COMPARISON AND EVALUTATION FOR THE DOSE DISTRIBUTION AND PHYSICAL CHARACTERISTICS BETWEEN TWO AAA AND AXB ALGORITHMS IN ECLIPSE v13.6 SOFTWARE ON TREATMENT PLANS IN REGIONS HETEROGENOUS DENSITIES AT 108 MILITARY CENTRAL HOSPITAL

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Abstract:

The aim of this study is to compare and evaluate the dose distribution and physical characteristics of two algorithms Anisotropic Analytical Algorithm (AAA) and Acuros XB (AXB) in Eclipse v13.6 software in regions heterogeneous densities.

Computed Tomography Simulation (CT – Sim) data of 48 treated cancer patients (20 head and neck cancer (H&N) patients, 15 esophageal cancer patients, 8 lung cancer patients with 3 Dimensions Conformal Radiation Therapy (3D-CRT) and 5 lung cancer patients treated with Volumetric Modulated Arc Therapy (VMAT)) were used to re-plan the Eclipse v13.6 software with two algorithm AAA and AXB. For all plans, the Quality of Coverage (Q), the Conformity Index (CI), the Homogeneity Index (HI) and the dose volume histograms (DVH) for the targets and the organs at risk (OARs) were compared and evaluated. Pretreatment quality assurance (QA) was performed using the Electronic Portal Imaging Device (EPID) for all VMAT plans, and the gamma index method was used to qualify the agreement between calculations and measurements. In addition, total Monitor Units (MUs) and the calculation time were investigated.

The indicators obtained from the H&N VMAT plans calculated by AAA close to ideal values than AXB. The total MUs obtained from two algorithms are approximately equal. The lung cancer 3D – CRT plans, the indicators for target and OARs are approximately the same. However, the calculation time of the AAA is faster than the AXB from 7.5 to 14 times. The indicator obtained from the lung cancer VMAT plans calculated by two algorithms AAA and AXB are approximately equal. The total MUs and time calculation are approximate the same. However, the V5, V10, V20 and Mean Lung Dose (MLD) obtained from AAA is lower than AXB. For esophageal cancer VMAT plans, the indicators HI_{RTOG}, HI_{Wu}, and Q calculated by AAA close to the ideal values than AXB. However, the indicators $CI_{Paddick}$, $CI_{ICRU-62}$, V5, V10, V20 and MLD calculated by AXB are better than AAA.

The dose distribution indicators obtained from AAA algorithm are better than AXB algorithm in H&N cancer and lung cancer plans. For the esophageal cancer plans, AXB algorithm gave the dose distribution indicator are better than AAA.

Keywords: *AAA, AXB, Conformity Index, Homogeneity Index, H&N cancer, Lung cancer, Esophageal cancer, Eclipse v13.6.*

Tóm tắt:

Mục đích của nghiên cứu này là để so sánh, đánh giá phân bố liều và các đặc trưng vật lý của hai thuật toán Anisotropic Analytical Algorithm (AAA) and Acuros XB (AXB) bằng phần mềm Eclipse v13.6 trong các vùng không đồng nhất.

Dữ liệu CT – mô phỏng của 48 bệnh nhân ung thư (20 bệnh nhân ung thư đầu – cổ, 15 bệnh nhân ung thư thực quản, 5 bệnh nhân ung thư phổi điều điều trị bằng kỹ thuật VMAT và 8 bệnh nhân ung thư phổi điều trị bằng kỹ thuật 3D – CRT) được sử dụng để lập lại kế hoạch trên phần Eclipse v13.6 bằng hai thuật toán AAA và AXB. Với tất cả các kế hoạch, sử dụng các chỉ số độ bao phủ (Quality of Coverage – Q), chỉ số độ phù hợp (Conformity Index – CI), chỉ số độ đồng nhất (Homogeneity Index – HI) và giản đồ liều khối (Dose Volume Histograms – DVH) cho khối u và các cơ quan nguy cấp (Organs at risk – OARs) được dùng để so sánh và đánh giá. Kiểm chuẩn chất lượng trước điều trị (Quality assurance – QA) được thực hiện bằng cách sử dụng EPID (Electronic Portal Imaging Device) cho tất cả các kế hoạch VMAT và phương pháp gamma index được sử dụng để đánh giá điều kiện đồng nhất giữa tính toán và đo đạc. Ngoài ra, số MU (Monitor Unit) và thời gian tính toán cũng được sử dụng nghiên cứu.

Các chỉ số thu được từ các kế hoạch VMAT ở vùng đầu – cổ được tính toán bằng thuật toán AAA cho giá trị gần với giá trị lý tưởng hơn thuật toán AXB. Tổng số MU của hai thuật toán xấp xỉ nhau. Ung thư phổi sử dụng kỹ thuật 3D-CRT, các chỉ số vào khối u và cơ quan nguy cấp có giá trị xấp xỉ nhau. Tuy nhiên, thời gian tính toán của thuật toán AAA nhanh gấp 7,5 đến 14 lần so với thuật toán AXB. Các chỉ số thu được từ các kế hoạch VMAT phổi được tính toán bởi hai thuật toán AAA và AXB có giá trị xấp xỉ nhau. Tổng số MU và thời gian tính toán xấp xỉ nhau, tuy nhiên giá trị V5, V10, V20 và liều trung bình phổi thu được từ thuật toán AAA thấp hơn thuật toán AXB. Với các kế hoạch VMAT thực quản, các giá trị HI_{RTOG}, HI_{Wu} và Q tính toán bởi thuật toán AAA cho giá trị gần với giá trị lý tưởng hơn thuật toán AXB. Tuy nhiên, các giá trị $CI_{Paddick}$, $CI_{ICRU-62}$, V5, V10, V20 và liều trung bình phổi tính toán bằng thuật toán AXB tốt hơn thuật toán AAA.

Các chỉ số phân bố liều thu được từ thuật toán AAA tốt hơn thuật toán AXB trong ung thư đầu cổ và ung thư phổi. Với ung thư thực quản, thuật toán AXB cho các chỉ số phân bố liều tốt hơn thuật toán AAA.

Từ khóa: *AAA, AXB, chỉ số độ đồng nhất, chỉ số độ trùng khớp, ung thư đầu cổ, ung thư phổi, ung thư thực quản, Eclipse v13.6.*

I. INTRODUCTION

The human body consists of many different types of cells, tissues, organs. They have different materials densities. In anatomical regions such as the brain, the density is uniform, while in the head & neck and thorax area are heterogeneous densities such as lung, bone, teeth, sinus, nasal cavity and mouth have complexities when calculation dose distribution in radiotherapy [1].

Since September 2017, The Department of Radiation Oncology and Radiosurgery – 108 Military Central Hospital is equipped with TrueBeam STx accelerator system and Eclipse v13.6 planning software. Head & neck cancer patients, lung cancer patients and esophagus cancer patients are indicated to treat by radiotherapy on TrueBeam STx linear accelerator, using 3D-CRT and VMAT techniques, AAA algorithm. A convolution-superposition algorithm used to calculate radiation dose distribution in a treatment planning system computer. Eclipse planning software adds Acuros XB algorithm to calculate doses in heterogeneous regions since v10.0. AXB algorithm is given based on solving the Linear Boltzmann transport equation (LBTE) [2]. AXB increases accuracy and reduces calculation time during the planning process [2].

Version 13.6 includes 2 algorithms: AAA and AXB applied to calculate the dose for the plan. To understand the advantages and disadvantages of two algorithms to calculate the dose of AAA algorithms and AXB algorithms. The indicators of dose distribution, physical characteristics and tolerance dose to healthy organs, plan with two algorithms on the same CT image sequence used for comparison.

II. MATERIALS AND METHODS

2.1 CT - simulate data set

In heterogeneous regions, we conducted retrospective studies based on simulated CT data of 48 patients including 20 head and neck cancer patients, 15 esophageal cancer patients, 5 cancer patients lung cancer were treated with the VMAT technique and 8 lung cancer patients were treated with the 3D-CRT technique at the Department of Radiation Oncology and Radiosurgery – 108 Military Central Hospital from September 2017 to February 2019. Thickness of each slice is 2.5 mm. The position of patients is head first-supine and simulated by CT GE Optima 580 machine.

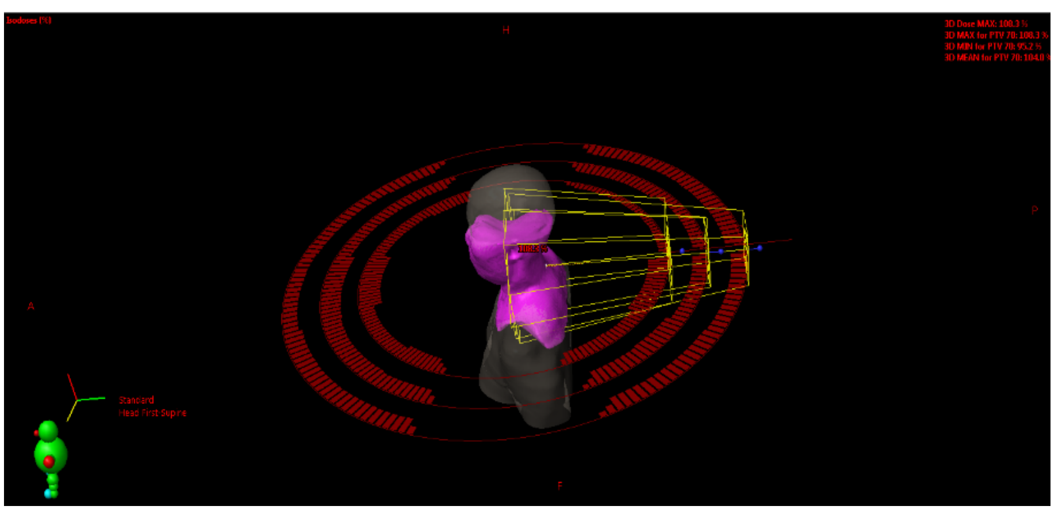

Figure 1: The arcs of H&N cancer.

Treatment planning for head and neck cancer patients using algorithm of calculating AAA dose, from 2 to 3 flat same arcs with avoidance sectors from 70 – 110 degrees and 250 – 290 degrees photon beam with 6 MV energy level (figure 1), dose rate of 600 MU/min, dose prescription from 60 – 70 Gy with a dose of 33-35 fractions.

In the thorax area of 13 lung cancer patients, the 3D-CRT technique and VMAT technique tumor volume from 5.7cm^3 to 476.2. cm^3 were used to treat for 8 and 5 patients, respectively. The energy of each photon beam of the 3D-CRT technique using 2 – 4 fields is 8 MV (figure 2), and the VMAT technique using 3 – 5 arcs is 6 MV with the dose rate at 600 MU/min (figure 3). The dose prescription is 20 – 45Gy with a dose of 5 – 20 fractions. 15 esophageal cancer patients were treated with the VMAT technique with tumor volume from 49.5 cm^3 to 582.7 cm^3. The energy of each photon beam of the VMAT technique using 3 – 5 arcs with avoidance sectors from 60 – 120 degrees and 240 – 300 degrees is 6 MV or 8 MV, the dose rate of 600 MU/min. The dose prescription is 41.4 Gy – 59.92 Gy with a dose of 23 – 28 fractions (figure 4).

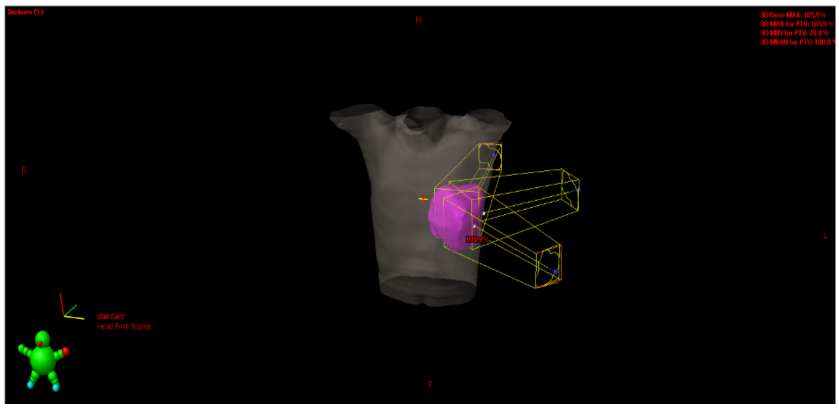

Figure 2: The fields of 3D – CRT lung.

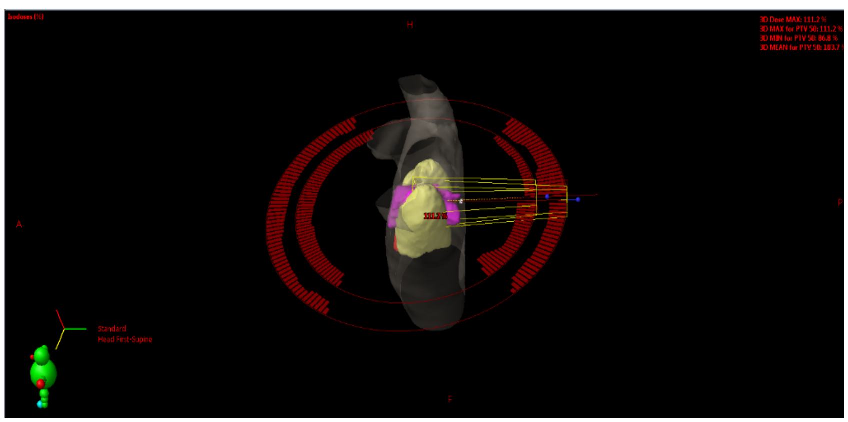

Figure 3: The arcs of VMAT lung.

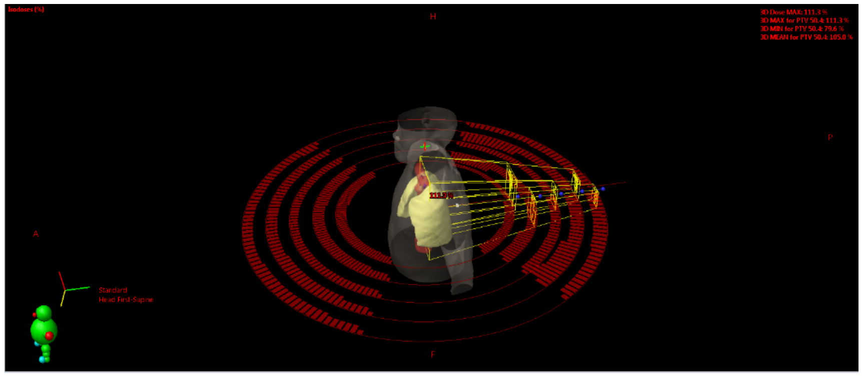

Figure 4: The arcs of VMAT esophageal.

To compare the advantages and disadvantages between the two algorithms, the evaluation indicators of dose including: Quality of coverage – Q [3], Conformity Index – CI [4,5], Homogeneity Index – HI [3,6] and physical characteristics – MUs are used. Table 1 present the formula for calculating the indicators.

Table 1: The formular of planning evaluation indicators.

Variables	Formula	Ideal value	References
Q	$\frac{Dmin}{DP}$	A = 1	RTOG – 1993 [3]
CI	$CI_{ICRU\text{ - }62} = \frac{PTV100}{PTV}$	A = 1	ICRU – 62 [4]
	$CI_{Paddick} = \frac{TVxTV}{PTVxPTV100}$	A = 1	Paddick [5]
HI	$HI = \frac{Dmax}{DP}$	A = 0	Wu – Qiuhen [6]
	$HI = \frac{D5-D95}{DP}$	$1 < A \leq 1.1$	RTOG – 1993 [3]

**Dmax = maximum dose, Dmin = minimum dose, DP = dose prescription, Dx = the percentage of the prescribed dose covering x% planning target volume, PTV = planning target volume, PTV_{100} = the volume PTV received 100% dose prescription, TV = target volume.*

Based on the Dose Volume Histogram DVH (Dose Volume Histogram), we compare and evaluate the value of tolerated dose at OARs between the AAA and AXB algorithms. Region – specific dose limits for the techniques recommended by the Radiation Therapy Oncology Group – RTOG [7 – 10].

Pretreatment quality assurance (QA) was performed using the Electronic Portal Imaging Device (EPID) for all VMAT plans.

2.2. Results

2.2.1 Head and neck cancer

The average value of Quality of coverage – Q, Conformity Index – CI, Homogeneity Index – HI, MUs and dose of tolerance at OARs of 40 plans H&N cancer patients is show in Table 2.

Table 2: Average values of HI, CI, Q, MUs and tolerant doses at OARs in the head and neck region.

Variables		AAA (Mean ± SD)	AXB (Mean ± SD)
HI	Wu [6] (10^{-1})	0.57 ± 0.12	0.62 ± 0.13
	RTOG [3] (10^{-1})	10.85 ± 0.17	10.94 ± 0.19
CI	Paddick [5] (10^{-1})	8.55 ± 0.29	8.46 ± 0.27
	ICRU - 62 [4] (10^{-1})	10.62 ± 0.35	10.73 ± 0.36
Q [3] (10^{-1})		8.93 ± 0.84	8.98 ± 0.03
MUs		535.93 ± 56.56	533.34 ± 60.37
Spinal Cord	Dmax (cGy)	3593.01 ± 425.22	3633.06 ± 432.44
Brain Stem	Dmax (cGy)	4217.46 ± 549.52	4241.84 ± 548.67
Parotid Grand Right	Dmean (cGy)	2202.77 ± 322.69	2196.03 ± 323.68
Parotid Grand Left	Dmean (cGy)	2252.47 ± 334.39	2227.23 ± 320.28
Eye Right	Dmax (cGy)	397.66 ± 143.41	395.43 ± 147.36
Eye Left	Dmax (cGy)	421.84 ± 223.42	439.47 ± 216.99
Optic Nerve Right	Dmax (cGy)	1667.02 ± 1108.07	1630.06 ± 1162.85
Optic Nerve Left	Dmax (cGy)	1969.82 ± 1618.24	2033.86 ± 1518.27
Inner Ear Right	Dmean (cGy)	2523.81 ± 1357.09	2554.61 ± 1536.69
Inner Ear Left	Dmean (cGy)	2795.57 ± 1385.06	2816.22 ± 1386.81
Mandible	Dmax (cGy)	6526.34 ± 949.01	6439.62 ± 939.66

**cGy = centigray, Dmean = mean dose, Dmax = maximum dose, SD = standard deviation.*

Table 2 show the evaluation indicators for tumor at the algorithm. Regarding the ability to OARs established radiotherapy plans met the evaluation criteria [7 – 10]. The value of tolerated dose at OARs, the algorithm AAA gives lower dose value than the AXB algorithm such as spinal cord (1.11%), brain stem (0.58%), left inner ear (0.74%) and right inner ear (1.22%), left optic nerve (3.25%) and left eye (4.18%). But the dose value of the AXB algorithm gives lower than the AAA algorithm in other OARs such as 1.35% in the mandible, 1.13% in the parotid gland left and 0.31% in the parotid gland right, 0.56% in the right eye and 2.27% in the right optic nerve. So the difference between results of AAA algorithm and ideal value is smaller than the disparity in AXB AXB algorithm results (table 1).

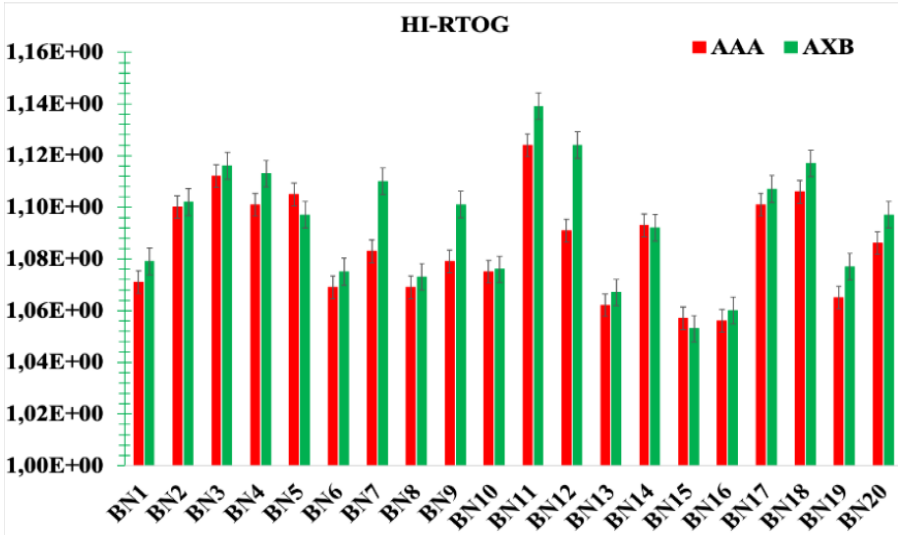

Figure 5: HI_{RTOG} index of 40 plans head and neck cancer patients.

2.2.2. Lung cancer

a. 3D – CRT

The average value of Quality of coverage – Q, Conformity Index – CI, Homogeneity Index – HI, MUs and dose of tolerance at OARs of 16 plans lung cancer patients is show in Table 3.

Table 3: Average values of HI, CI, Q, MUs and tolerant doses at OARs of 16 plans lung cancer patients with 3D-CRT.

Variables		AAA (Mean ± SD)	AXB (Mean ± SD)
HI	RTOG [3] (10^{-1})	10.55 ± 0.08	10.74 ± 0.13
	Wu [6] (10^{-1})	0.68 ± 0.10	0.70 ± 0.11
CI	Paddick [5] (10^{-1})	5.22 ± 1.03	5.09 ± 1.20
	ICRU – 62 [4] (10^{-1})	11.35 ± 3.73	11.06 ± 3.20
Q [3] (10^{-1})		8.58 ± 0.76	8.95 ± 0.32
MUs		424.94 ± 66.12	417.44 ± 61.57
Spinal Cord	Dmax (cGy)	1799.23 ± 909.20	1790.19 ± 857.67
Lung	Dmean (cGy)	561.71 ± 257.04	558.93 ± 261.43
	V5 (%)	28.99 ± 11.13	30.60 ± 13.14
	V10 (%)	18.14 ± 4.75	18.08 ± 4.73
	V20 (%)	10.13 ± 6.25	9.82 ± 5.87

Table 3 show the indicators for dose assessment in tumors, the HI_{RTOG} and HI_{Wu} indexes calculated by results of the AAA algorithm give closer to ideal values than AXB algorithms. However, $CI_{ICRU-62}$ index, Q and MUs, the AXB algorithm gives results better than AAA algorithm. In terms of the ability to OARs, established radiotherapy plans met the evaluation criteria [7-10]. The average dose into the spinal cord of the two plans uses the AAA algorithm approximating the AXB algorithm (1799.23 cGy compared to 1790.19 cGy). In lung, the DLM values are smaller than 2000 cGy, the values of the two algorithms do not change much, approximately equal (561.71 cGy with 558.93 cGy), varying by 0.49%. V5 volume, the plans use the AXB algorithm higher than the AAA algorithm 5.05%. Meanwhile with V10, V20 volume, the plans use AAA algorithm approximating AXB algorithm.

b. VMAT

The average value of Quality of coverage – Q, Conformity Index – CI, Homogeneity Index – HI, MUs and dose of tolerance at OARs of 10 plans lung cancer patients is show in Table 4.

Table 4: Average values of HI, CI, Q, MUs and tolerant doses at OARs of 10 plans lung cancer patients with VMAT.

Variables		AAA (Mean ± SD)	AXB (Mean ± SD)
HI	RTOG [3] (10^{-1})	10.82 ± 0.26	10.80 ± 0.17
	Wu [6] (10^{-1})	0.51 ± 0.06	0.55 ± 0.06
CI	Paddick [5] (10^{-1})	8.91 ± 0.68	8.80 ± 0.18
	ICRU – 62 [4] (10^{-1})	10.23 ± 0.74	10.27 ± 0.21
Q [3] (10^{-1})		9.13 ± 0.56	9.17 ± 0.51
MUs		553.75 ± 119.54	557.37 ± 127.92
Spinal Cord	Dmax (cGy)	2262.44 ± 733.54	2283.80 ± 478.96
Heart	Dmean (cGy)	534.78 ± 532.05	540.94 ± 540.87
Lung	Dmean (cGy)	629.28 ± 188.58	636.60 ± 197.32
	V5 (%)	35.53 ± 7.95	35.95 ± 7.59
	V10 (%)	21.76 ± 8.00	22.88 ± 8.81
	V20 (%)	7.68 ± 3.71	7.81 ± 3.68

Table 4 show that HI_{RTOG}, Q and MUs, the two algorithms give approximate results. HI_{Wu}, $CI_{Paddick}$ and $CI_{ICRU-62}$ indexes, AAA algorithm gives better results than AXB algorithm. Regarding the ability to organ at risk, established radiotherapy plans met the evaluation criteria [7 - 10]. The dose to the spinal-cord in the plans using 2 algorithms AAA and AXB are all Dmax < 4500 cGy. However, the algorithm AAA gives the average dose value to 0.94% lower than the AXB algorithm. For lungs, lung volume received dose V5, V10, V20 and MLD calculation value AAA give lower value than AXB algorithm respectively: 1.18%, 5.14%, 1.69%, 1.16%. The dose index for the heart, the average Dmean value of the plans when calculated with the AAA algorithm is lower than the AXB algorithm.

2.2.3 Esophageal cancer

The average value of Quality of coverage – Q, Conformity Index – CI, Homogeneity Index – HI, MUs and dose of tolerance at OARs of 30 plans esophageal cancer patients is show in Table 5.

Table 5: Average values of HI, CI, Q, MUs and tolerant doses at OARs of 30 plans esophageal cancer patients with VMAT.

Variables		AAA (Mean ± SD)	AXB (Mean ± SD)
HI	RTOG [3] (10^{-1})	11.04 ± 0.16	11.12 ± 0.15
	Wu [6] (10^{-1})	0.73 ± 0.11	0.77 ± 0.11
CI	Paddick [5] (10^{-1})	8.41 ± 0.63	8.61 ± 0.73
	ICRU- 62 [4] (10^{-1})	10.28 ± 0.74	10.08 ± 0.90
Q [3] (10^{-1})		8.56 ± 0.78	8.34 ± 0.92
MUs		477.46 ± 69.53	469.75 ± 71.12
Spinal Cord	Dmax (cGy)	3970. 29 ± 252.24	3979.25 ± 222.28
Heart	Dmean (cGy)	1609.59 ± 969.44	1604.82 ± 968.27
Lung	Dmean (cGy)	974.77 ± 194.12	956.93 ± 185.79
	V5 (%)	50.02 ± 8.90	48.57 ± 8.30
	V10 (%)	34.02 ± 6.41	33.62 ± 5.85
	V20 (%)	16.02 ± 5.36	15.86 ± 5.30

Table 5 show that HI_{RTOG}, HI_{Wu}, Q, the AAA algorithm all results close to the ideal value than the AXB algorithm, but the $CI_{Paddick}$ and $CI_{ICRU-62}$, the AXB algorithm gives results better than compared with the AAA algorithm. In terms of the ability to OARs, radiotherapy plans are almost met the criteria [7-10]. The dose to the spinal cord in the plans when using the algorithms AAA and AXB are both Dmax values < 4500 cGy and have approximately the same value. For lungs, lung volume received dose V5, V10, V20 and Dmean calculated by AAA algorithm gives higher value than AXB algorithm, respectively: 2.99%, 1.19%, 1.01%, 1.86%. The dose index for the heart is the average Dmean value of the plans when calculated with the AAA algorithm and the AXB algorithm for approximately the same value.

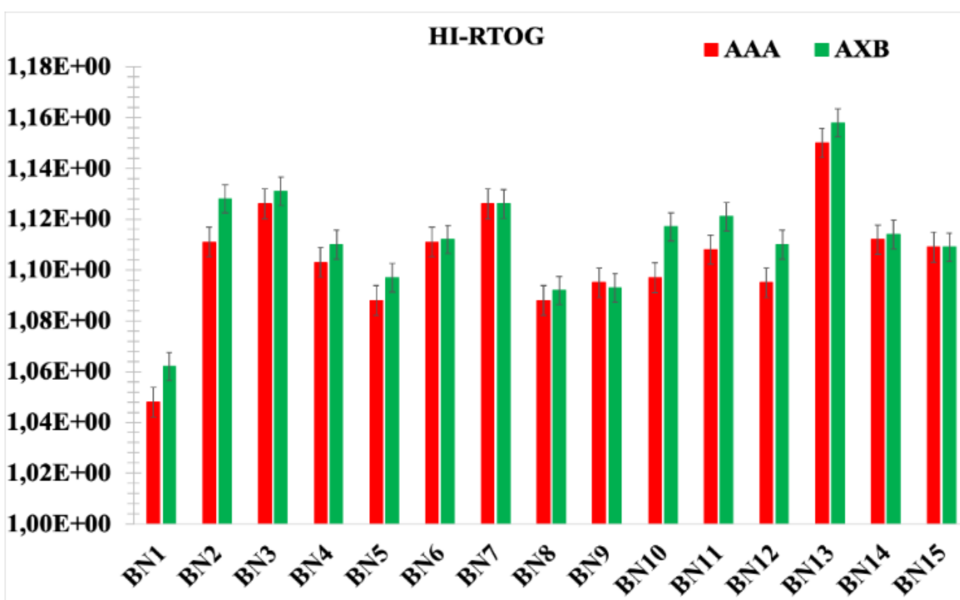

Figure 6: HI_{RTOG} index of 30 plans esophageal cancer patients.

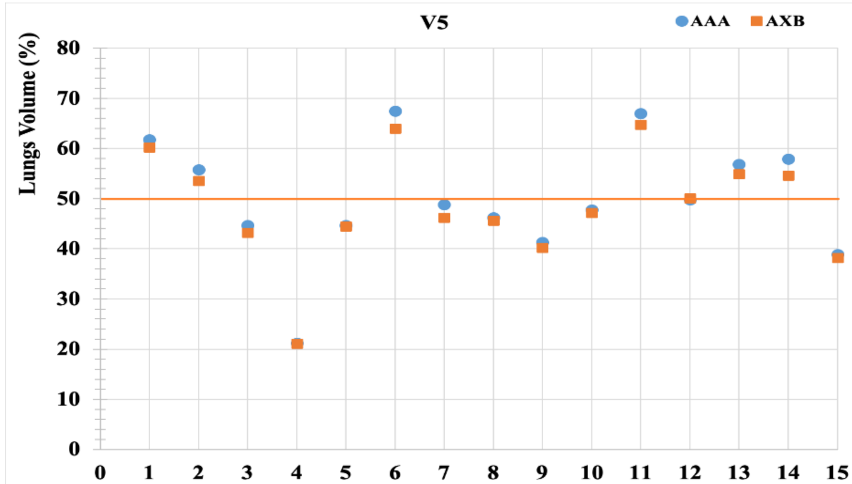

Figure 7: Volume received 5Gy dose in lungs of 30 plans esophageal cancer patients.

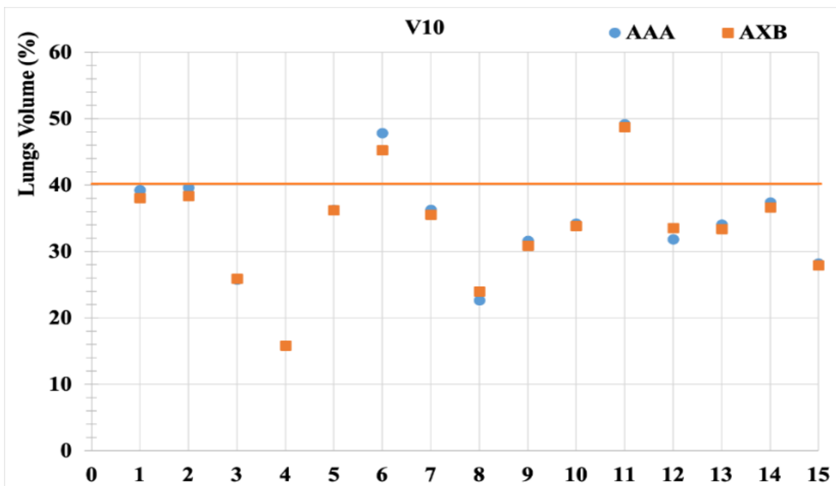

Figure 8: Volume received 10Gy dose in lungs of 30 plans esophageal cancer patients.

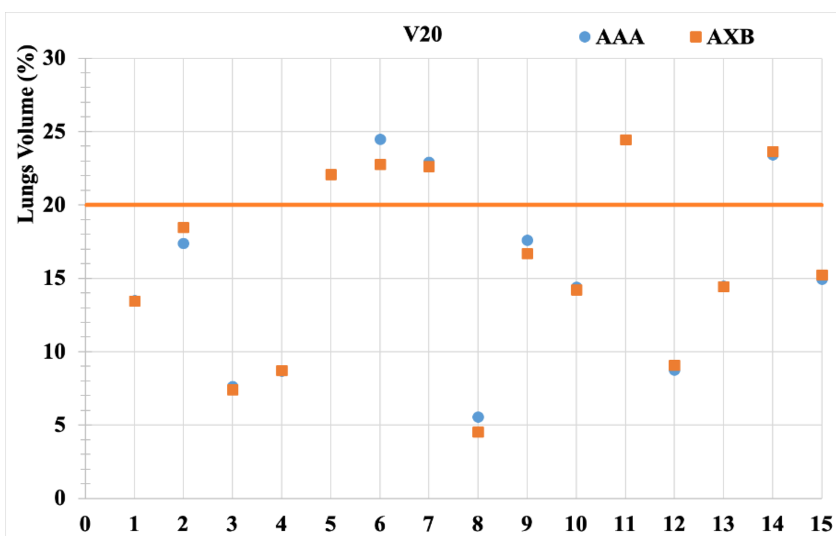

Figure 9: Volume received 20Gy dose in lungs of 30 plans esophageal cancer patients.

III. DISCUSSIONS

The previous studies on heterogeneous regions of J. Mazurier et al. [13], W.-Z. Chen et al. [14], YL Woon et al. [15] have shown the AXB algorithm calculated the dose more accurate, close to the actual measured value and Monte – Carlo simulation.

However, in the process of studying and calculating the data collected at the Department of Radiation Oncology and Radiosurgery – 108 Military Central Hospital, we found the algorithm AAA and AXB both have their own advantages and disadvantages.

For regions with uniform density, the results are calculated by two algorithms for similar results. It consistent with the studies of YL Woon et al. [15] but the calculation time AXB algorithm is slower than AAA algorithm. Therefore, it is preferable to use AAA algorithm to plan with tumors in areas with relatively uniform density.

For heterogeneous regions such as head and neck regions, tissue density changes insignificantly, so the results are calculated by the algorithm. AAA gives no significant difference in the value of tumor entry compared to AXB algorithm. However, the AAA algorithm for tumor dose assessment indicators is slightly better than the AXB algorithm, so it is currently preferred to plan.

In case tumors close to the skin or near the air sinus, it is preferable to use AXB algorithm because the accuracy of this algorithm is higher than the AAA algorithm. For the thorax area with large tissue density changes. In terms of 3D-CRT technique, the results between the two algorithms are similar but due to the calculation time of AAA algorithm is much faster than the AXB algorithm, so the case of lung cancer is indicated technically 3D-CRT, we use AAA algorithm to plan. In terms of VMAT technique, this is a high technique, using a large number of MUs, so a higher accuracy is needed to avoid much impact on the OARs. Therefore, it is important to plan the appropriate algorithm to produce accurate results. The study results show that the HI_{RTOG} index calculated by the AXB algorithm is higher than the AAA algorithm, which proves that the dose distribution for AXB algorithm will be higher than the AAA algorithm.

There is a big difference in the tolerated dose on the OARs between the two algorithms. For example, the volume of receiving V5 lung dose in esophageal cancer is calculated by the algorithm AAA for higher volume receiving dose than AXB algorithm. This is consistent with the published study of Y.L. Woon et al. [15]. In esophageal cancer, large volume of tumor, spread over many different density areas, close to the lungs, in many cases we have to accept V5 volume greater than the recommended threshold, specific data is shown in Figure 7 with the red line is the recommended threshold (50%), the green dot is the AAA algorithm, the orange dot is the AXB algorithm.

The results of treatment are assessed on two criteria: tumor eradication and protection of healthy organs. In OARs, the lungs are particularly sensitive to radiation, manifesting symptoms after 1 – 3 months if overdose [16], calculating the correct tolerance dose to OARs especially the lung is very important therefore the use of AXB algorithm to use dose calculation at the thorax area. This is consistent with the reality being implemented at the Department of Radiation Oncology and Radiosurgery – 108 Military Central Hospital.

This study has only been studied in the head & neck and thorax regions so we will continue to compare and evaluate the dose distribution on other areas of the body such as the abdomen, pelvic area with the number of patients studied greater resuscitation to statistically position each tumor. There by, making recommendations on the use of dose calculation algorithms for tumors in the body regions.

IV. CONCLUSIONS

The time advantage should use AAA algorithm to calculate the dose to improve working efficiency. However, with tumors located near the air sinus or close to the skin, use the AXB algorithm to calculate the dose. For thorax area, we will prioritize the use of AXB algorithm to calculate the dose. This is consistent with previously published studies of W. S. Rh et al. [11] and L. Wang et al. [12]. However, the above conclusions are for reference only, the use of algorithms must depend on many factors such as location, size of the tumor, the system of radiotherapy that the facility equipped, ... that medical physicists will choose the most suitable algorithm.

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