

Identification of Female Prostate Gland

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In 2002 the Federative International Committee for Anatomical Terminology (FICAT) officially renamed paraurethral glands into female prostate gland and included the notion «female prostate gland» in the list of anatomical structures, but its role, functioning, features of its influence on the state of sexual function, and relation to the formation of urogenital disorders still remain undetermined.

The objective: Optimization of study of angioarchitecture of female prostate gland.

Patients and methods. A sexological, gynaecological, and urological examination of 22 sexually active women aged from 24 to 42 years, with the average age $32,1 \pm 0,4$, was carried out.

Ultrasound study of vessels in paraurethral zone with the Doppler method was carried out using the ultrasound diagnostic expert class system XARIO of TOSHIBA in the regime of grey scale.

Before the study the catheterization of urinary bladder and introduction of elastic vessel (50 ml), filled with gel, in the vagina were conducted.

A prostatospecific antigen (PSA total, free) in blood serum was determined.

Results. Accumulation of tissues of paraurethral glands in the projection of distal part of urethra was established in 7 (31,8%) women, in the proximal part – in 12 (54,5%), and along the whole urethra – in 3 (13,7%) in the form of an oval formation, length $2,2 \pm 0,25$ cm, width $1,52 \pm 0,14$ cm, thickness $1,3 \pm 0,16$ cm, and volume $4,75 \pm 0,65$ cm³ (anticipated female prostate gland).

Diameter of vessels in the examined organs was from 0,28 to 0,36 cm, blood flow speed (Vps) constituted from 8,7 to 11,0 cm/s, resistivity index (IR) – 0,6–0,62, pulsatility index (IP) – 1,44–1,21. At the background of videoerotic stimulation the intensification of blood flow in the specified anatomical structures was marked: diameter of vessels constituted 0,28–0,41 cm, Vps – 8,9–11,9 cm/s, IR – 0,67–0,74, IP – 1,5–1,6.

In all women PSA was revealed in blood serum: average levels for PSA total – $4,22 \pm 1,22$ ng/ml, and free $0,11 \pm 0,02$ ng/ml.

Conclusion. Ultrasound study of vessels of paraurethral zone with Doppler method on the previously catheterized urinary bladder allows determining female prostate gland as a separate anatomical structure.

Key words: female prostate gland, paraurethral glands, zona G, the ultrasound diagnostic.

In spite of the fact since ancient times (Herophilus in III century AD, and Hippocrates in IV century BC) it has been stated that the accumulation of glandular tissue in the projection of the front wall of vagina closer to introitus vaginae is a female prostate gland (FPG), its role, functioning, features of its influence on the state of sexual function, and relation to the formation of urogenital disorders still remain undetermined [1].

It is widely known that the piece of the front wall located 3–4 cm away from introitus vaginae, and also with in the back urethra, namely in the place of orifice from the cervix of bladder, is a sensitive erogenous zone.

It was in 1672 that the Dutch physiologist and histologist Reinier de Graaf firstly described and illustrated numerous glands and ducts surrounding women's urethra as female prostate gland («corpus glandulosum») [2].

In 1880 Alexander J. Skene offered a hypothesis on the existence of female prostate gland with two paraurethral ducts that is opened near the external orifice of urethra. The anatomic formation described by the author, defined as female prostate gland, is perceived by people in medicine mostly as «Skene glands» [3].

In this very period Rudolf Virchow said that these glands are an independent urinary organ. During the direct research of these tissues the researcher established the accumulation of «amyloid bodies of prostate», typical exclusively for male prostate [4].

In 1947 John Huffman when filling anatomic preparations by hot wax established 3-dimension models of paraurethral glands with the common features of their types, size and number. The author compared this anatomic formation with the structure of a tree. In his opinion, by length urethra reminds the structure of a tree, while ducts of paraurethral glands coming from it remind the extensive network of branches [5].

As Ernst Grafenberg defined it, this anatomic formation is a rudiment of male prostate gland and represented by paraurethral glands (1950) [6].

The concept «spot G» was introduced by Frank Addiego to memorize the E. Grafenberg's discovery and in future made widely known through the scientific and popular publication «The G-spot and Other Recent Discoveries about Human Sexuality» [7].

John Perry and Beverly Whipple named this zone as spot G in the honour of E. Grafenberg and recognized as the erogenous zone of first order [8].

In 2001 professor Terrence M. Hines pointed at the insufficient evidence, namely lack of morphological and biochemical research, regarding the recognition of the Grafenberg zone, which is a projection of accumulation of paraurethral glands, a relish for male prostate gland in women's body [9].

Nevertheless, the deep study carried out by Milan Zaviacic et al was taken as a basis for scientific reasoning regarding the inclusion of the concept «female prostate» by the Federative Committee on Anatomical Terminology (FICAT) into the list of anatomical structures in 2002 [10].

However, the ambiguity in perception of the studied issue, the imperfection of histomorphological, biochemical and clinical studies need further deep investigation of anatomic-functional characteristics of female prostate gland (equated with paraurethral glands) and its role in formation of sexual and urogenital disorders in female body.

Comparison of characteristics of male and female prostate glands has shown that male prostate gland surrounds urethra, while female prostate gland is located inside the urethra.

Front and back types of FPG location are distinguished. In the front type of FPG localization (found in 70% of women) the largest amount of prostate tissues are located in the distal part of urethra and match with the topographical location of

zone G (projection of the area of back urethra and cervix of bladder). The back type is found only in 10% of women and characterized by maximum concentration of prostate tissues in the projection of proximal part of urethra [7]. The thickness of walls and length of female urethra limit the zone where prostate gland is located, and that is why its size is smaller in comparison with male gland and constitutes in average $3,3 \times 1,9 \times 1,0$, while average weight (3,9 g) is four times smaller than the male one (23,7 g).

Morphological research of FPG structure has shown that in the stroma of this anatomic formation ducts and plain muscles similar to the ones in male prostate gland (MPG) are found, but the structure of ducts in FPG is more developed. The histological research study of FPG tissues by Rudolf Virchow has allowed to reveal 'amyloid bodies', also typical for MPG.

The system of excretory ducts of FPG is represented by more numerous canals, whereby ejaculate comes to urethra. Alexander J. Skene said that in paraurethral glands a peculiar content of secretion, which comes from urethra to vagina, qualitatively and numerous (more intensively) differs from secretion from Bartolin's glands that are also formed in the beginning of sexual arousal. The author stated: «Orifices located near the entrance to vagina and surrounding vagina, glands, namely Bartolin's ones, facilitate the extraction of mucus at the beginning of sexual act during sexual arousal, rather than during orgasm» [3]. During orgasm the liquid, extracted from urethra, is not represented by urine, but by glandular secretion. It needs to be pointed out that in some cases secretion coming out from female urethra is so abundant that there are reasons to compare it with the phenomenon of male ejaculation [11]. Considering the similarity of FPG and MPG in morphological characteristics, exogenous and neuroendocrinal functions, the study of markers of tissue structures, namely Prostate-Specific Antigen (PSA), requires special attention. Data on the sensitiveness of this marker in the examination of biological material (blood serum, ejaculate) in women of different age is accumulated. This is the very secretion of paraurethral glands, which is the substrate that is extracted during sexual arousal and requires the definition of PSA levels in it. The revealed fragments in the examined biological material match with the analogous ones of MPG ejaculate [12, 13]. Diagnostic data on the identification of FPG in modern conditions remain limited. However, ultrasound study with the use of Doppler method of vessels of this anatomic and functional structure in comparison with the assessment of tissue organ-specific markers and clinical characteristics has perspectives.

The objective: Optimization of study of angioarchitecture of female prostate gland.

PATIENTS AND METHODS

22 sexually active women of reproductive age (aged from 24 to 42 years, with the average age $32,1 \pm 0,4$), who were on preventive check-up in the Department of Restorative Urology and Modern Technologies of the State Institution 'Institute of Urology of the NAMS of Ukraine', have been examined.

The examined group included women-volunteers that gave consent to this examination following the requirements of ethical committee. The latter was carried out in compliance with the rules of confidentiality.

To improve ultrasound visualization of FPG a new methodology of check-up with preliminary catheterization of bladder and introduction of 50,0 ml vessel, filled with gel, in the vagina was suggested. Implementation of this methodology of ultrasound study, in our opinion, has to facilitate visual-

ization of paraurethral glands. In these conditions we considered FPG as a separate anatomic structure, represented by several constituents.

As it is known, ultrasound study with the use of Doppler method to study vessels of this anatomic structure allows evaluation of parameters and indicators of blood flow with high level of informational content and absence of risks of complications and undesirable consequences for patients.

The study was carried out using the ultrasound diagnostic expert class system XARIO of TOSHIBA in the regime of grey scale (B-regime) and with the use of coloured Doppler carding (CDC) and determination of Doppler indices.

The regime of Advanced Dynamik Flow (improved dynamic flow) gives coloured Doppler carding high dimensional resolution to reveal even insignificant vascularization and vague flows.

It was considered that the program Panoramik View enhances visualization of large-format image with two-dimensional effect and improvement of study of topographic anatomy of FPG zone.

Two types of transmitters were used: multi-frequency linear (5,0–12,0 MHz) and endocavitary multi-frequency (9,0–14,0 MHz) ones.

In the regime of coloured Doppler carding the evaluation of vascular angioarchitecture and features of parenchymatous blood flow of FPG, namely paraurethral glands and G zone (their presence or absence, features of localization, intensity and symmetry), was carried out.

The unified angle of scanning between ray and vessel, which constituted from 0 to 40 degrees, was used, and the assessment of Doppler signals was also carried out.

Indicators of 3–4 complexes were evaluated. The measuring of linear size was carried out – diameters of vessels of the above mentioned structures and assessment of Doppler indicators: peak systolic speed of blood flow (V_s sm/s), resistive index (IR), and pulsatility index (IP).

Nobody of the examined took contraceptives or hormonal medicine. The study was carried out in the first phase of menstrual cycle (between 5 and 10 days of cycle).

During the visualization of female PG the patient was installed in a condition on the back on the sofa. Anesthetic (categegel) was introduced into urethra with the catheterization of bladder using Foley catheter No. 12 or No. 14, with the filled gel vessel for 10–15 cm³. The vessel, filled with gel having the volume of 50.0 ml, was introduced into the vagina area (to improve the visualization of the studied zone). After the end of study the catheter was removed from bladder, and the 3–5 day antibacterial therapy in order to prevent possible complications was prescribed.

The check-up was carried out both in the state of peace and after the stimulating lubricant had been put on genitals, and also after the video-erotic stimulation for 20-30 minutes. The study was carried out in the conditions comfortable for the patient.

All women were prescribed Prostate Specific Antigen (PSA total, free) in blood serum.

RESULTS

As a result the length of urethra of the examined constituted $3,1 \pm 1,2$ cm (pic. 1).

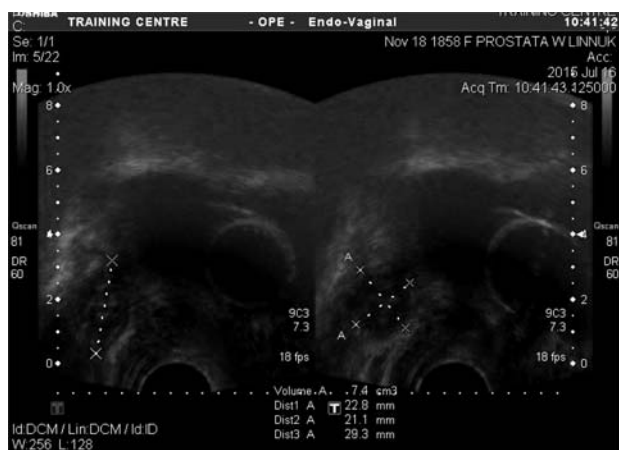
In the projection of distal part of urethra the accumulation of paraurethral glands was established in 7 (31,8%) examined patients (pic. 2), in the proximal part – in 12 (54,5%) (pic. 3), along the whole urethra – in 3 (13,7%), as a formation of oval form (length $2,2 \pm 0,25$ cm, width $1,52 \pm 0,14$, thickness $1,3 \pm 0,16$), with a volume $4,75 \pm 0,65$ cm³ and a specific level of development (assumed female prostate gland).



Pic. 1. Definition of length of female urethra

Patient L., aged 31
Length of urethra – 2,8 cm

In the projection of back urethra an isoechogenic oval formation of homogenous structure and with clear boundaries was visualized, size: length – 2,93 cm, width – 2,11 cm, thickness – 2,28 cm, volume – 7,4 cm³.



Pic. 2. Distal type of location of paraurethral glands

Patient P., aged 38

Concentration of prostatic tissue in the projection of proximal part of urethra. Prostatic tissue is observed along the urethra and has expressive cellular structure.

During coloured Doppler carding it was established that the diameter of vessels in the examined women in the zone of prostate gland varied between 0,28 and 0,36 mm, maximum speed of blood flow (Vs) was determined within 8,9–11,1 cm/s, resistive index (IR) – 0,6–0,62, and pulsatility index – 1,44–1,21.

Preliminary video-erotic stimulation during 20–30 minutes was accompanied by the strengthening of blood flow in the mentioned anatomic structures: diameter of vessels in these conditions constituted 0,26–0,41 cm, Vs – 8,9–11,9 cm/s, IR – 0,67–0,74, IP – 1,5–1,6 (Pics. 4, 5).

In 19 (86,4%) women in the projection of front wall of vagina at the distance of 3,2–5,3 cm from introitus vaginae and back wall of urethra, and at the distance of 4–4,5 cm from the external orifice of urinary canal a formation looking as a clear isoechogenic oval, with 1,24 to 1,3 cm length and 0,68 to 0,9 cm width (assumed G zone) (Pic. 6 a, b).

This formation grew in size at the background of sexual stimulation (length 1,28–1,41 cm, width 0,8–1,1 cm) (pic. 7).

This zone was projected on the zone of accumulation of paraurethral glands under the condition of their both distal and proximal location.



Pic. 3. Proximal type of location of paraurethral glands.

Patient L., aged 31



Pic. 4. Visualization of paraurethral glands at the background of sexual stimulation. The diameter of vessels constitutes 0,26–0,28 cm



Pic. 5. Assessment of Doppler indicators of vessels in FPG at the background of sexual stimulation. Vps – 14,9 cm/s, Vd – 0,4 cm/s, IP – 2,37, IR – 0,94



Fig. 6 a. Visualization of G zone Patient K., aged 28

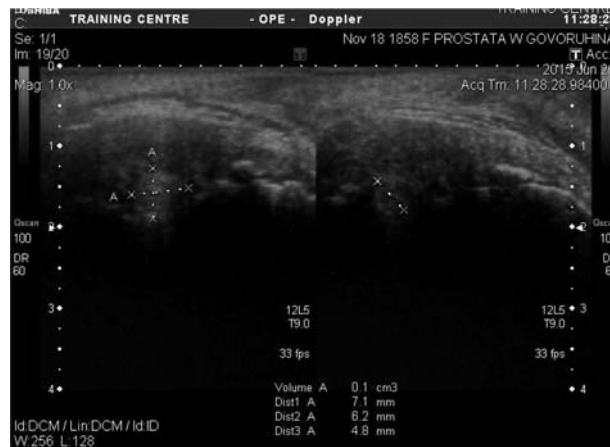


Fig. 6 b. Visualization of size of G zone before sexual stimulation. Patient K., aged 28 Length 0.71 cm, width 0.62 cm, and thickness 0.48 cm

Therefore, paraurethral glands were verified in all the examined patients, and formation, regarded as G zone, was observed in 19 (86,4%) out of 22 examined, both in distal and proximal types of their localization.

Among the examined women the presence of Prostate-Specific Antigen (PSA total – $4,22 \pm 1,22$ ng/ml, PSAfree – $0,11 \pm 0,02$ ng/ml) in blood serum was established.

For a long time the discussion on whether women have an organ, which is homogenous to male prostate gland, has lasted. Contrary to the view of Barched and similar views regarding the «mythical invention on the existence of prostate gland in women's body», the list of evidence for its existence and influence on sexual function, and relation to the formation of the spectre of urogenital disorders are presented [1].

The existence of this anatomic structure in women's body is confirmed at the biochemical level by the expression of important markers, including PSA and prostate-specific phosphatase [14].

The methodology of ultrasound study with the use of Doppler method for vessels of female prostate gland allows visualizing the probable state as a separate anatomic structure, represented by paraurethral glands (with different types of localization and level of development at the expense of individual features of branching of paraurethral glands), while the projection of accumulation of gland tissue from the side of vagina corresponds to the G zone (found in 86,4% of the examined with proximal and distal localization of paraurethral glands).

The suggested methodology of the improved visualization of female prostate gland and all its fragments allows broadening the understanding about the features of this anatomic structure in accordance with the features of paraurethral glands with different types of their localization, level of development and view on G zone.

CONCLUSION

The ultrasound study with the inclusion of the Doppler method of vessels of paraurethral zone on previously catheterized bladder allows determining female prostate gland, represented by paraurethral glands, as a separate anatomic structure.

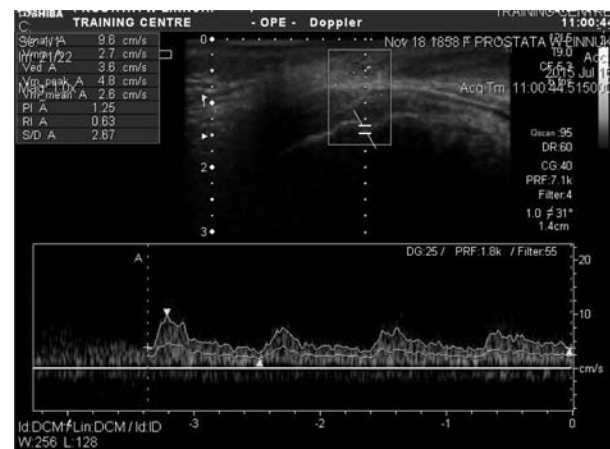


Fig. 7. Doppler of vessels of G zone at the background of sexual stimulation.

Determination of Doppler indicators of vessels of G at the background of sexual stimulation: maximum Vs – 9,6 cm/s, Vd – 2,7 cm/s, IP – 1,25, IR – 0,63.

The received results of observations and their clinical illustration allow assuming that the use of the suggested ultrasound methodology of research optimizes the visualization of prostate gland zone of a woman and allows reaching high quality and image clarity of the described structures, and also to evaluate the features of blood flow.

The presence of Prostate-Specific Antigen in the blood serum of the examined women is another indirect evidence of the presence of prostate, as an anatomic formation, in a women's body.

The received results are accumulated and require detailed clinical analysis with the inclusion of ultrasound study using the Doppler method of vessels of paraurethral zone, definition of biochemical markers (PSA and prostate-specific phosphatase) both in blood serum and in secretion out of urethra, in combination with microbiological, morphological, histochemical and immunological studies and will allow broadening the understanding of this anatomic structure.

Ідентифікація жіночої передміхурової залози

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У 2002 році Федеральний Комітет з Анатомічної Термінології (FICAT) офіційно перейменував парауретральні залози в жіночу передміхурову залозу і включив термін «жіноча передміхурова залоза» до переліку анатомічних структур

Мета дослідження: оптимізація вивчення структури та ангиоархитектоники жіночої передміхурової залози.

Матеріали та методи. Проведено сексологічне, гінекологічне, урологічне обстеження 22 сексуально активних жінок віком від 24 до 42 років, середній вік – 32,1±0,4 року.

Ультрасонографічне дослідження з методом доплерографії судин парауретральної зони здійснювали на ультразвуковій діагностичній системі XARIO фірми TOSHIBA експертного класу в режимі сірої шкали.

Перед дослідженням проводили катетеризацію сечового міхура та введення у піхву еластичного балона (50 мл), заповненого гелем.

Визначали простатспецифічний антиген (PSA total, free) у сироватці крові.

Результати. Установлено накопичення тканини жіночої передміхурової залози в проекції дистальної частини сечівника – у 7 (31,8%) жінок, проксимальної – у 12 (54,5%), уздовж усього сечівника – у 3 (13,7%) у формі овального утворення: довжина – 2,2±0,25 см, ширина – 1,52±0,14 см, товщина – 1,3±0,16 см, об'єм – 4,75±0,65 см³ (передбачувана жіноча передміхурова залоза).

Діаметр судин у досліджуваних органах був від 0,28 до 0,36 см, швидкість кровотоку (Vps) становила від 8,7 до 11,0 см/с, індекс резистентності (IR) – 0,6–0,62, індекс пульсативності (IP) – 1,44–1,21. На тлі відеоеротичної стимуляції відзначено посилення кровотоку у зазначених анатомічних структурах: діаметр судин становив 0,28–0,41 см, Vps – 8,9–11,9 см/с, IR – 0,67–0,74, IP – 1,5–1,6.

У 19 (86,4%) жінок в проекції передньої стінки піхви на відстані 3,2–5,3 см від introitus vaginae та задньої стінки сечівника на відстані 4–4,5 см від його зовнішнього отвору діагностовано утворення у формі чіткого ізоехогенного овалу, довжиною від 1,24 до 1,3 см, шириною – 0,68–0,9 см (зона G), що збільшувалось за розмірами та тлі сексуальної стимуляції (довжина – 1,28–1,41 см, ширина – 0,8–1,1 см).

У всіх жінок виявлено PSA у сироватці крові: середні рівні для PSA total – 4,22±1,22 ng/ml, free – 0,11±0,02 ng/ml.

Заключення. Ультразвукове дослідження з методом доплерографії судин парауретральної зони на попередньо закатетеризованому сечовому міхурі дозволяє визначити жіночу передміхурову залозу та зону G як окрему анатомічну структуру.

Ключові слова: жіноча передміхурова залоза, парауретральні залози, зона G, ультразвукова діагностика.

Ідентификация женской предстательной железы

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В 2002 году Федеральный Комитет Анатомической Терминологии (FICAT) официально переименовал парауретральные железы в женскую предстательную железу, включив термин «женская предстательная железа» в перечень анатомических структур.

Цель исследования: оптимизация изучения ангиоархитектоники женской предстательной железы.

Материалы и методы. Проведено гинекологическое, урологическое, сексологическое обследование 22 сексуально активных женщин в возрасте от 24 до 42 лет, средний возраст – 32,1±0,4 года.

Ультрасонографическое исследование с методом доплерографии сосудов парауретральной зоны проводили на ультразвуковой диагностической системе XARIO фирмы TOSHIBA экспертного класса в режиме серой шкалы.

Перед исследованием осуществляли катетеризацию мочевого пузыря, а также введение во влагалище эластичного баллона (50 мл), заполненного гелем.

Определяли простатспецифический антиген (PSA total, free) в сыворотке крови.

Результаты. Установлено скопление ткани женской предстательной железы в проекции дистальной части мочеиспускательного канала – у 7 (31,8%) женщин, проксимальной – у 12 (54,5%), вдоль всего мочеиспускательного канала – у 3 (13,7%) в форме овального образования: длина – 2,2±0,25 см, ширина – 1,52±0,14 см, толщина – 1,3±0,16 см, объем – 4,75±0,65 см³ (предполагаемая женская предстательная железа).

Діаметр сосудов в исследованных структурах был от 0,28 до 0,36 см, скорость кровотока (Vps) составила от 8,7 до 11,0 см/с, индекс резистентности (IR) – 0,6–0,62, индекс пульсативности (IP) – 1,44–1,21. При проведении видеоэротической стимуляции установлено усиление кровотока в отмеченных анатомических структурах: диаметр сосудов составил 0,28–0,41 см, Vps – 8,9–11,9 см/с, IR – 0,67–0,74, IP – 1,5–1,6.

У 19 (86,4%) женщин в проекции передней стенки влагалища на расстоянии 3,2–5,3 см от introitus vaginae и задней стенки мочеиспускательного канала на расстоянии 4–4,5 см от его наружного отверстия диагностировано образование в форме четкого ізоехогенного овала длиной от 1,24 до 1,3 см, шириной – 0,68–0,9 см (зона G), увеличивающееся в размерах на фоне сексуальной стимуляции (длина – 1,28–1,41 см, ширина – 0,8–1,1 см).

У всех женщин установлено PSA в сыворотке крови: средние уровни для PSA total – 4,22±1,22 ng/ml, free – 0,11±0,02 ng/ml.

Заключення. Ультразвуковое исследование с методом доплерографии сосудов парауретральной зоны на предварительно закатетеризованном мочевом пузыре позволяет изучать женскую предстательную железу и зону G как отдельную анатомическую структуру.

Ключевые слова: женская предстательная железа, парауретральные железы, зона G, ультразвуковая диагностика.

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