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# EFFECTIVENESS OF SEQUENCES T2 WEIGHTED TURBO SPIN ECHO AND T2 WEIGHTED MULTIVANE ON FEMALE PELVIC MRI SAGITTAL IMAGE

Sudiyono[1)] Fatimah[2)] Fadila Putri Andika[3)]

[1)] Department of Radiology, Semarang Health Polytechnique, Pedalangan Banyumanik Semarang, Central Java, 50265, Indonesia / Doctoral Student Faculty of Medicine, Universitas Diponegoro, Semarang, Indonesia Tembalang, Semarang, Central Java, 50275, Indonesia

[2)] Department of Radiology, Semarang Health Polytechnique, Pedalangan Banyumanik Semarang, Central Java, 50265, Indonesia

[3)] Radiographer of Semarang Health Polytechnic, Pedalangan Banyumanik Semarang, Central Java, 50265, Indonesia

Abstract

MRI of the female pelvis displays the best anatomical information on the sagittal section. The standard sequence used in the MRI examination of the female pelvis in the sagittal section is the T2 Weighted Turbo Spin Echo (T2W TSE) . However, the use of the Turbo Spin Echo (TSE) is sensitive to movement , so that motion artifacts often appear. To reduce artifacts researchers tried a T2 Weighted Multivane sequence on MRI of the female sagittal pelvis.

This study aims to determine the differences in anatomical image information between the T2 Weighted Turbo Spin Echo sequences ( T2TSE) and T2 Weighted Multivane (T2WM) and to find out which sequence is more optimal in producing anatomical image information on MRI examination of the female pelvis in the Sagittal section .

This type of research is quasi experimental. Data were obtained from 10 volunteers who were examined using the MRI 3 Tesla device at the Radiology Installation at dr. Saiful Anwar Malang. Each volunteer was examined using the T2WTSE dan T2WM sequents on the sagital section. The resulting image was then assessed by 2 radiologist. Data analysis was carried out using the Wilcoxon test , while the selection of the best sequence used the mean rank. Significance test using $\alpha = 0 , 05$ .

The results of statistical tests showed that there was a significant difference in Female Pelvic MRI images between the T2 WTSE and T2 WM sequences ( p-value <0.05). The mean rank value indacates that T2WM is more optimal in producing image information. The highest mean rank in rectal anatomy is T2WM 5.00.

Keywords: T2 Turbo Spin Echo, T2 Multivane, MRI of the female pelvis

## INTRODUCTION

Magnetic Resonance Imaging (MRI) is a technique of depicting body cross-sections based on the principle of magnetic resonance at the nucleus of hydrogen atoms. The MRI imaging technique is relatively complex because the images produced depend on many parameters. This tool has the ability to make images of coronal , sagittal , axial and oblique sections without much manipulation of the patient's body. If the parameter selection is right, the quality of the image of the human body will be clear, so that the anatomy and pathology of body tissues can be evaluated carefully (Notosiswoyo and Suswati, 2004) .

MRI medical imaging has advantages over other medical imaging, namely superior MRI for detecting several abnormalities in soft tissues such as the brain and bone marrow, being able to provide a clearer detailed description of anatomy, being able to perform better functional examinations, capable of making axial, coronal, and and sagittal without changing the position of the patient, each of these slice images can consist of several slices with a specified slice thickness , and MRI does not use ionizing radiation (Soesanti, et al, 2010).

According to Moeller and Reif (2003) the sequences used in pelvic MRI examinations to view the uterus, vagina and baladder are axial T2W TSE, Axial T1W TSE, Coronal T2 W TIRM (Turbo Inversion Recovery Magnitude) or STIR (Short Tau Inversion Recovery) or Coronal T2W TSE Fat Sat and Sagital T2W TSE.

Preliminary studies were conducted in Regional General Hospital Dr. Saiful Anwal Malang, MRI examination of the female pelvis using sequences os sagital T2WM, Axial T2WM, Axial T1WM, axial DWI and coronal T2WFSM. All sequences using the Turbo Spin Eco (TSE) were replaced by Multivane sequences.

Multivane is a motion correction technique recently introduced which is said to be similar to the Propeller technique using rotating blade in k-space , which makes it possible to detect in-plane motion affecting low frequencies in the center of the k-space and correct movement in the plane of each blade to reduce the effect movement in images (Kang, et al, 2015).

In terms of motion correction , Multivane is a strong competitor for the Cartesian motion correction strategy . If movement occurs, the Cartesian image will contain artifacts that cannot be removed except through repeated techniques or repeat scans and will take longer. Or with the aid of reference markers or navigator echoes which must be obtained other than imagery to provide information about the movement.

Research focused on the sagittal section , with the consideration that the sagittal section can show organs located in the midline of the pelvis, namely the bladder , uterus , rectum , and cervix (Westbrook, 2014). And according to Olson, et al (1992) sagittal sections are the best choice for evaluating the uterus , cervix , vagina , cul-de-sac , and tumor expansion in the bladder or rectum .

The purpose of this study was to determine the differences in anatomical image information between the T2 Weighted Turbo Spin Echo and T2 Weighted Multivane sequences and to determine which sequences are more optimal in producing anatomical image information on the MRI examination of the female pelvis in the Sagittal section .

## METHOD

Research are Quasi experiment . The study sample was ten volunteers, each of whom was subjected to MRI examinations of the woman's pelvis using sequences of T2 Weighted Turbo Spin Echo (T2WTSE) and T2 Weighted Multivane (T2WM). Assessment of anatomical image information was carried out by 2 respondents, Radiologist using a questionnaire sheet provided by giving a score of 1 to 3.

Score 3 = Clearly (when i nformation image of the anatomy of an organ is observed seemed demarcated and easily viewed by the observer ) score 2 = fairly clear ( get the image of the anatomy of an organ is observed not demarcated ) and a score of 1 = not clear ( image information anatomy the observed organs are not clear, even the observer finds it difficult to find the information referred to in the image being observed ) . The anatomical image assessed includes the clarity of the organs in the Uterus , Cervix , Vagina, Cul-de-sac, Bladder and Rectum areas .

To find out the difference between the image information anatomical sequences T2WTSE and T2WM, analyzed by test W ilcoxon , while the selection of a sequence that is optimally performed by selecting values mean rank tertinggi. Signifikansi statistical test with $\alpha = 0.05$.

## RESULTS AND DISCUSION

The parameter used the T2W TSE and T2WM sequences are shown in tabel 1.

Table 1. Parameters of T2 Weighted Turbo Spin Echo and T2 Weighted Multivane

| **Parameter** | T2 Weighted Turbo Spin Echo | T2 Weighted Multivane |
|---|---|---|
| Time R epetition (ms) | 3000 | 3000 |
| Time E cho (ms) | 100 | 100 |
| Slice Thickness (mm) | 3 | 3 |
| Flip Angle (degrees) | 90 | 90 |
| Field of View (mm) | 240 x 240 | 240 x 240 |

This study was conducted on 10 volunteers , as seen in the tabel 2.

Table 2. Sample Characteristics

| Characteristics | amount | Percentage |
|---|---|---|
| a. Age | | |
| 20 - 21 | 4 | 40% |
| 22 - 23 | 4 | 40% |
| 24 - 25 | 2 | 20% |
| b. Weight | | |
| 40 - 45 | 4 | 40% |
| 46 - 50 | 3 | 3 0% |
| 51 - 55 | 3 | 3 0% |

Samples were scanned with T2WTSE and T2WM sequences. The MRI image of female pelvic displayed on monitor screen for analysis by radiologist. The analysis was carried out based on observations on anatomy of uterus, cul-de-sac, bladder and rectum. Observer / Radiologist gave a chect list (√) on the questionaire with a score of 1 to 3.

The data obtained from the questionnaire results were analyzed first, the level of agreement between the two respondents using the Cohen's Kappa test. It is expected that between the two respondents to have a strong level of concentration, that is, at least Kappa = 0.61– 0.80 (Viera , 2005 ). Based on test results obtained Cohens Kappa value of 0.719 indicates that there is a level of strong agreement among the respondents because the value obtained is in the range of values of 0 , 61 -0.80.

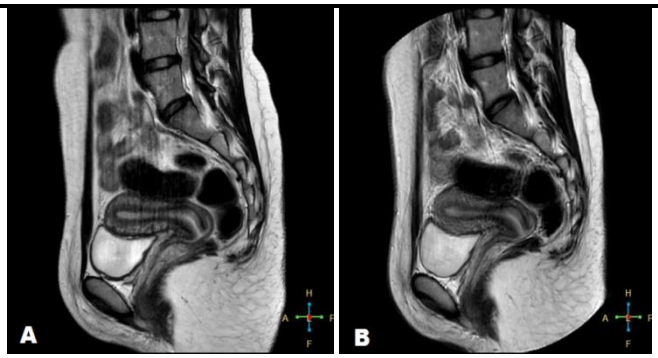


Figure 1. ( A) Image sequences T2W TSE, (B) Image sequence T2WM

The results of the Wilcoxon test on the clarity of the overall anatomical image information can be seen in table 3.The Wilcoxon test results for each anatomical criterion can be seen in table 4.

Table 3 . Different Test of T2W TSE and T2W Multivane Images

| Sequences | p-value | Information |
|---|---|---|
| T2W Turbo Spin Echo<br>Multivane T2W | 0.005 | There are differences |

Table 3 shows that there are differences in pelvic MRI images between T2W TSE and T2W Multivane sequences (p = 0 , 0005 ).

Next, the researchers conducted different tests between organs in the pelvis which included images of the uterus, cervic, vagina, cul-de-sac, bladder and rectum as shown in table 4.

Table 4 . Different test for each organ T2W TSE and T2W Multivane image

| No. | Anatomy | p-value | Information |
|---|---|---|---|
| 1. | Uterus | 0.011 | There are differences |
| 2. | Cervix | 0.021 | There are differences |
| 3. | Vagina | 0.008 | There are differences |
| 4. | Cul-de-sac | 0.008 | There are differences |
| 5. | Bladder | 0.008 | There are differences |
| 6. | Rectum | 0.003 | There are differences |

Table 4 shows that all the organs observed showed a significant difference (p < 0.05 ) between the images produced by the T2W TSE and T2W Multivane sequences.

To find out which sequence is more optimal as a whole, it is analyzed by looking at the highest mean rank value as in table 5 . To find out which sequence is more optimal in each anatomy can be seen in table 6 .

Table 5 . Overall Mean Rank

| Sequences | Mean Rank |
|---|---|
| T2W Turbo Spin Echo | 1.00 |
| Multivane T2W | 6.00 |

Table 6 . Mean Rank of each anatomy

| Anatomical Image | Sequences | Mean Rank |
|---|---|---|
| Uterus | T2W Turbo Spin Echo | 5,50 |
| | Multivane T2W | 5,50 |
| Cervix | T2W Turbo Spin Echo | 4.00 |
| | Multivane T2W | 5.13 |
| Vagina | T2W Turbo Spin Echo | 0.00 |
| | Multivane T2W | 4.00 |
| Cul-de-sac | T2W Turbo Spin Echo | 0.00 |
| | Multivane T2W | 4.00 |
| Bladder | T2W Turbo Spin Echo | 0.00 |
| | Multivane T2W | 4.00 |
| Rectum | T2W Turbo Spin Echo | 0.00 |
| | Multivane T2W | 5.00 |

Based on the results of the mean rank of each anatomy, it is known that the uterine anatomy of the two sequences both produces optimal anatomical image information but overall it can be seen that the mean rank of T2 W Eighted Multivane is higher than the T2 W Eighted Turbo Spin Echo so that the T2 W Eighted Multivane produces more optimal image information than the T2 W Eighted Turbo Spin Echo .

## DISCUSSION

1. Differences in image information between the use of T2 Weighted Turbo Spin Echo and T2 Weighted Multivane sequences on MRI of the sagittal female pelvis

   Based on result of the test statitic Wilcoxon shows of significance $p_{value}$=0.0005 ($p_{value}$<0.05), means indicates the significant difference in the information iamge between the sequence T2W TSE and T2W Multivane on MRI pelvic female sagital section.

   The difference occurs due to the different acquisition modes used in the T2 Weighted Turbo Spin Echo and T2 Weighted Multivane sequences . In the T2 Weighted Turbo Spin Echo sequence using the Cartesian acquisition mode . In this acquisition mode the data from the MR signal will fill the k-space in the order of lines per line (Elster, 2018). Turbo Spin Echo reduces the acquisition time but has the disadvantage that it is sensitive to motion so it can increase motion , image bluring and flow artifacts (Westbrook, et al, 2011).

   Whereas in the T2 Weighted Multivane sequence , the acquisition mode used is Multivane which has an advantage over Cartesian, which is to reduce the appearance of motion artifacts. This is reinforced by previous research by Meier-Schroers , et al. (2015) which states that the Multivane technique is based on different sampling methods that obtain parallel data forms (" strips " or " blades ") rotating around the center of k-space at each Time of Repetition (TR ). Because some forms of data overlap , this technique results in oversampling of the center of the k-space , which is displayed to reduce motion artifacts.

   In addition, the parameter of the long TR value at T2 Weighted will increase the risk of motion artifacts. This is in accordance with the theory of Wesbrook, et al. (2011) which states that increasing TR will increase the scan time and the opportunity for patient movement. Because of the risk of motion artifacts, an alternative Multivane acquisition mode is used which will reduce motion artifacts that arise during MRI examinations.

   Scan time, the T2 Weighted Turbo Spin Echo sequence is faster, which is 04:00 minutes, while the T2 Weighted Multivane is 1 minute 45 seconds longer, which is 05:45. H al are consistent with previous research by Oshita, et al (2014) which states that the scan time T2W Multivane longer than T2W Cartesian ( Turbo Spin Echo ). The T2W Multivane scan time is longer because the Number of Excitation needed to cover the k-space is 2 times that of the Cartesian. A large NEX will extend the scan time .

2. Optimal image sequences between the use of T2 weighted Turbo Spin Echo and T2 Weighte d Multivane on MRI Pelvis woman cuts sagittal

   Values mean rank between the two sequences have a range that far especially in the anatomy of the rectum is the value of mean rank in the sequence T2 weighted Turbo Spin Echo of 0.00 while the sequences T2 weighted Multivane have values mean rank 5.00.

   The T2 Weighted Multivane sequence using the Multivane acquisition mode has the advantage of minimizing the emergence of motion artifacts so as to produce optimal MRI images in displaying anatomical image information. But it also has a drawback, namely the longer scan time due to Number of Excitation takes longer to fill k-space . Long scan times affect the SAR ( Specific Absorption Rate ), which is the radiofrequency power sent to the tissue during an MRI examination. With a long scan time , the SAR value is higher and the patient will feel his body tissue heating up (Allison and Yanasak, 2015).

## CONCLUSION

There is significant difference image of female pelvis MRI image sagital section between T2W TSE and T2WM with $p_{value}$ <0.05. T2W Multivane is more optimal in producing MRI image information of sagital female pelvic campared to the T2W TSE.

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