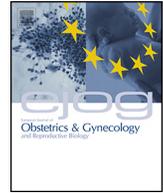




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Anatomic documentation of the G-spot complex role in the genesis of anterior vaginal wall ballooning

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ABSTRACT

Objectives: To expand previous G-spot anatomical and histological investigations; to examine the G-spot complex anatomic role in the anterior vaginal wall ballooning bio-mechanisms; and to determine, which division of autonomic nervous system (sympathetic or parasympathetic) dominates at the time of female sudden death.

Study design: A prospective–descriptive case series anatomical study on eleven consecutive fresh humane female cadavers was conducted. Anterior vaginal wall stratum-by-stratum macro-dissections were executed in axial, coronal and sagittal plains. Upon G-spot extirpations, micro-dissections were performed. The G-spot tissues were stained with hematoxylin and eosin for histological examinations to authenticate the G-spot anatomical and histological characteristic features.

Results: The G-spot complex was identified and present in all subjects on either the distal vaginal left (more often) or on the right side from the lateral margin of the urethra; the G-spot anatomical and microscopic characteristic features have been authenticated; the G-spot complex expansion elevated anterior vaginal walls in each subject; the autonomic parasympathetic nervous system was the dominant division at the time of female subject sudden death.

Conclusion: This study advances our anatomical and histological understanding of the G-spot complex and its role in the genesis of anterior vaginal ballooning bio-mechanisms. The G-spot complex is under parasympathetic nervous system domination at the time of female sudden death.

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1. Introduction

Since the 3rd Century A.D., the anterior vaginal wall, as a sexual arousal zone, was and still is a topic of interest for many researchers [1]. In 1950, Gräfenberg reported that “An erotic zone always could be demonstrated on the anterior wall of the vagina along the course of the urethra” and also established that “It could be found in all women . . .” Additionally, he noticed, “After the orgasm was achieved a complete relaxation of the anterior vaginal wall sets in [2].” Gräfenberg’s clinical observations were verified by other investigations on many occasions [3–6].

In 2010, Jannini et al. published opinions of experts’ relating to the existence of the G-spot. The experts presented historic, anatomical and histological data and could not agree among themselves on the subject matter. Some of them argued that the G-spot existed as an anatomical structures and other disagreed [7]. In 2012, Jannini et al., in the other article of expert opinions,

concluded “The assumption that women may experience only the clitoral, external orgasm is not based on the best available scientific evidence [8].” This suggestion could theoretically support the G-spot anatomical existence. In 2013, Buisson and Jannini evaluated movements of the clitorourethrovaginal complex by ultrasonography during separate clitoral and vaginal simulations on three women. The authors determined that only vaginal stimulation produced the clitorourethrovaginal complex movements [9]. These findings indicated that the vaginal sexual stimulation (internal stimulation) had different independent mechanism(s) in responding to sexual stimulation than external clitoral sexual stimulation.

In April 2012, Ostrzenski published the historic article relating to the discovery of the anatomical G-spot existence [10]. This discovery was verified by the International Study Group on the G-spot in 2014 [11]. Also, the new histological characteristic features was discovered by Ostrzenski et al. in 2014 [11]. Furthermore, it has been reported that the G-spot was responsible for anterior vaginal wall enlargement during the sexual arousal phase without the actual physical evidence of the G-spot anatomical existence [2,4]. Many study’s protocols were designed

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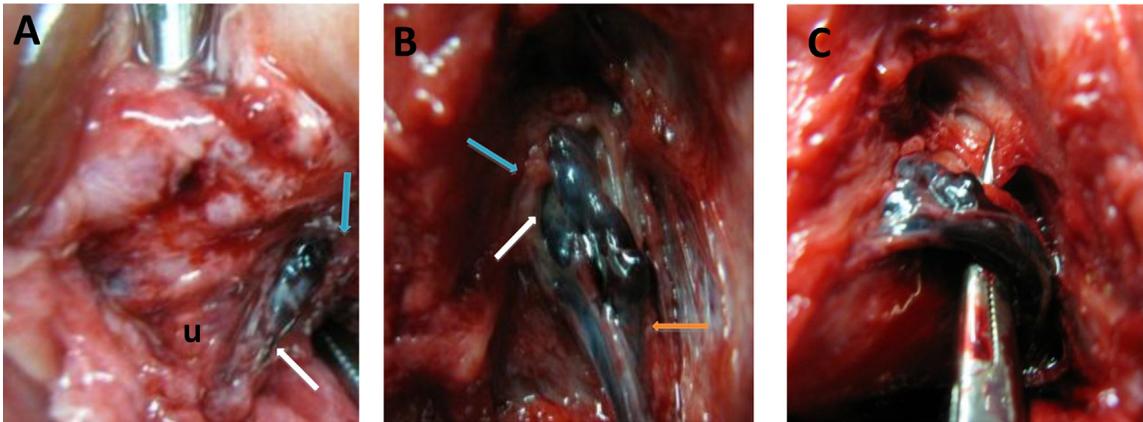


Fig. 1. G-spot complex anatomic characteristics on an axial dissection (selected from eleven subjects). Panel A, the subject was 83-years old. Note the G-spot with the vessel (a band-like structure) going into the funnel-shaped structure (the white arrow). The blue arrow represents the G-spot's sac wall. In Panel B, 31-year-old subject: the orange arrow shows the distended vessel trunk and surrounding G-spot vessels. The white arrow denotes the partially covered G-spot by surrounding vessels. Panel C, 27-year-old subject: the G-spot sac and surrounding vessels were dissected from the base and the instrument was inserted under the sac (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

and executed based upon this assumption, which was established on the notion of the majority of women are self-assured about existing the G-spot [12].

The objectives of this current study were to expand and to authenticate previously reported the G-spot anatomical and histological characteristic features reported by Ostrzenski and Ostrzenski et al. [10,11]; to examine the G-spot complex anatomical role in the anterior vaginal wall ballooning bio-mechanisms; and to determine, which division of autonomic nervous system (sympathetic or parasympathetic) dominates at the time of female sudden death.

2. Materials and methods

The study's protocol was designed as a prospective–descriptive case series anatomical study on fresh human female cadavers. The Ethics Committee approved the investigation's protocol and anatomic dissections conducted at the Department of Forensic Medicine (DFM), Warsaw Medical University (WMU), Poland. Demographic data of suddenly deceased subjects were limited to registration numbers at the DFM, their initials and age were on hand. No additional demographic or medical history information was available.

The anterior vaginal walls were dissected stratum-by-stratum on eleven consecutive fresh Caucasian female cadavers. Also,

micro-dissections were performed on the extirpated G-spot structure.

2.1. Inclusion/exclusion criteria

Those subjects who were approved by the Chairman of the DFM at WMU were considered for study inclusions. Fresh Caucasian female cadavers who expired fewer than 48 h prior to performing anatomic macro- and micro-dissections with an intact uterus, cervix and no visible scars on the distal anterior vaginal wall were included. Those subjects who demonstrated a disseminated process of illness, contagious diseases, abnormal configuration or size of female external genitals, enlarged inguinal lymphatic nodes, intra-vaginal bruises or hematoma formations were excluded. Also, those subjects who were raped were excluded.

Eleven adult Caucasian female cadavers met the inclusion criteria. A digital photo camera was used for documentations. The following G-spot's anatomical parameters were evaluated: location, region, position, orientation, the angle created between the left- or right-lateral urethral boundary and the upper border of the G-spot's sac. The coronal plane (cranial-to-caudal), axial plane (ventral-to-caudal), geometry, and distinct anatomical features were recorded. In each subject's G-spot complex anatomic structure was extirpated and sections were performed, which were stained with hematoxylin and eosin at the Histologic



Fig. 2. G-spot's complex appearances and different sizes are exemplified from 3 subjects. Panel A, 46-year-old subject; on an axialplane, the G-spot covered with surrounding blood vessels (the white arrow) and the thickness of the G-spot's sac wall are shown between the blue arrows. Panel B, the smallest G-spot size with its surrounding vessels was obtained from subject no. 1, a 46-year-old and the largest specimen originated from subject no. 2, a 31-year-old. Panel C, the specimens from figure B were micro-dissected with surrounding vessels extirpated and isolated G-spot structures presented (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

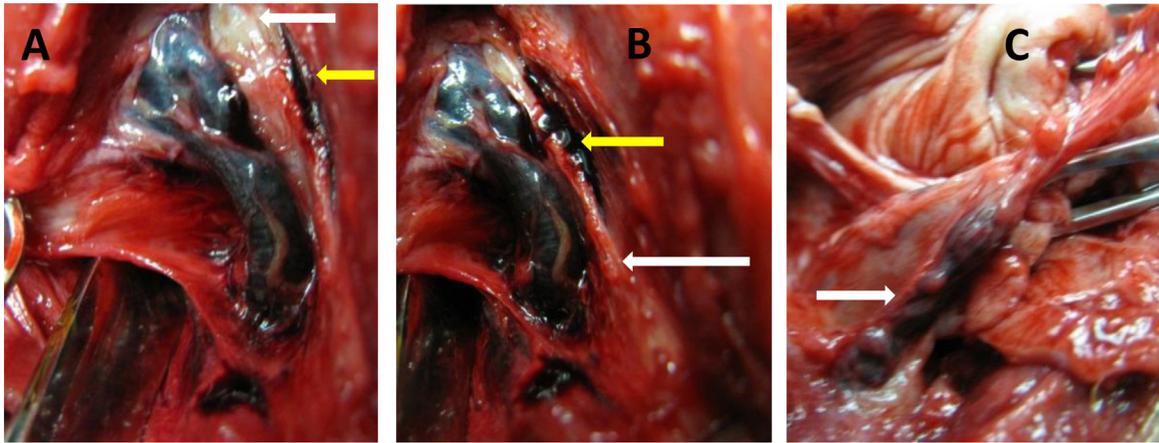


Fig. 3. G-spot's complex distended blood vessels are presented from 3 different subjects. Panel A, 48-years-old subject; G-spot vessels became distended and are pressing on the intact anterior vaginal wall (the white arrow). Just under the vaginal sub-epithelium additional distended vessels are identified (the yellow arrow). Panel B, 46-year-old subject; the white arrow directs a much thinner and irregular anterior vaginal wall. Panel C, 54-year-old subject. The white arrow indicates expanding ability of surrounding G-spot vessels, which were released from the sac (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Laboratory of the Department of Forensic Medicine, WMU and microscopic examinations were executed at the Department of Pathomorphology, WMU.

2.2. Study qualifications

Both manual and electronic literature searches have been carried out from 1900 to June 2013 using Medical Subject Headings (MeSH), which were selected and used in a search on ISI Web of Science (including conferences proceedings); PubMed, ACOGNET, ProQuest, OVID, Cochrane Collection, the Lancet onLine Collection, MDConsultant, New England Journal of Medicine, American College of Physician onLine Resources, Highwire Journal, and Citation Index Reference.

3. Results

Electronic and manual literature searches failed to identify any scientific publication relating to the anatomical documentation of the G-spot role in the human female mechanism of anterior vaginal wall ballooning. The sample size of the study was sufficient to adequately address objectives. All subjects were Caucasian women

in ages between 27 and 83 years old with a mean age of 50 ± 23 (standard deviation); six women were in the reproductive age and five were in the postmenopausal age. The subjects have been admitted to the DFM for mandatory postmortem forensic autopsy.

The current study's discovered: 1. Bio-mechanism of anterior vaginal wall ballooning. 2. The presence of G-spot's "erogenous" vessels. 3. The autonomic parasympathetic nervous system was the G-spot dominant division at the time of woman's sudden death. Also, the present study confirmed the previously published G-spot anatomical characteristic features and verified the G-spot's histologic characteristic features [10,11].

The G-spot was identified in all eleven subjects (100%). The distance from the lateral border of the urethra to the G-spot's tail ranged from 3.1 mm to 5.7 mm, a mean distance of 4.4 ± 1.3 mm (standard deviation). The G-spot was located within the region of the distal anterior vaginal wall either on the left-lateral or right-lateral urethral borders with a mean of 5.0 ± 0.2 mm (standard deviation), and 5.5 cm down from the urethral meatus with a mean of $1.0 \text{ cm} \pm$ (Figs. 1 and 3). The G-spot complex was found on the left side of the urethra in eight subjects (72%) and on the right side in three (28%). The G-spot's orientation was in a diagonal plane with the angle from 18° to 35° created between the left- or right-lateral urethral boundary and the upper border of the G-spot's sac

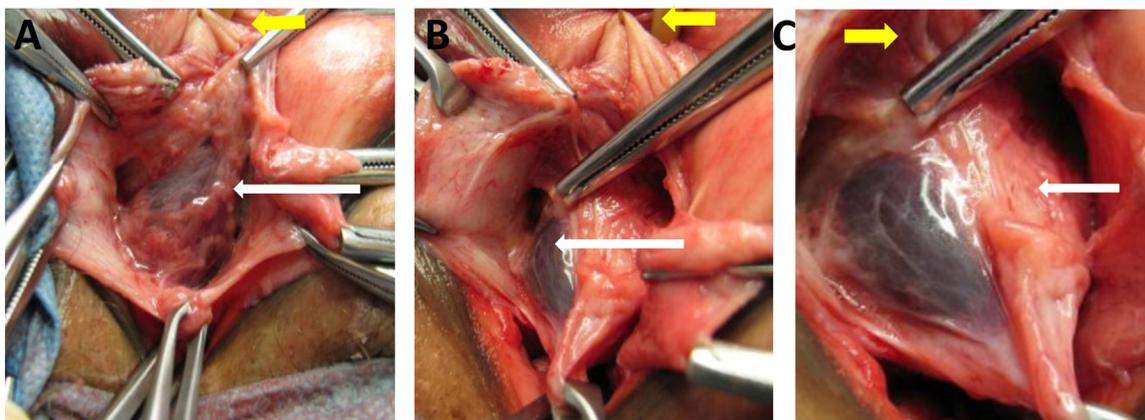


Fig. 4. Anterior vaginal wall ballooning mechanism observed on 3 selected subjects. Panel A, 69-year-old who demonstrated small anterior vaginal wall ballooning (the white arrow). Panel B, 51-years-old presented with medium anterior vaginal wall ballooning (the white arrow) Panel C, 50-years-old with largest anterior vaginal wall ballooning (the white arrow). The yellow arrow depicts the urethral meatus (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

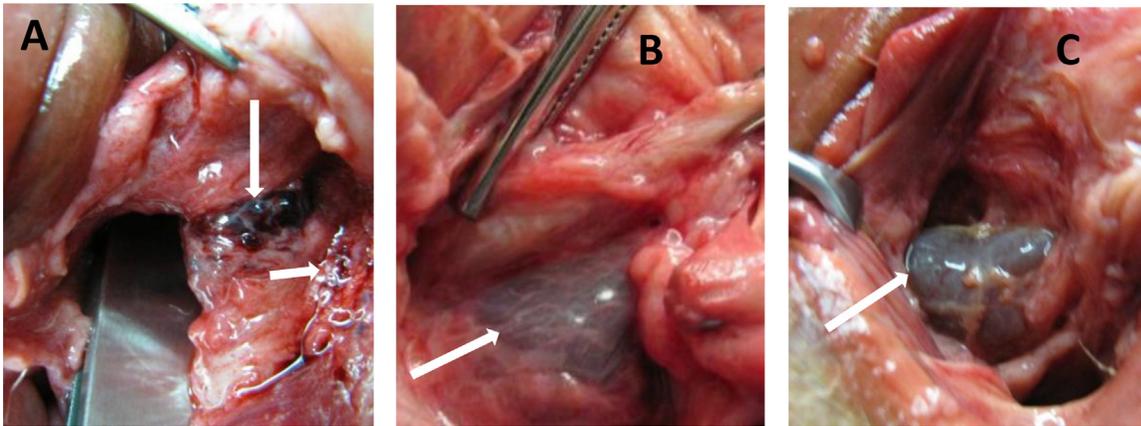


Fig. 5. G-spot's complex with exposed surrounding blood vessels are viewed from 3 different subjects. Panels A, B, and C represent exposed surrounding vessels of the G-spot (the white arrows). The specimens were obtained from A, 83-, B, 55-, and C, 50-year-old subjects respectively. In Panel A, the smaller arrow depicts the vaginal wall's vessels. Filled blood vessels are creating pressure upon the anterior vaginal wall and contributing to the ballooning mechanisms of the anterior vaginal wall (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

(Fig. 1 A and B). The G-spot rested within the sac with recorded wall thickness of a mean 1.6 ± 0.4 mm of standard deviation (Figs. 1–5). Upon opening the sac, the G-spot's anatomic structure itself was surrounded by and intimately fused with vessels resembling grape-like clusters, which were resting on the G-spot anterior surface and were separated by the white-colored tissue, (Fig. 1A). At the lower pole of the G-spot, a tiny band-like structure was identified, which grossly resembles a vascular structure and it traveled into the funnel-shaped cylinder of the G-spot (Fig. 1A). Surrounding vessels were filled with blood in each subject in various degrees (Figs. 1–5). The boundaries of the G-spot were very well outlined (Fig. 1A, B and C), unless the distended vessels obscured the view (Figs. 2–5). The size of the stripped off from the G-spot vessels varied with a mean of 8 ± 5 mm of standard deviation (Fig. 2B and C). Upon opening the G-spot's sac, the G-spot complex structure expands on the average of 5 times of its original size (Fig. 2B). The G-spot's sac merged with the anterior vaginal wall. The G-spot's geometry was a cylindrical shape, which became narrower at the lower border (the G-spot tail) creating a funnel-shape or a bottle-shape in the coronal plane (cranial-to-caudal), which laterally fused with vessels (Figs. 1 and 3). At the G-spot distal pole, the band-like vessel emerged (Fig. 1A, B, and C). The axial plane (ventral-to-caudal) of the G-spot three parts was visible: the head (the upper pole and widest diameters), the middle part, and the tail (Figs. 1 and 3).

Surrounding G-spot's "erogenous" blood vessel distensions varied and depended upon the amount of blood entrapped within the vessel lumens (Figs. 1, 3–5). Upon separating the erogenous blood vessels from the G-spot, they demonstrated the ability to expand (Fig. 3C). The anterior vaginal wall's vessels, under the subepithelial layer of the vagina, also demonstrated distension;

although, to a lesser degree (Fig. 2A and B). The anterior vaginal wall, above the G-spot, varied in thickness (Fig. 3A and B).

The ballooning mechanism of the anterior vaginal wall was observed in each subject. The size of the anterior vaginal ballooning depended upon amount of vascular retained blood (Fig. 4). The anterior vaginal wall was elevated and stretched in the ventral–dorsal plane (Fig. 4C). The anterior surface of erogenous blood vessels looked like a mosaic of blue grape-clusters (Figs. 1–3, 5).

The G-spot complex histological characteristic feature findings can be summarized as the neurovascular structure, Fig. 6B, with the presence of its own identifiable nerve ganglion, Fig. 6A and C. No secretory glands, ducts, cavernous, spongiosum or erectile tissues was identified.

4. Comments

The current study's protocol was designed as a prospective–descriptive case series anatomical study on fresh human female cadavers. The decision relating to the selection of the case series study was based on scientific article, which was published in the peer review journal. A case series study produces "... a high sensitivity for detecting novelty and therefore remain one of the cornerstone of medical progress ..." [13].

The G-spot's geometry was anatomically defined as a cylindrical shape structure, which became narrower at the lower border (the G-spot tail) creating a funnel-shape or a bottle-shape in the coronal plane (cranial-to-caudal) with fused with vessels (Figs. 1 and 3). At the G-spot distal pole, the band-like vessel emerged (Fig. 1A–C). The axial plane (ventral-to-caudal) of the G-spot three parts was visible: the head (the upper pole and widest diameters), the middle part, and the tail (Figs. 1 and 3).

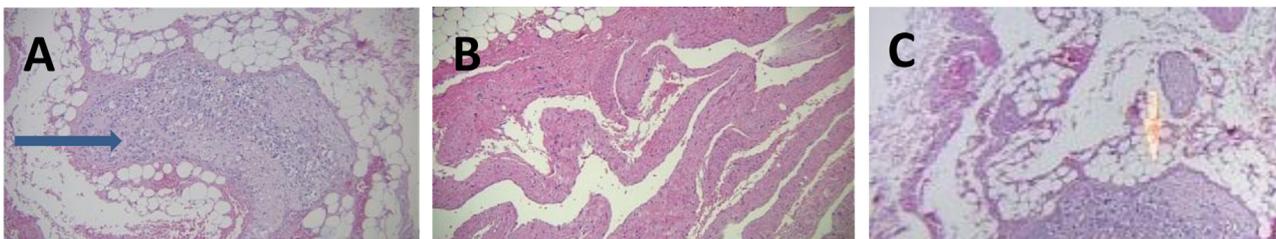


Fig. 6. G-spot histologic characteristics (hematoxylin/eosin stainings) selected from eleven subjects. Panel A, the nerve ganglion is present in an adipose tissue bed (the arrow). Panel B, collapsed vessel structures with blood thrombus within the lumens. Panel C, the adipose tissue surrounds large vessels and an abundant collection of nerve endings and a nerve-ganglion (the white arrow) (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The G-spot's surrounding "erogenous" blood vessels distension varied and depended upon the amount of blood entrapped within the vessel lumens (Figs. 1, 3–5). Upon separating the erogenous blood vessels from the G-spot, they demonstrated the ability to expand (Fig. 3C). The anterior vaginal wall's vessels, under the subepithelial layer of the vagina, also demonstrated distension; although, to a lesser degree (Fig. 2A and B). The anterior vaginal wall, above the G-spot, varied in thickness (Fig. 3A and B). In summary, the G-spot is located within the distal, anterior vaginal wall and anatomically is defined as a diminutive, cylindrical-shape structure with three unified sections (the head, middle part, and tail) and intimately fused with surrounding vessels.

In the current investigation, reliable and reproducible histological characteristic features of the G-spot were determined, which defined microscopically the G-spot as a neurovascular structure with the presence of its own nerve ganglion. The presence of the nerve ganglion within the G-spot itself was an extraordinary scientific discovery, since no nerve ganglion has ever been identified within vaginal walls in the human [14,15]. The nerve ganglion distinguishes the G-spot structure from the vaginal wall and it gives more independent actions in responding to parasympathetic and sympathetic stimulations. Also, the presence of the G-spot's nerve ganglion assists in understanding the role of the G-spot complex in an anterior vaginal wall ballooning effect. The pelvic ganglia are a mixture of autonomic sympathetic and parasympathetic neurons [14,15].

The strength of this current study is the fact that the G-spot complex was present in each and every adult human female subject who participated in this investigation. The constant anatomical location, the consistent relationship to adjacent structures, and the distinct geometry of the G-spot complex allowed identifying and reproducing the results, which are the major scientific accomplishments.

The current study's results presents a potential of significant impact not only on the comprehensive understanding of complex female sexual response cycle but also harbors a potential impact on clinical diagnostic and therapeutic approaches. The neurovascular components of the G-spot can be a part of neurogenic dysfunction(s) and the vascular component can be responsible for vasculogenic dysfunction(s) or combined neural and vascular dysfunction(s). Clinically, the vasculogenic etiology of female sexual dysfunction was postulated in the form of hemodynamic insufficiency that compromised vaginal engorgement and clitoral erection [16].

Inherent limitations exist in each anatomic study, since the results are subject to researcher's interpretations. Moreover, the weakness of study on fresh cadavers is the presence of topographic postmortem distortions. Also, the absence of accepted terms can have effect on the descriptive meaning. Variations in the G-spot complex anatomy may exist between different ethnic and racial groups; however, it couldn't be established from this sample size, since only Caucasian female cadavers were available.

The anatomy of G-spot's location, region, position, orientation, the angle created between the lateral urethral boundary and the upper border of the G-spot sac, G-spot relationship with adjacent structures, insertion boundary, the distal endpoint and proximal endpoint, coronal plane (cranial-to-caudal), axial plane (ventral-to-caudal), geometry were determined and documented. Definitive measurements of the G-spot itself and G-spot complex were not an ideal reflection of actual sizes due to the fact that at the time of death, the autonomic parasympathetic nervous division dominated and the G-spot as a neurovascular anatomic structure and surrounding erogenous vessels were filled with retained blood within their vascular lumens (Fig. 6A–C).

In the past, the G-spot histology has been presented as the tissue containing glands and ducts [17]. However, this microscopic

G-spot description corresponded to the Skene's glands and ducts and did not correspond to the G-spot histological current description, which was determined in this study [11]. The current investigation did not identify any histological component within the G-spot itself, which even remotely resembled gland or duct tissues, (Fig. 6A–C). This new histologic discovery puts to rest two speculative interpretations: 1. the G-spot is a secretory organ and 2. female ejaculatory fluid is produced by the G-spot [18]. Neither of those processes can occur within the G-spot tissue. Though the years, a female ejaculation phenomenon has been reported in the scientific literature [3,18–20]. It has been suggested that true female ejaculation fluid can be distinguished from urine by performing prostate-specific antigen [21]. Also, visual inspection can assist in determining the presence of ejaculation fluid, which appears as "... a very scanty, thick, and whitish fluid from the female prostate." In contrast, "... abundant fluid that is ejected in gushes (squirting) is different from the real female ejaculation." [21] However, this fluid cannot be produced or excreted from the G-spot based upon histological characteristic features [11].

The absence of cavernous or spongiosum, or erectile tissue disqualified the concept that G-spot erection caused anterior vaginal wall engorgement (Fig. 6A–C). Additionally, the G-spot's histological findings were in the harmony with electrovaginogram results, which established that the electric vaginal waves originated from and within the G-spot; so, the G-spot could be considered a pacemaker [22]. The G-spot's histological findings were dense nerve endings and the presence of the nerve ganglion, which would support the notion that the G-spot was an anatomical structure able to produce female orgasms (vaginal activated human female orgasm or internal orgasm) independently from the clitoris also called as external orgasm [8,19,20]. Furthermore, MRI results suggested that the vagus nerve could conduct stimulating impulses directly from the vagina to the brain with bypassing the spinal cord pathway. These findings effectively eliminated the notion the vagina was as a passive transmitting anatomic structure of penile thrusting "... an active organ, transmitting, during intercourse, the effect of penile thrusting in the vagina to the clitoris ..." [20]. In the light of the current investigation and others, the clitorio-centric doctrine of human female orgasm cannot unequivocally support this notion.

It has been reported that vaginal wall engorgement depended upon the autonomic nervous system, in which the parasympathetic division facilitates input responsible for vascular dilatation and inhibitory sympathetic division reverses the vaginal wall engorgement process [2–4]. The autonomic parasympathetic division physically widens the vascular ingress for blood flows. This mechanism leads to distension, retention, and increased blood pressure within the G-spot's erogenous blood vessels, which anatomically manifested as a ballooning appearance of the anterior vaginal wall. Such a phenomenon was observed in each subject of this current study with different degrees of blood retention within vessels (Figs. 1–5). The more blood retention was observed, (Fig. 4), the larger anterior vaginal wall ballooning was manifested (Fig. 3A and B). Additionally, the vaginal wall's vasculatures participated in the anterior vaginal ballooning mechanism, but to the much lesser degree than the G-spot's erogenous vessels (Fig. 3A, B and Fig. 5B, C). The vaginal wall large vasculatures are located above the G-spot and have dual functions: 1. enhancing the anterior vaginal wall ballooning effect and 2. providing G-spot cushioning during sexual intercourse. An immediate clinical benefit of this observation was anatomic documentations, which established that anterior vaginal wall injections could be contra productive and dangerous medical approach (Fig. 3A and B), for instance, anterior vaginal wall injections with collagen as it was promoted in G-spot Amplification[®] (anecdotal data from the marketing literature).

Injections should be withheld until such time that scientific/clinical, well designed and well-executed study results prove otherwise. Additionally, a scientific-clinical investigation should be conducted to document the rationale of hormonal injections (estrogens, androgens or oxytocin) into the anterior vaginal wall for improving or treating human female sexual function.

5. Conclusions

This study advances our understanding of the G-spot anatomy, histology, and the anterior vaginal ballooning bio-mechanism. The G-spot complex plays an anatomic role in the genesis of anterior vaginal ballooning bio-mechanisms. The G-spot complex is under parasympathetic nerves system domination at the time of sudden death.

Conflict of interest

The author does not report any conflict of interest.

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