the two algorithms is in the range of 2-3%. This difference was not significant.

Case 2: Breast cancer
The results from figure 7 show that there is no significant difference between two algorithms for this case.

CONCLUSIONS

One of the major factors in TPSs is the accuracy of dose calculation algorithm. Therefore, it is important to understand these algorithms. In results of this study, we found that the difference between using heterogeneity correction on prowess panther is not significant in calculation dose for 3D-CRT plans. Therefore in dose calculation using the identity of the tissue or does not need to be consideration carefully in conjunction with suitable doses indicated. In this article, we have just stopped at the doses examined in the tumor (PTV) including the parameters: V95, maxdose, mindose, meandose for two cases of breast cancer and lung cancer. Further research directions, next to the survey differences in dose in the tumor, we will conduct further surveys at agencies doses and additional parameters such as V5, V10, V20, MU.

REFERENCES


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