◈ Original Article ◈

The Difference of the Changes of Images on Ultrasound Scanner Setting Parameters

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Abstract

The setting parameters of ultrasound scanner give influences to change of image. Sonographers have used a Matlab program to make Low Contrast Sensitivity(LCS) value and compared original images in order to evaluate the use of the supersonic diagnosis machinery. We confirmed the change of image in Grayscale values using Photoshop program. Experiment equipment of our research used A Medison Accuvix V10, A Multi-Tissue Ultrasound Phantom(040 GSE) of CHRIS Company, A Adobe Photoshop CS4 Program, A Convex Probe, A USB memory stick, A Probe Fixation Equipment. The method used Gain, Dynamic Range(DR) of the setting parameters of ultrasound scanner and researched Gain and DR was set to 10 dB. We changed the different settings to see the changes of images using Grayscale values of a Photoshop program about tissue images of a phantom. This study evaluated DR and Gain whether it is an image controller to get the optimum contrast to produce an image to see the how effect on the images. We did not use Gateway in supersonic diagnosis machinery. We can easily open to open the files through Photoshop program before we get Digital Imaging and Communications in Medicine(DICOM) files use USB memory stick in supersonic diagnosis machinery. When we diagnosed the lesion of the patient with ultrasound, the contrast and the Gray scale value of image are very important. In this research, we determined the optimum setting parameters that provided useful information to diagnose disease and evaluated the change of improved images.

Key Words : Ultrasound scanner, LCS, DR, DICOM

Ⅰ. Introduction

Because Ultrasound uses sound's wave, it is not exposured to radiation unlike other radiation equipment. So user and a patient are safe and users can verify the image promptly.[1] Ultrasound is easy to use and relatively economical, so it is used for primary diagnostic equipment.[2] The ultrasound users worked at the hospital are making an effort to get the best images that contain diagnostic information as many as possible. The accuracy of ultrasound depends on the user's skills of the sonographer, and the sonographer need to develop their skills and find out the image change according to different

Received August 30, 2010/ 1st Revised October 4, 2010/
Accepted for Publication October 15, 2010
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setting of equipment. The parameter of ultrasound affects the image. The parameter includes Frequency, Time Gain Compensation(TGC), Dynamic Range(DR) Gain, and it is important to understand them.[3~4] In this experiment, variable DR will be decided a range of echo which are the strong and the weak and will be indicated the high and low signals within the wide range of gray scale. Also, Gain can adjust the brightness of images.[5~6] Present, in this parameters, there is a method that can verify the image quality using the phantom but this method can get the image through the special processing. To get a best images, we experiment the image change according to the parameter and record images pixel value using the Photoshop CS 4 Program that ordinary people can use easily. This is the experiment to find out the image change according to the parameter and to verify the specific image change. Therefore, we were obtained the best image of the scan and there will be distinguished the diagnostic diseases from noraml.

Ⅱ. Material and Method

1. Material

In the present study, we used the Medison Accuvix V10. The Phantom we used is Multi-Tissue Ultrasound Phantom(040 GSE, CIRS, USA). The probe we used C2-5 EL(C2-5 EL, Medison, Korea), Convex Probe. Also we were used probe fixed equipment, photo shop CS 4 program and USB memory stick.

2. Method

Using the ultrasound equipment we were selected the area of the phantom and were analysis of the change of image according to the parameter. We were used equipment, Medison Accuvix V10, and used the probe fixed equipment

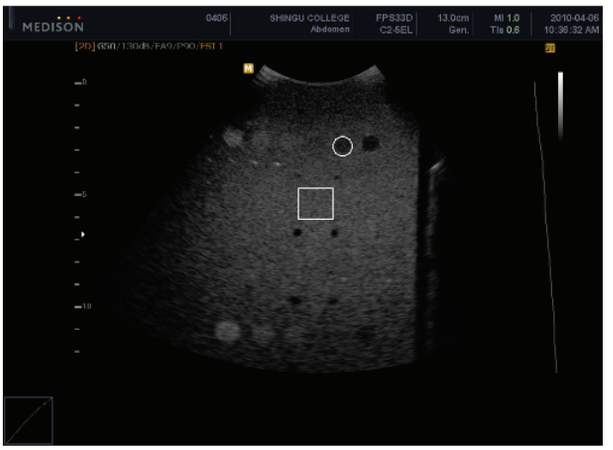

Fig. 1. The image of the phantom of the desginated range.

to fix the phantom with probe. For this study isthat we were used variable DR and Gain. Therange of DR were 50, 60, 70, 80, 90, 100, 110, 120, 130, 140 and 150 dB. and the range of Gain were 20, 30, 40, 50, 60, 70, 80, 90 and 100 dB. And we gained 117 images from the variable DR and Gain.

The 117 images were transferred from ultrasound equipment to USB memory stick with DICOM file. After the DICOM file which acquired ultrasound equipment loads in the Photoshop CS4 Program, we designated a part of the cyst(-3 dB) and 1 × 1 cm^2 area which is similar to parenchyma tissue. And we measured gray scale of the average intensity(Fig. 1). We made a diagram and graph from the value of measurement that are different between cyst and gray scale of the tissue by using DR and Gain.

Ⅲ. Result

This study is to investigate how affect the image caused by DR and Gain. Fixed DR, the image was brighter with Gain which are increased by every 10 dB(Table 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13).

Table 1. In DR 50 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	50	0.50	15.05
2	30	50	6.02	52.10
3	40	50	22.98	115.56
4	50	50	72.26	182.16
5	60	50	130.02	222.95
6	70	50	199.74	250.53
7	80	50	240.00	253.39
8	90	50	252.89	253.46
9	100	50	253.48	253.70

Table 2. In DR 60 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	60	0.44	11.22
2	30	60	4.98	38.93
3	40	60	17.23	83.68
4	50	60	55.84	141.43
5	60	60	99.98	190.19
6	70	60	151.28	233.00
7	80	60	206.66	250.48
8	90	60	241.07	253.28
9	100	60	250.53	253.49

Table 3. In DR 70 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	70	0.40	9.12
2	30	70	3.36	28.71
3	40	70	14.21	65.44
4	50	70	40.77	109.86
5	60	70	76.62	152.09
6	70	70	120.78	195.47
7	80	70	165.39	232.34
8	90	70	206.54	249.66
9	100	70	240.76	250.12

Table 4. In DR 80 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	80	0.36	7.28
2	30	80	2.96	22.89
3	40	80	10.95	51.34
4	50	80	34.26	88.55
5	60	80	61.24	124.17
6	70	80	98.15	161.35
7	80	80	135.59	196.96
8	90	80	173.36	229.63
9	100	80	208.93	248.54

Table 5. In DR 90 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	90	0.32	6.05
2	30	90	2.69	19.11
3	40	90	9.72	42.77
4	50	90	27.14	72.76
5	60	90	49.88	102.60
6	70	90	80.51	136.95
7	80	90	114.51	169.88
8	90	90	156.83	202.68
9	100	90	185.42	224.96

Table 6. In DR 100 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	100	0.27	5.21
2	30	100	2.32	16.42
3	40	100	8.55	34.21
4	50	100	23.86	62.87
5	60	100	37.80	88.68
6	70	100	67.39	116.58
7	80	100	98.01	146.62
8	90	100	124.41	175.08
9	100	100	158.79	200.42

Table 7. In DR 110 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN (dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	110	0.15	4.78
2	30	110	2.18	13.89
3	40	110	7.38	28.32
4	50	110	21.45	47.67
5	60	110	37.17	74.75
6	70	110	59.40	100.93
7	80	110	85.42	127.46
8	90	110	109.47	153.26
9	100	110	139.45	177.47

Table 8. In DR 120 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	120	0.21	4.73
2	30	120	2.07	13.47
3	40	120	6.63	25.48
4	50	120	18.97	42.05
5	60	120	33.32	61.22
6	70	120	51.39	86.99
7	80	120	75.53	110.81
8	90	120	96.25	135.52
9	100	120	123.03	157.78

Table 9. In DR 130 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	130	0.16	4.29
2	30	130	1.99	10.98
3	40	130	6.28	24.58
4	50	130	18.01	40.99
5	60	130	30.71	57.55
6	70	130	48.34	78.00
7	80	130	66.58	99.36
8	90	130	85.58	120.79
9	100	130	111.20	142.79

Table 10. In DR 140 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	140	0.13	3.91
2	30	140	1.61	9.69
3	40	140	6.01	21.96
4	50	140	16.59	36.51
5	60	140	26.40	51.38
6	70	140	41.94	69.33
7	80	140	59.09	88.55
8	90	140	75.61	108.12
9	100	140	97.53	126.47

Table 11. In DR 150 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	150	0.11	3.57
2	30	150	1.36	8.38
3	40	150	5.66	19.04
4	50	150	14.10	32.55
5	60	150	23.42	45.68
6	70	150	38.32	61.78
7	80	150	51.49	78.89
8	90	150	67.65	96.50
9	100	150	85.34	113.82

Table 12. In DR 160 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classification	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	160	0.08	3.08
2	30	160	1.18	7.53
3	40	160	5.38	17.23
4	50	160	12.53	29.59
5	60	160	20.54	41.40
6	70	160	34.99	55.83
7	80	160	48.56	71.08
8	90	160	61.28	87.42
9	100	160	76.91	103.52

Table 13. In DR 170 dB, the result that the gain increased in 10 dB (unit : Grayscale value)

Classifi-cation	GAIN(dB)	DR(dB)	Cyst (−3 dB)	Parenchyma tissue
1	20	170	0.07	2.93
2	30	170	1.02	6.94
3	40	170	5.12	15.57
4	50	170	12.10	26.96
5	60	170	18.22	37.71
6	70	170	32.55	50.81
7	80	170	46.04	64.78
8	90	170	57.31	79.69
9	100	170	70.88	95.99

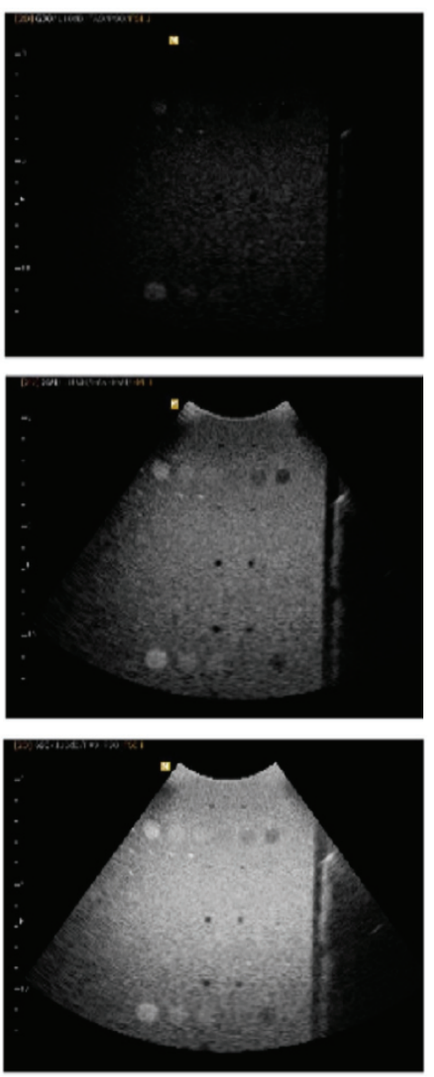

Fig. 2. There are image when Gain 30 dB increasing from the condition which fixes DR

We measured the gray scale of the average intensity using by Photo shop CS 4 program. Then the figure were increasing significantly and it means that the image were brighter(Fig. 2).

We were reviewed the data of Table 1~13 that are indicated fixed Gain were increased in 10 dB of DR. and the gray scale of the average intensity was decreased(Fig. 3).

It means that it is not change of bright but change of amplitude ratio. If the DR was narrow, the image was rough because amplitude ratio was

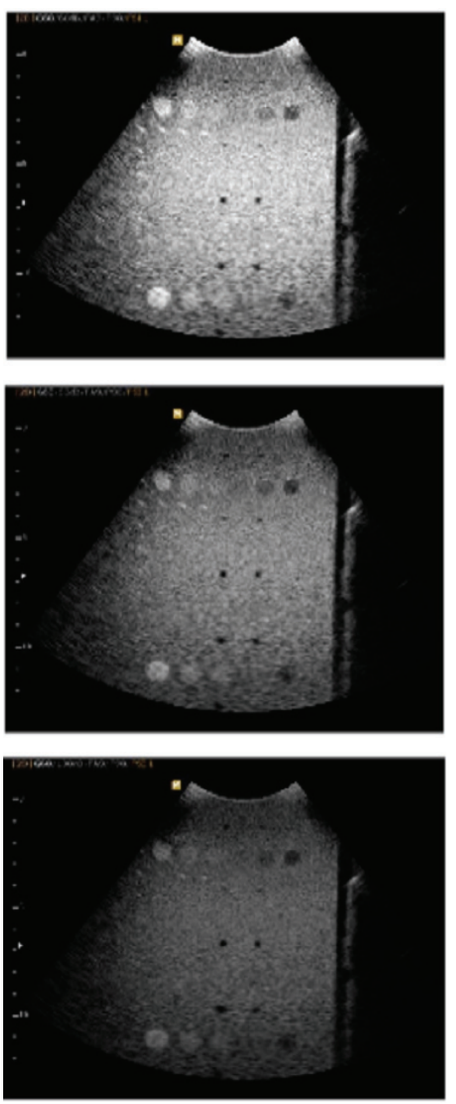

Fig. 3. There are images when DR 30 dB increasing from the condition which fixes Gain

small. And if the DR is wide, it is difficult to distinguish the normal tissue. We draw the data on the basis of this data. In the DR 50~170 dB, the graph showed that the Gain of the cyst increased in 10 dB(Fig. 4). In the DR 50~170 dB, the graph showed that the Gain of parenchyma increased in 10 dB(Fig. 5). According to the data, the graph showed that bigger the value of grey scale was greater contrast with differences of cyst in the parenchyma tissue(Fig. 4). Therefore, best setting were when the DR was 50 dB, the suitable Gain was 50 dB, when the DR was 60 dB, the Gain was 60 dB, when the DR was 70 dB, the Gain was 60 dB, when the DR was 80 dB, the Gain was 60 dB, and when the DR was 90 dB, the Gain was 70 dB. And this graph also changed from curved graph to straight graph that in the parenchyma, the distinction of the cyst were less influenced with gain by the increasing DR(Fig. 6).

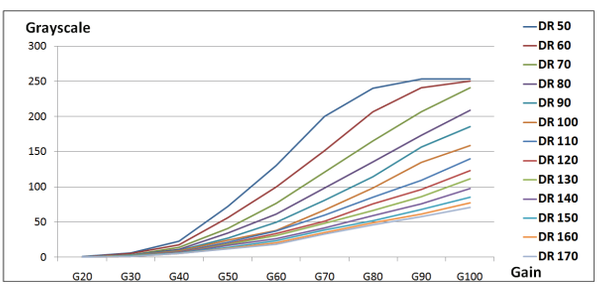

Fig. 4. In DR 50~170 dB, the graph that cyst's Gain increased in 10 dB

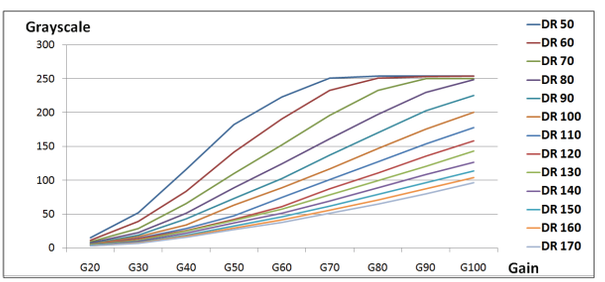

Fig. 5. In DR 50~170 dB, the graph that Gain of parenchyma increased in 10 dB

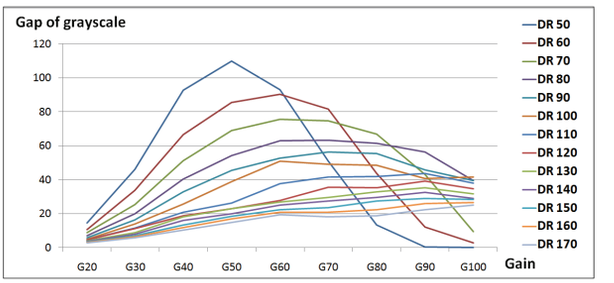

Fig. 6. Gain's effect caused by DR change

Ⅳ. Discussion

Ultrasound detects the returned ultrasonic waves and indicates the image on the monitor in real time. Because Ultrasound is simple method, the patient can be comfortable and it is harmless to humans so that there are many advantage for the diagnostic examination. The parameter of the Ultrasound equipment affects the change of the image and can be easy to control the parameter. It is possible to evaluate objectively with the ATS 539 phantom for LCS value, but it requires more professional knowledges to get the value of ATS 539 phantom.[7~8] There is the phantom that can conform the axial resolution, distance resolution and cyst. We were used phantom that are experimented how affected the image by setting of parameter. Because Ultrasound can be affected by a variable image according to the gel and probe angle. Therefore, we were used the probe fixed equipment to get a accurate value and we made it to confirm the change of image by quantitatively and objectively. Also we were find out that we did not use the Gateway, instead of, Using the USB memory stick to achieve the DICOM file. Then were able to evaluate by the Photoshop program.[9~11] Actually, Using the printer in the equipment, there is many cases that give the image to the patient. Because it is too small, there are many difficulties to observe the diagnostic area. However, Photo shop program can be possible to change freely, it can be overcome

the weakness of this matter and there will be useful for the diagnosis. Contrast and gray scale are very important for the diagnosis of the patient using ultrasound. This study was to investigate how affect the image caused by DR and Gain using ultrasound parameters. and it is anticipated that it will produce the useful information to set up the best variable parameters in clinical setting. Also, many ultrasound companies setting are different, so that further the experiment will be necessary for best parameter for the each equipement.

Ⅴ. Conclusion

In this study result showed that bigger the value of grey scale was greater contrast with differences of cyst in the parenchyma tissue. and the best setting of gray scale were when the DR was 50 dB, the suitable Gain was 50 dB. Also there were when the DR was 60 dB, the Gain was 60 dB, when the DR was 70 dB, the Gain was 60 dB, when the DR was 80 dB, the Gain was 60 dB, and when the DR was 90 dB, the Gain was 70 dB. Depends on the sonographer and use of equipment of ultrasound, in this study will be provided useful information that for the setting of the scanning parameter of diagnostic ultrasound.

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