

DIAMETER OF CORPORA CAVERNOSA, CORPORA SPONGIOSA AND CAVERNOSA ARTERY IN PATIENTS WITH ERECTILE DYSFUNCTION USING GRAYSCALE ULTRASONOGRAPHY ON FLACCID PHASE AT DR. SUTOMO REGIONAL PUBLIC HOSPITAL, SURABAYA

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Abstract

Background : Erectile dysfunction is a condition in men that often has a negative impact on quality of life. Penile grayscale ultrasonography in the flaccid phase is a non-invasive imaging modality to evaluate anatomy of the right and left corpora cavernosa, cavernosa artery, and corpora spongiosa of the penis. **Objective :** To determine the profile of penile structure in patients with erectile dysfunction evaluated using a gray scale ultrasonography in the flaccid phase. **Methods:** This was a retrospective descriptive study in male patients (aged 30-65 years) with erectile dysfunction who underwent an ultrasonography examination at the Radiology Department of Dr. Soetomo Hospital, Surabaya in December 2019 to June 2020. The degree of erectile dysfunction is based on the value of *International Index of Erectile Function-5* (IIEF-5). Penile ultrasonography was performed during the flaccid phase, cavernous artery diameter was measured, diameter of the right and left corpora cavernosa and corpora spongiosa were measured at the base of the penis. **Results:** 30 patients with erectile dysfunction, 11 (36%) mild patients, 8 (27%) mild-moderate patients, 8 (27%) moderate grade patients, and 3 (10%) severe patients. Mean diameter of cavernous artery, corpora cavernosa, corpora spongiosa of erectile dysfunction patients measured in the flaccid phase was 0.062 cm, 1.0 cm, and 0.9 cm, respectively. **Conclusion:** Penile grayscale ultrasonography in the flaccid phase can be used to measure the diameter, where the more severe degree of erectile dysfunction, diameter of corpora cavernosa, corpora spongiosa, and cavernosa artery became smaller.

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Keywords : Penile grayscale ultrasound, erectile dysfunction, flaccid phase

1. Background

Erectile dysfunction is a condition in men that often has a negative impact on the quality of life. Incidence of erectile dysfunction is 13-76% of men increases, which increases with age. Erectile dysfunction is caused by many organic factors, especially in the vascular system. In erectile dysfunction cases, there are many endothelium damage of penile blood vessels, such as atherosclerosis which causes the erection not optimal resulted from inelasticity of penile blood vessels. The elasticity of penile blood vessels plays an important role in an erection because the vessels are enlarged and filled with blood.

Penile ultrasonography in flaccid conditions is a diagnostic and evaluation tool according to several studies, it can describe condition of the penis such as during an erect condition. Sen *et al*, in 2007 conducted a study of 40 people with erectile dysfunction, proving that PSV was below 10 cm/s The flaccid phase can predict

patients with erectile dysfunction without evaluation in the erectile phase with a sensitivity of 94.1%.

Several studies on the diameter of corpora cavernosa and cavernosa artery have been carried out, including by Chairil OA *et al* in 2005 from University of Malaysia, which examined diameter of corpora penis in infants using an ultrasonography. Smith DP *et al* in 1995 conducted a study of diameter of penis corpora in children and its relationship with sexual development. To dare, studies on diameter of corpora penis remains rare, especially in patients with erectile dysfunction. One of the studies was done by Kuang-kuo Chen *et al* in 1997, which measured diameter of corpora cavernosa and penile volume in 20 patients with erectile dysfunction in the flaccid phase compared to their erectile phase.

Research at Dr. Sutomo Hospital Surabaya in 2019 by Fahmi MN *et al*. proved that peak systole velocity measured by color doppler ultrasound in patients with erectile dysfunction was decreased, in line with the severity of erectile dysfunction. This showed that blood flow to corpora cavernosa in patients with erectile dysfunction is lower than normal people. Due to data absence from previous studies, especially in Indonesia, it encourages authors to conduct a study on description of diameter of corpora cavernosa, corpora spongiosa and cavernosa artery of patients with erectile dysfunction evaluated using a grayscale ultrasonography in the flaccid phase at Dr. Sutomo, Surabaya.

2. Methods

This was a descriptive retrospective study using patient data of penile ultrasonography. The study sample was all male patients with erectile dysfunction who underwent an ultrasonography examination at the Radiology Department of Hospital Dr. Soetomo, Surabaya in December 2019 to June 2020. Inclusion criteria were men with mild to severe erectile dysfunction, aged 30 to 65 years, married and still living with their wives, sexually active. Meanwhile patients with psychological disorders, spinal cord injury, history of penile implant use, history of heart attack, stroke, and life-threatening arrhythmias, and abnormal anatomy of the penis that made examination difficult were excluded from the study.

Independent variable was patients with mild to severe erectile dysfunction according to IIEF-5. Dependent variables in this study were diameter of corpora cavernosa, corpora spongiosa and cavernosa artery. Erectile Dysfunction (ED) is a condition characterized by inability to achieve and maintain optimal penile erection, and this condition can reduce the patient's quality of life. Diagnosis of ED is made based on the value of International Index of Erectile Function-5 (IIEF-5), which score of 5-21 is diagnosed as ED, and it is not considered as ED if score is 22-25. Based on the degree according to the IIEF-5 score, ED was classified into mild (17-21), mild-moderate (12-16), moderate (8- 11) and severe (5-7). Ultrasonography (USG General Electric Logiq E9) is a diagnostic tool based on sound waves. Measurements were made at the base of the penis in the ventral part each measurement is done three times on each corpora, then average value was calculated. Examination was carried out in the flaccid phase, diameter of cavernosa artery, corpora cavernosa as well as right and left corpora spongiosa were measured at the base of the penis.

Data from this study presented in tables along with a narrative explanation.

3. Results

In the current study, there were 30 patients. Mean age was 49 years, the youngest age was 40 years old, while oldest age was 61 years.

Table 5.1 Distribution of sample by age

Age	Sample Size
40-45	8
46-50	8
51-55	13
56-61	1

From total of 30 samples, based on IIEF-5 degree of erectile dysfunction, 11 patients had mild erectile

dysfunction, 8 patients had mild-moderate erectile dysfunction, 8 people had moderate erectile dysfunction and the remaining 3 people had severe erectile dysfunction.

Table 5.2 Distribution of sample according to degree of erectile dysfunction

Degree of Erectile Dysfunction (IIEF-5)	Sample size
Mild	11
Mild – Moderate	8
Moderate	8
Severe	3

In mild degree group (11 patients), the largest diameter of cavernous artery was 0.11 cm and the smallest was 0.08 cm with an average diameter of 0.093 cm. In mild-moderate group, the largest diameter was 0.10 cm, the smallest was 0.07 cm and average diameter of 0.074 cm, while in moderate group the largest diameter was 0.10 cm, the smallest was 0.07 cm with average diameter of 0.083 cm. In severe group, the largest diameter was 0.08 cm and the smallest was 0.07 cm with average of 0.073 cm.

Table 5.3 Diameter of cavernosa artery

Degree of Erectile Dysfunction	Average Diameter(Cm)
Mild	0,093 ± 0,017
Mild – Moderate	0,074 ± 0,03
Moderate	0,083± 0,017
Severe	0,073 ± 0,08

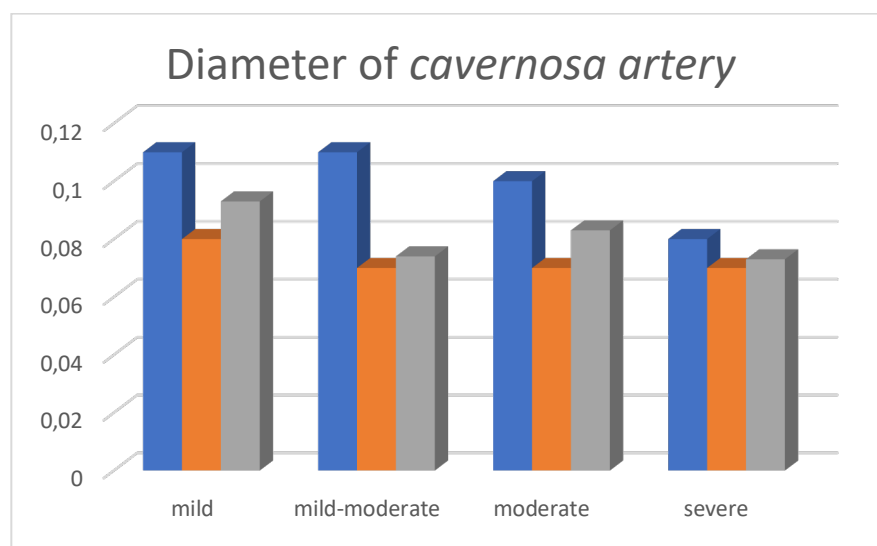


Diagram 5.3 Diameter of cavernosa artery.

From 11 patients with mild erectile dysfunction, average diameter of right corpora cavernosa was 1.2 cm and left was 1.17 cm, the largest right diameter was 2 cm and the largest left diameter was 1.6 cm, while the smallest diameter of right corpora cavernosa was 0.9 cm and left was 1 cm. From 8 patients with mild-moderate degree of dysfunction, mean diameter of right corpora cavernosa was 1.05 cm and left was 1.03 cm, with the largest right diameter of 1.1 cm and the largest left diameter of 1.1 cm, while the smallest diameter of right corpora cavernosa was 1 cm and left was 1 cm. Of 8 patients with moderate degrees of erectile dysfunction,

mean diameter of right corpora cavernosa was 1.2 cm and left was 1.2 cm with the largest right diameter of 1.3 cm and largest left diameter of 1.3 cm, while the smallest diameter of right corpora cavernosa was 1 cm and left was 1 cm. Of the 3 patients with severe degrees, average diameter of right corpora cavernosa was 1.1 cm and left was 1 cm with largest right diameter of 1.2 cm and largest left diameter of 1.1 cm, while the smallest diameter of right corpora cavernosa was 1.1 cm and left was 1 cm.

Table 5.4 Diameter of right corpora cavernosa

Degree of Erectile Dysfunction	Average Diameter (cm)
Mild	1,1 ± 0,3
Mild – Moderate	1,0 ± 0,2
Moderate	1,2 ± 0,2
Severe	1,0 ± 0,3

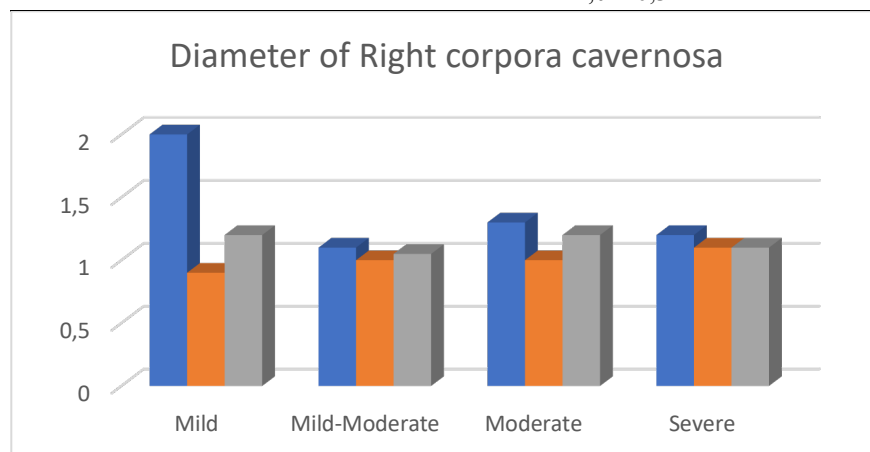


Diagram 5.4 Diameter of right corpora cavernosa.

Table 5.5 Diameter of left corpora cavernosa

Degree of Erectile Dysfunction	Average Diameter (cm)
Mild	1,3 ± 0,4
Mild – Moderate	1,1 ± 0,1
Moderate	1,0 ± 0,2
Severe	1,0 ± 0,1

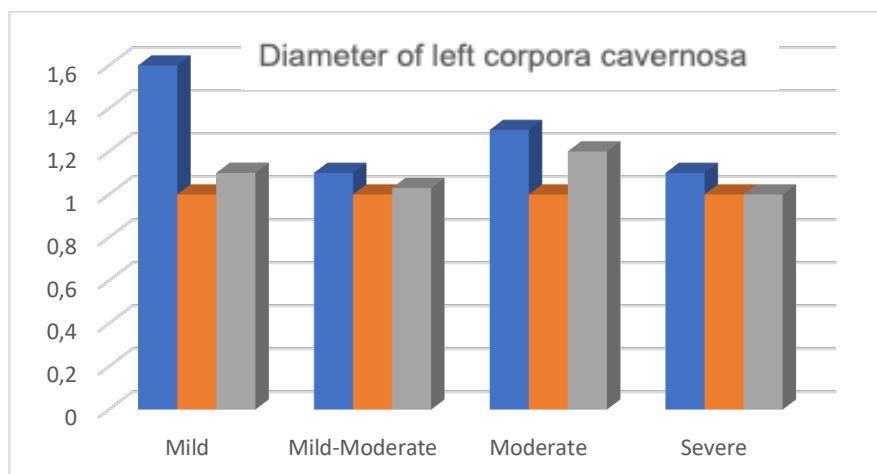


Diagram 5.5 Diameter of left corpora cavernosa.

Diameter of *corpora spongiosa*, among 11 patients with mild erectile dysfunction, average diameter was 1.2 cm, with the largest diameter of 1.7 cm and the smallest of 1 cm. Of 8 patients with mild-moderate erectile dysfunction, it was found that average diameter of corpora spongiosa was 1.1 cm with the largest diameter of 1.3 cm and the smallest was 1 cm. From 8 patients with moderate erectile dysfunction, average diameter of corpora spongiosa was 1.2 cm with the largest diameter of 1.3 cm and the smallest of 1.1 cm. Among 3 patients with severe erectile dysfunction, the average diameter of the corpora spongiosa was 1.01 cm, with the largest diameter of 1.1 cm and the smallest of 1 cm.

Table 5.6 Diameter of corpora spongiosa

Degree of Erectile Dysfunction	Average Diameter (cm)
Mild	1,7 ± 0,3
Mild – Moderate	1,3 ± 0,4
Moderate	1,3 ± 0,2
Severe	1,1 ± 0,4

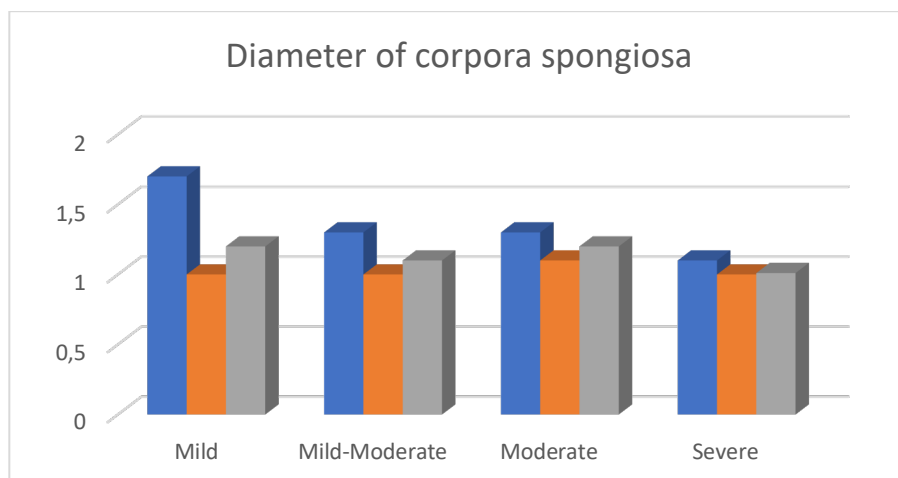


Diagram 5.6 Diameter of corpora spongiosa.

4. Discussion

In the current study, 30 patients had erectile dysfunction with various degrees, which 11 patients (36%) had mild-moderate degrees, 8 patients (27%) had moderate degree, 8 patients (27%) had moderate and 3 patients (10%) had severe dysfunction. In terms of age, from a total of 30 patients, most patients are in the age group of 51-55 years (43%), age group of 40-45 years and 46-50 years (27%), consistent with various previous studies, including studies by Aversa A *et al* (2010); Gatkin *et al* (2017) and Vardi Y (2009), suggested that incidence of erectile dysfunction in various countries increases with age.^{5,7,12}

Previous study by Fahmi.M,N *et al* 2019 suggested that vascular flow to cavernous artery in patients with erectile dysfunction has been shown to be decreased. It is widely known that decrease in vascular flow leading to decrease of total volume of blood delivered per minute. Long term decrease in volume of blood delivered to corpora cavernosa was thought to resulted in decrease of corpora cavernosa volume.

This study found that cavernous artery diameter of patients with erectile dysfunction of all degrees was 0.062 cm. This is in accordance with results of previous studies conducted by Wahl SI, Rubin MB, Bakal CW in 1997 which suggested that diameter of cavernous artery in patients with erectile dysfunction in America ranges from 0.03 to 0.07 cm.

Average diameter of *corpora cavernosa* from 30 patients with mild to severe erectile dysfunction in the current study was 1.0 cm. To date, studies related to diameter of corpora cavernosa remained rare. One of the studies was conducted by Kuang-kuo Chen in 1997, which measured diameter of corpora cavernosa and penile volume in 20 patients with erectile dysfunction in the flaccid phase compared with erection phase. Meanwhile in this study, diameter of corpora cavernosa in patients with erectile dysfunction in the flaccid phase was 0.84 cm.¹⁰

In this study, average diameter of corpora spongiosa in 30 patients with erectile dysfunction was 0.9 cm, while there were no data that mention normal diameter of corpora spongiosa. Other studies that have been conducted are the measurement of total penile diameter, including a study by David Veale *et al* in 2015, which examined diameter of penis in 15.521 people in UK, with average overall penile diameter was 1.89 cm.¹³

This study found significant difference in diameter of the corpora cavernosa in patients with mild-to-moderate erectile dysfunction, while difference between mild-moderate and moderate degrees was not significant, which needed further research.

There are several limitations to this study. First, the examination in this study was only carried out in the flaccid phase and was not performed in erection phase due to limited available drugs. Second, there are still few similar studies that can be used as a comparison. Third, there is no other demographic data, such as patient weight, height and other data that can be used as additional variables in this study. Fourth, number of samples is limited to only 30 patients, means that results of this study cannot be used as a standard reference for penis examination and similar study with larger sample size is needed.

5. Conclusion

In the current study, total subjects was 30 patients with erectile dysfunction, 11 patients (36%) had mild degree, 8 patients (27%) had mild-moderate degree (27%) and 3 patients (10%) had severe degrees. Average cavernous artery diameter of patients with erectile dysfunction measured in the flaccid phase was 0.062 cm. Average corpora cavernosa diameter of patients with erectile dysfunction measured in the flaccid phase was 1.0 cm. Average corpora spongiosa diameter of patients with erectile dysfunction measured in the flaccid phase was 0.9 cm. Therefore, authors suggested further research by adding other variables, such as weight, height, age and body mass index (BMI) and erection phase to each measurement variables

6. Conflict of Interest

There is no conflict of interest in this study.

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