

Bladder Volume Assessment for Prostate Radiotherapy Using Ultrasound

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INTRODUCTION

Bladder protocol in treating prostate cancer patients is essential to minimize small bowel and bladder toxicity. Therefore, we integrate the bladder volume assessment using ultrasound scanner together with verbal instruction to increase accuracy of the treatment. The aim of this study is to evaluate the effectiveness of bladder volume assessment using ultrasound scanner in patients undergoing treatment for prostate cancer.

METHODS

Ten patients underwent radical radiotherapy for prostate cancer from February 2020 until November 2020 were randomly selected in this study. Patients were instructed to empty their bladder before drinking 3 cups of water 30-60 minutes prior to CT Simulation. Each patient underwent ultrasound scan (Figure 1.0) to determine the bladder volume before the CT scan was performed and post CT scan was done to acquire the average bladder volume. An ultrasound scan was performed daily on each patient to examine the bladder volume (Figure 1.1, Figure 1.2) prior to the treatment. Daily cone beam CT were performed to verify the internal organs and bladder filling before proceeding with treatment.

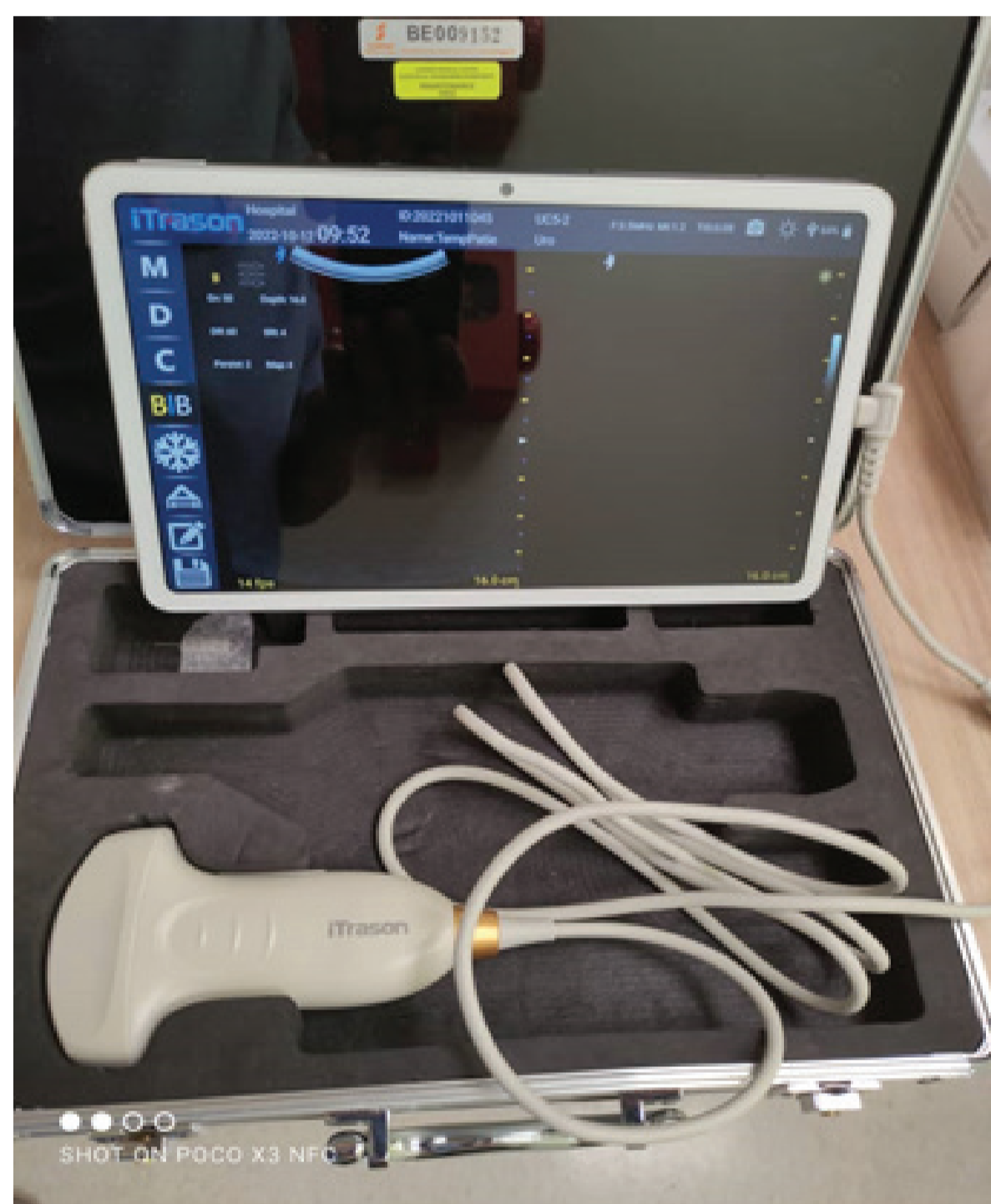
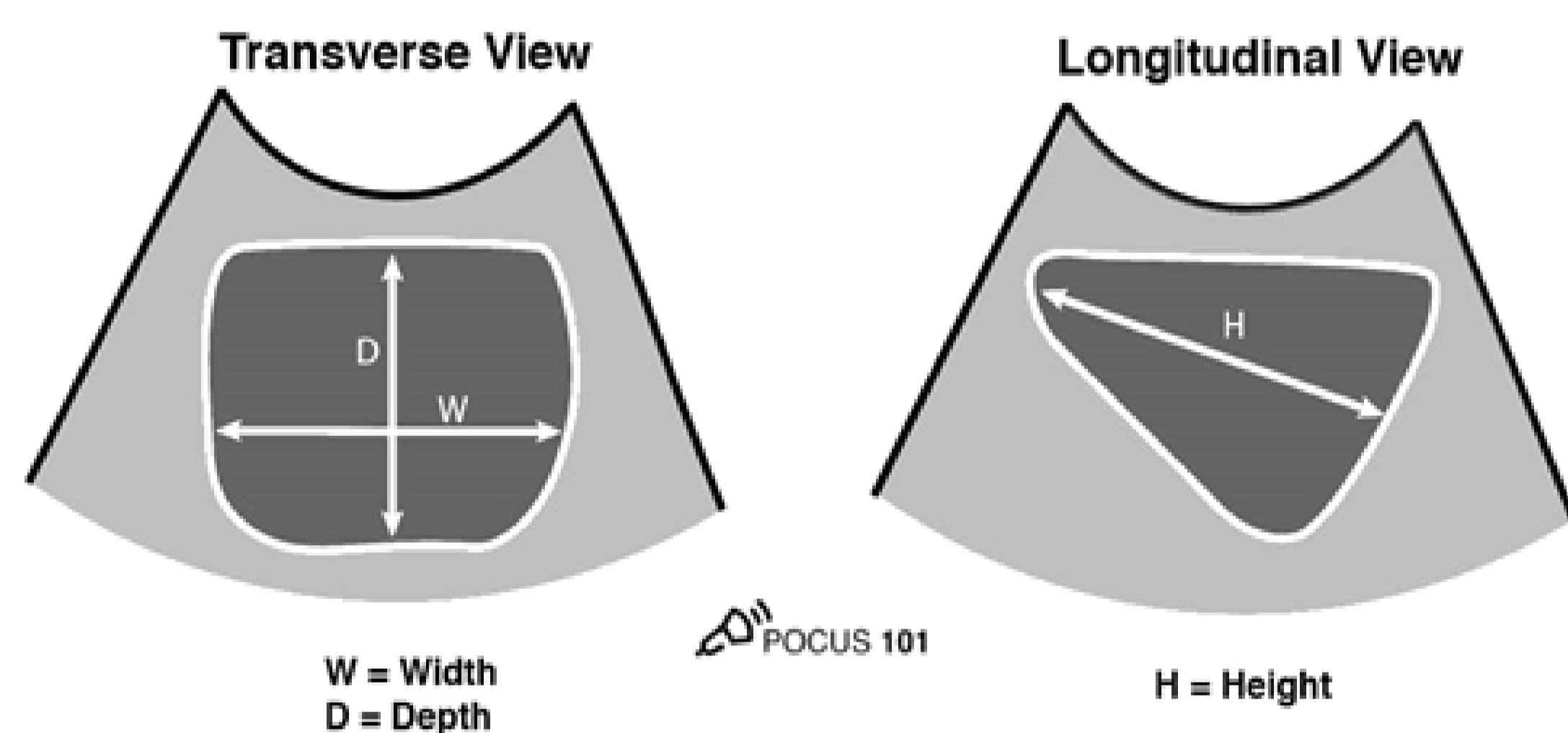


Figure 1.0 iTrason ultrasound machine

$$\text{Bladder Volume} = \text{Width} \times \text{Depth} \times \text{Height} \times 0.7^*$$



*0.7 is the correction coefficient. This value depends on the shape of the bladder

Figure 1.1 Formula for the measurement of bladder volume

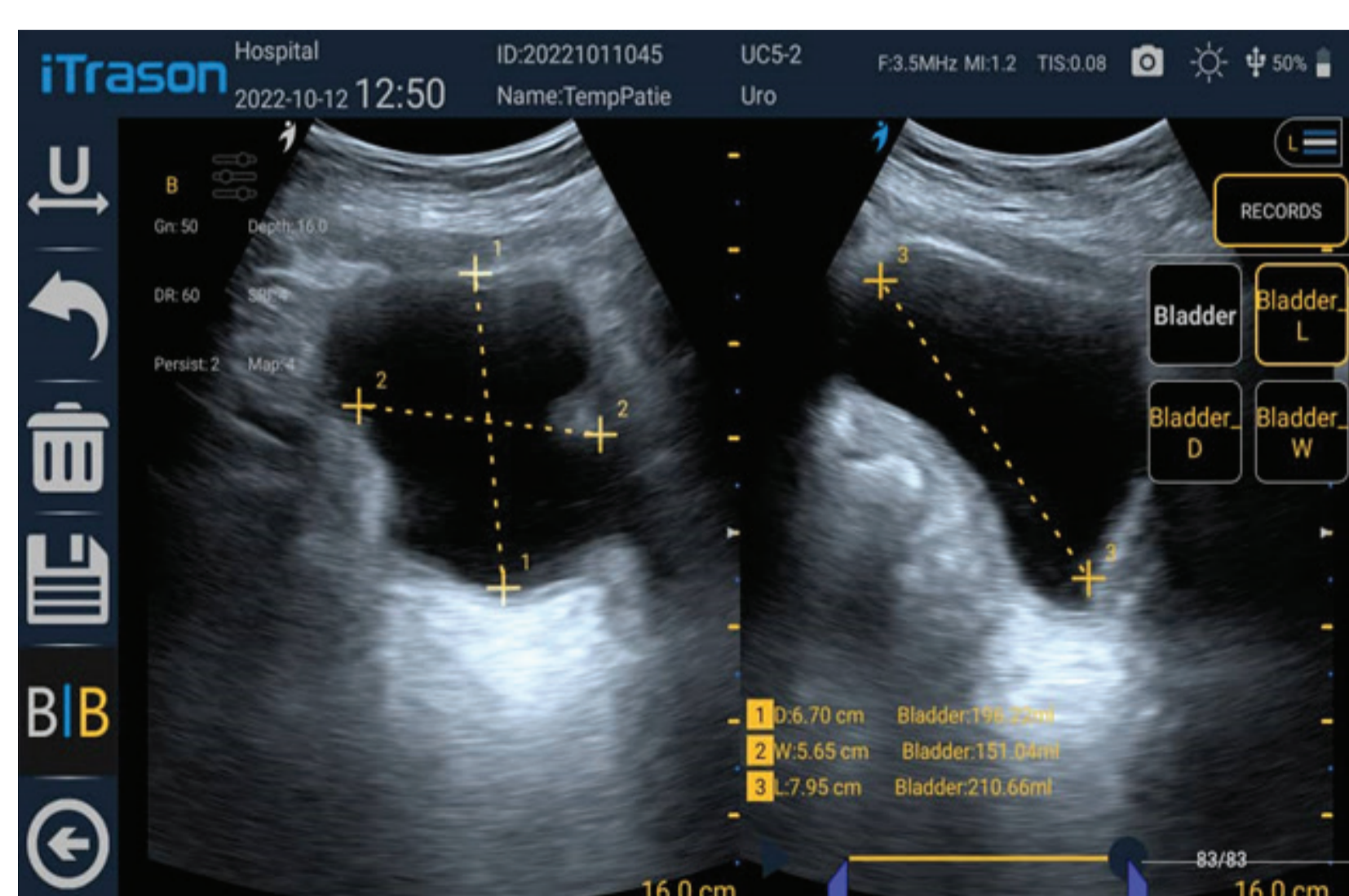


Figure 1.2 Measurement of bladder volume using iTrason ultrasound machine

RESULTS

Table 1.0 showed the measurement of bladder volume for CT simulation with the mean value at 147.30 ± 30.81 mL, with the lowest measurement is 110 mL and the highest at 200 mL. Whereas the bladder volume during treatment is at the average of 138.58 ± 29.69 mL, while the minimum measurement is 99.80 mL and the maximum measurement at 192.20 mL. The average of differences in bladder volume compared with daily treatment was at 5.97%, with the lowest differences at 1.82% and the highest differences at 12.46%. Test Retest Reliability (Table 1.1) using Pearson Correlation Coefficient showed excellent reliability between the measurement of bladder volume from CT Simulation when compared to daily treatment, at $r = 0.989$, 95% Confidence Interval (CI). Figure 1.3 showed the reliability of the measurement between the CT-simulation and treatment.

Table 1.0 Descriptive analysis

| | CT simulation | Treatment |
|----------------|---------------|-----------|
| Mean | 147.30 | 138.58 |
| Std. Deviation | 30.81 | 29.69 |
| Minimum | 110.00 | 99.80 |
| Maximum | 200.00 | 192.20 |

Table 1.1 Pearson Correlation between CT simulation and treatment

| | | CT simulation | Treatment |
|---------------|---------------------|--------------------|--------------------|
| CT simulation | Pearson Correlation | 1.000 | 0.989 ^a |
| | Sig. (2-tailed) | | 0.000 |
| | N | 10 | 10 |
| Treatment | Pearson Correlation | 0.989 ^a | 1.000 |
| | Sig. (2-tailed) | 0.000 | |
| | N | 10 | 10 |

a. Significant at .05 level

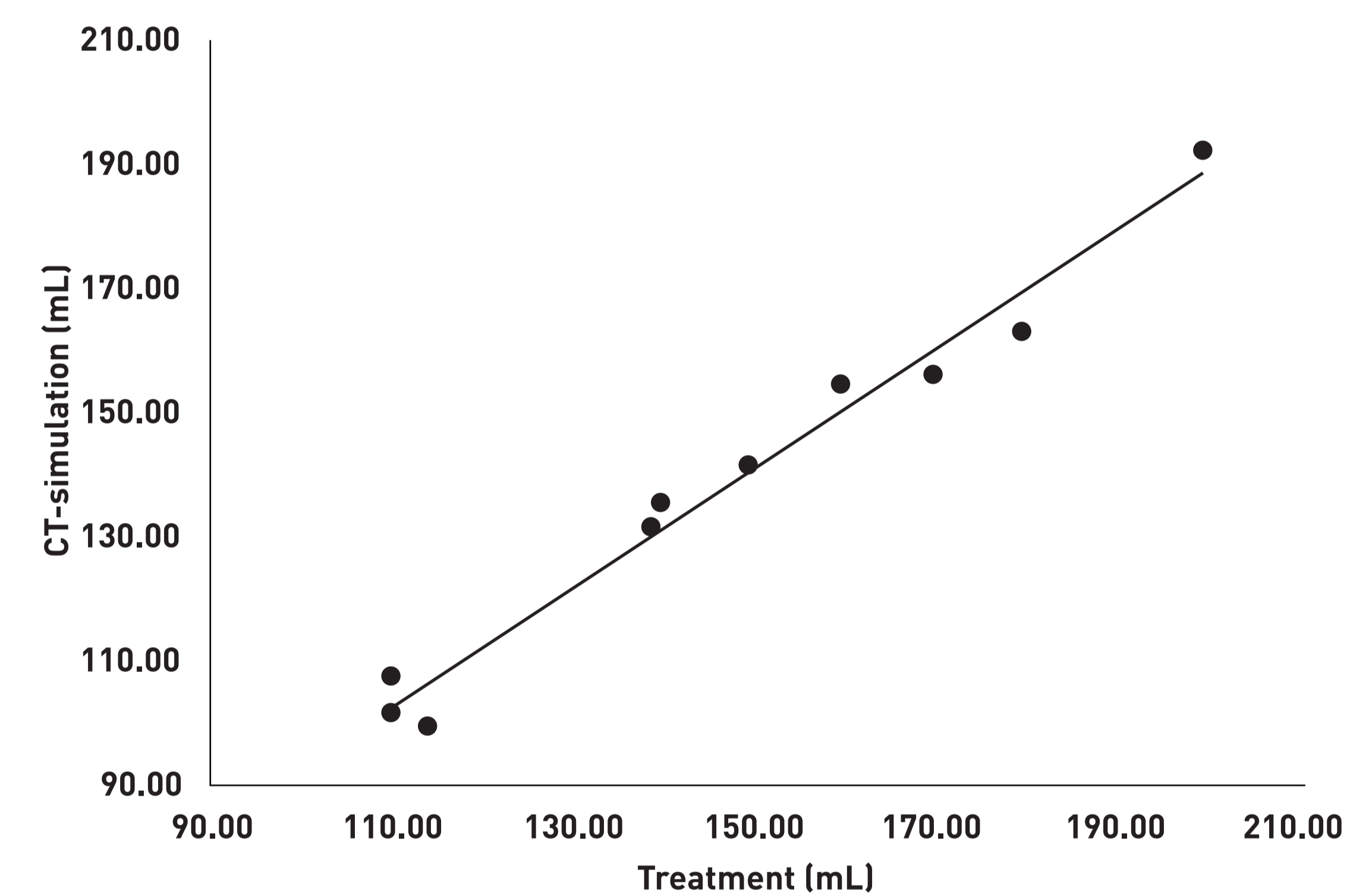


Figure 1.3 Correlation between bladder volume (mL) measurement during CT-simulation and treatment

DISCUSSION

Bladder volume could be achieved as corresponding to during CT Simulation with the aid of ultrasound scan. The volume of bladder was mostly achievable during daily treatment for each patient and allowed patients to have less radiation exposure due to less number of CBCT performed.

CONCLUSION

Daily CBCT shows significant improvement in reproducing similar bladder volume for daily treatment. The guidance of an ultrasound scanner provides a better experience for patient and smooth workflow for the department.

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