Lecture complex

Discipline: Normal genitourinary system “Physiology”

Discipline code: MSN-2209

Title of EP: 6B10115 “Medicine”

Volume of teaching hours/credits: 150 hours/5 credits (1 credit)

Course and semester of study: 2nd year, 3rd semester

Length of lectures: 2 hours.

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The lecture complex was developed in accordance with the work program of the discipline Genitourinary system in the norm "Physiology" (syllabus) according to EP 6B10115 "Medicine" and discussed at a meeting of the department

Protocol No. 1 " 01 " 09 2023

Head department, candidate of medical sciences, associate professor B.D. Tanabaev

Lecture No. 1

1. Topic: Physiology of the excretory system.

2. Purpose: to study the processes of urine formation, urination and the mechanisms of their regulation.

3. Lecture abstracts

Excretion is a part of metabolism carried out by removing from the body the final and intermediate products of metabolism, foreign and altered substances, to ensure the optimal composition of the internal environment and normal life activity. Excretion processes are an integral feature of life, so their violations inevitably lead to disturbances in homeostasis, metabolism and functions of the body, which can cause its death.

Excretory organs include kidneys, sweat glands, lungs, and intestines.

The kidneys remove water, a number of metabolic products, excess salts, foreign and toxic products after they are inactivated in other organs.

The urinary organs consist of two kidneys, the excretion of which is urine, and of organs that serve for the accumulation and removal of urine (ureter, bladder, urethra).

The structural and functional unit of the kidneys is the nephron, in which the entire set of processes of urine formation takes place.

The nephron begins with a microscopic double-walled cup-shaped capsule - the Shumlyansky-Bowman capsule. The capsule encloses a plexus of capillaries and the Malpighian glomerulus.

The initial part of the renal tubule of a convoluted shape departs from the cavity of the Shumlyansky-Bowman capsule - a convoluted tubule of the 1st order (proximal), heading towards the medulla of the kidney. At the border between the cortical and medulla layers, the tubule narrows and straightens, forming a loop of Henle in the medulla, consisting of a descending and ascending part. The ascending straight tubule in the medulla passes into the convoluted tubule of the second order (distal). The distal convoluted tubule passes into the collecting ducts, which, starting in the cortex, pass into the medulla, reach the tops of the pyramids and open into the renal ganglia through the papillary ducts.

According to modern concepts, the formation of final urine is the result of 3 processes: filtration, reabsorption and secretion.

Glomerular or glomerular filtration occurs from the blood plasma of the renal glomerulus into the capsule (Shumlyansky-Bauman), i.e. through the blood-renal barrier.

Filtration of water and low-molecular components of plasma through the glomerular filter, which is poorly permeable to high-molecular substances, is due to the difference between the hydrostatic pressure of the blood in the capillaries of the glomerulus (70-80 mm Hg), the oncological pressure of blood plasma proteins (25-30 mm Hg) and the hydrostatic pressure of the ultra-filtrate of blood plasma in the glomerular capsule

(about 20 mmHg), the effective filtration pressure, which determines the glomerular filtration rate, is equal to 20 mmHg.

The total surface of the glomerular capillaries reaches one and a half to 2 m2/100 grams of the kidney. The filter membrane, which stands in the way of fluid from the lumen of the capillary into the cavity of the glomerular capsule, consists of 3 layers: endothelial cells, basement membrane and endocytic epithelial cells. An adult produces 150-180 liters of primary urine per day.

Primary urine from the Shumlyansky-Bowman capsule enters the renal tubules, where reabsorption occurs, i.e. reabsorption of water and some substances contained in primary urine into the blood. Reabsorption of various substances in the renal tubules is ensured by active and passive transport. 99% of water is subject to reverse absorption, as well as everything necessary for the life of the substance, and the absorption substances are concentrated and removed from concentration at a given time.

In the proximal nephron, the reabsorption of sodium, potassium, chlorine and water is a constant value (obligate reabsorption). In the distal convoluted tubules and collecting ducts of ions and water, its value can be regulated and varies depending on the functional state of the body (facultative reabsorption).

The kidney tubules are capable of secreting certain substances; antibiotics, chloramphenicol, streptomycin, monomycin, kanamycin, etc.

Under normal water conditions, about 1-1.5 liters of urine are released per day.

The act of urination is a complex reflex process. The urination center is located in the II-IV cruciate segments of the spinal cord and is under the control of neurons located above the centers of the brain, including the cerebral cortex.

Urination occurs due to stimulation of the nerve formations of the bladder and urethra. When P urine when filling the urine bladder reaches 12-15 cm water column. - stretching of the walls, which irritates the sensitive nerve endings of the bladder. Afferent signals reach the urinary center in the spinal cord, from where they travel through the parasympathetic nerves to the bladder and cause contractions of its walls.

The phase of urine accumulation is distinguished. It lasts from 2-3 hours to 5 hours or more. Therefore, normally 4-6 bowel movements are performed per day. An indispensable condition for the accumulation of urine in the bladder is the closed lumen of the internal opening of the urethra. This is determined by the function of the closure apparatus of the triangle and bladder neck, as well as the contraction of the striated urethral sphincter. The muscles of the pelvic floor and urogenital diaphragm contribute to the accumulation of urine in the bladder.

Thanks to them, a certain (immobile) position of the bladder is maintained and the vesico-rectal angle is maintained. If the tone of the genitourinary diaphragm decreases, this can lead to urinary incontinence when coughing, laughing, straining, or physical activity (this often happens in women).

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As the bladder fills, the amplitude of respiratory pressure fluctuations in the lumen of the bladder progressively decreases. This is due to the fact that as the bladder fills, the detrusor reduces its tone and excitability. With a slow flow of urine, the detrusor adapts to the load, its excitability decreases, and its tone decreases. If the bladder fills very quickly, adaptation does not have time to occur. This causes a reflex increase in intravesical pressure, the urge to urinate.

Normally, during the filling phase, the detrusor provides a stable, low (up to 15 cm of water column) pressure inside the bladder, while the closing apparatus of the bladder and the urethral sphincter maintain high pressure (60 mm of water column), which prevents the flow of urine into the urethra.

As the bladder fills, intravesical pressure increases. And when this pressure reaches sufficiently high values, a reflex of inhibition of urine formation occurs: renal blood flow decreases and the volume of filtration decreases.

It should be emphasized that such a reflex, caused by the influence on the tone of the afferent arterioles, occurs when any area is overfilled with urine - the pelvis, ureter, bladder.

Continence of urine in the bladder is ensured by the functioning of the bladder neck and the internal opening of the urethra.

Although there are no circular smooth muscles in this zone, i.e., typical sphincters, there is a blockage - it is caused by the presence of a cavernous mechanism - the uvula of the bladder. The detrusor is innervated by cholinergic fibers, which activate the detrusor and cause bladder emptying, as well as by sympathetic fibers.

Beta-adrenergic receptors are predominantly localized in the body and bottom of the bladder. Alpha adrenergic receptors are located in the cervical region. Thus, due to sympathetic influences, the bladder is blocked (alpha effect) and the detrusor is relaxed (beta effect).

The act of urination (emptying). [When the normal capacity of the bladder is reached - 150-250 ml, the flow of impulses from baroreceptors and mechanoreceptors to the spinal centers of urination (1l, L2, 82-§4) increases, as well as to the higher located parts of the central nervous system - to the center of urination in the hypothalamus and to the cerebral cortex hemispheres.

As urine accumulates, the frequency of generation of action potentials increases, and the urge to urinate and the micturition reflex occur. Under physiological conditions, the reflex can be voluntarily evoked or suppressed. The act of urination occurs due to the contraction of the detrusor. When urination begins, the pressure in the bladder decreases and the flow of impulses to the central nervous system decreases, but

emptying continues, since, as it flows through the urethra, urine (as an electrolyte) excites the receptors present here that support the contraction of the detrusor.

1) The first functional circle connects the motor centers of the bladder muscles, located in the frontal lobes of the cerebral hemispheres, with the reticular formation. This circle connects the thalamus, basal ganglia and limbic system. What is the physiological meaning of this circle? When, as a result of the flow of impulses from the baro- and mechanoreceptors of the bladder, a reflex increase in detrusor tone occurs, inhibitory influences arrive from the basal nuclei and from the limbic system to the spinal centers. But through the cerebral cortex, voluntary regulation of the act of urination is carried out. This circle matures in ontogenesis in the first years, and in old age it is destroyed. The second functional circle is the path from the bladder receptors to the micturition centers in the reticular formation. From them begin the reticulospinal tracts, which play a certain role in the activation of somatic muscles involved in the act of urination.

2) In general, the task of this circle is to create a coordinated micturition reflex of sufficient duration until the bladder is completely emptied.

3) The third circle - starts from the detrusor receptors, the flow of impulses from which reaches the motor neurons of the sacral spinal cord. Due to this pathway, the motor neurons innervating the periurethral muscles are inhibited, so it relaxes, which promotes urination.

4) The fourth circle - thanks to it, segmental innervation of the striated periurethral muscles is carried out. The supraspinal pathway runs from the stretch receptors of the pelvic floor muscles to the thalamus and then to the cortex, from where signals travel along the pyramidal tract to the pelvic floor muscles. When this path is disrupted, a spasm of the striated urethral sphincter occurs. The segmental pathway represents a flow of impulses from the stretch receptors of the pelvic muscles to the motor neurons of the spinal cord, and from them to the pelvic muscles. When this path is disrupted, persistent relaxation of the striated sphincter occurs.

5) Fifth circle - ensures the transmission of the flow of impulses from the urethral receptors to the spinal centers of urination, due to this, emptying ends only when the bladder is completely released.

4. Illustrative material:

-presentation of lecture material;
-posters on the topic of the lesson;
- handouts (tables, diagrams, illustrations).

5. Literature application No. 1

6.Test questions (feedback)

1. What is the structural and functional unit of the kidneys?
2. How many phases of the urine formation process are there?

3. How is urine formation regulated?
4. At what pH of urine does the urge to urinate occur when the bladder is filled with urine?
5. How many functional circles are there during the act of urination?
6. How is urination regulated?

Lecture No. 2

1. Topic: Human reproductive system.

2. Purpose: to study the human reproductive system, its age-related characteristics, the functions of the male and female reproductive systems and the functional characteristics of the female reproductive system.

3. Lecture abstracts

The human reproductive system performs a reproductive function.

The sex glands (gonads) produce sex hormones. These include female sex hormones, including estrogens (estrone, estradiol and estriol), progestins (including progesterone), as well as male sex hormones - androgens (including testosterone). All of them are steroid hormones synthesized from a single precursor - cholesterol.

Sex hormones should also include hormonal factors that are involved in the regulation of their production - gonadoliberin, follitropin (FSH - follicle-stimulating hormone), lutropin (LT - luteinizing hormone).

As part of the hormonal regulation of reproductive processes, a group of hormones produced in the placenta is also considered, including chorionic gonadotropin, chorionic somatomammotropin (placental lactogen), as well as the hormone of the adenohypophysis - prolactin and the factors regulating its production - prolactostatin and prolactoliberin.

In addition, in recent years, substances have been discovered that play a certain role in the regulation of human reproductive function, for example, inhibin, relaxin, a factor that inhibits the development of the Müllerian duct, etc.

Male sex hormones are produced in men and women in the adrenal glands (reticular cortex), in the testicles of men and in the ovary (external theca layer) of women. The main site of androgen production is the testicle.

The testicle is the male reproductive gonad, where spermatogenesis and androgen production occur. Spermatogenesis occurs in convoluted tubules, which are lined with primary germ cells - spermatogonia and Sertoli cells. Sertoli cells nourish sperm.

Androgens are produced by Leydig cells - these are interstitial cells of the testicle; the collection of these cells is often called the pubertal gland. Androgens are synthesized from cholesterol, mainly under the influence of FSH and LH.

Physiological effects of testosterone: - participates in the sexual differentiation of the gonad and in the development of primary sexual characteristics (internal and external genitalia), in the development of secondary sexual characteristics (hair growth and male skeletal organization);

- stimulates the growth of the skeleton and all tissues of the body, accelerates the maturation of the skeleton, stops the epiphyseal growth of tubular bones, which limits the growth of the body in length;
- has an anabolic effect - stimulates protein synthesis in skeletal muscles and other tissues;
— provides libido and potency, ensures male type of sexual behavior;
- participates in the regulation of spermatogenesis (due to its effect on Sertoli cells).
Excess testosterone causes hypersexuality, increased height
hair.
The regulation of testosterone levels is carried out due to its direct influence on the hypothalamus (GnRH-producing neurons of the tonic center - "GnRH release -" LH release - "testosterone production in the testicle by Leuzig cells. When testosterone levels are increased, GnRH production decreases and vice versa.

The female reproductive system performs the reproductive function.

During pregnancy, progesterone, together with estrogens, promotes morphological changes in the uterus, myometrium, and mammary glands. It was believed that progesterone inhibits the contractile activity of the uterus and blocks the effects of stimulants, promoting gestation. Chapo's progesterone block theory became widespread in the 50s and 60s. Animal experiments have shown that labor cannot begin unless the level of progesterone production decreases to minimum levels. This is typical for a rabbit, rat, pig.

For women, however, the situation is different. On the eve of childbirth, progesterone levels not only do not decrease, but, on the contrary, tend to increase. Consequently, women give birth against a background of high progesterone levels. This means that progesterone is not able to inhibit the contractile activity of the uterus in women?

This situation is probably true for the 2nd and 3rd trimesters of pregnancy, when the beta-adrenergic receptor inhibitory mechanism comes to the aid of the progesterone mechanism, causing inhibition of spontaneous and induced contractile activity of the myometrium. In the first trimester, progesterone may still have a direct inhibitory effect on the uterus: if it is insufficient, there is a threat of termination of pregnancy or miscarriage.

If fertilization of the egg occurs, then human chorionic gonadotropin, produced from the very first hours of the existence of the fertilized egg, and subsequently placental lactogen, support the production of progesterone in the corpus luteum. After the formation of the placenta, the role of the corpus luteum decreases, but until the end of pregnancy it continues to function as a source of progesterone.

In the absence of a signal from the egg (absence of human chorionic gonadotropin), the corpus luteum is reduced with a decrease in progesterone production. This process probably occurs under the influence of prostaglandins, the level of which increases

towards the end of the luteal phase of the cycle and leads to a change in ovarian blood flow, which causes luteolysis - reduction of the corpus luteum. At the same time, prostaglandins activate the production of FSH, and against the background of a decrease in the level of progesterone and prolactin, there is an increase in the release of gonadoliberin from the tonic center of the hypothalamus, which enhances the production of FSH and LH. The cycle repeats itself again.

It is customary to distinguish between the ovarian cycle and the uterine cycle.

In women, the entire menstrual cycle lasts, on average, 28 days. Some women have 21, 26 or 32 days. With a 28-day cycle, the ovarian cycle consists of three phases, each of which takes the following period of time:

1) follicular phase - from 1 to 14 days of the cycle;

2) ovulatory phase or ovulation phase - 14th day of the cycle;

3) luteal phase - from 15 to 28 days.

Accordingly, the level of sex hormones changes as follows: during the follicular phase of the cycle, the level of estrogen gradually increases, reaching a maximum at the time of ovulation (or rather

- one day before ovulation), and from the 15th day - from the beginning of the luteal phase - the level of progesterone predominates.

Certain changes occur in the uterus and its endometrium during the cycle. They are divided into 4 phases: desquamation, regeneration, proliferation and secretion.

The desquamation phase represents the shedding of the endometrium—menstruation.

It (phase) lasts 3-5 days. Almost in parallel with it, the regeneration phase begins - restoration of the endometrium, which ends by 5-6 days from the first day of menstruation. Then comes the proliferation phase - the growth of the endometrium, the development of glands in it. The phase lasts until day 14 (until ovulation). The secretion phase - from 15 to 28 days inclusive - under the influence of progesterone, the endometrial glands begin to produce a secretion containing glycogen.

Thus, in this phase, the uterine mucosa is ready to accept a fertilized egg for further development. Then, due to vasoconstriction, necrosis occurs and the desquamation phase (rejection of the endometrium) begins again.

The secretion of milk is milk fat, lactose (milk sugar), proteins, water, and mineral salts. Milk fat is a mixture of lipids: triglycerides, diglycerides, monoglycerides, free fatty acids, phospholipids and sterols. All fatty acids that make up milk are synthesized directly in the alveolar cells, and some come from the blood. A drop of fat is pushed into the lumen of the alveoli through a process called exocytosis (actively).

Proteins are also synthesized inside alveolar cells - from amino acids brought in with the blood. The main protein of milk is casein. Lactose is synthesized from glucose also in alveolar cells—in the Golgi apparatus.

4. Illustration material:

- presentation of lecture material;
- posters on the topic of the lesson;
- tables, diagrams.

5. Literature: see Appendix No. 1.

6. Test questions (feedback)

1. What function does the human reproductive system perform?
2. What organs represent the male reproductive system?
3. What hormones are secreted by the male gonads?
4. What function does the female reproductive system perform?
5. What functions do the mammary glands perform?
6. Are the mammary glands classified as external or internal secretion glands?

Appendix No. 1.

Literature
in physiology:
In Russian:
main:

1. Kositsky, G. I. Human physiology. T.1: textbook / G. I. Kositsky.-3rd ed. revised. and additional –Almaty: New book. 2021. – 268 p.

2. Kositsky, G. I. Human physiology. T.2: textbook / G. I. Kositsky. - 3rd ed. reworked and additional - Almaty: New book, 2021. - 284 p.

3. Kositsky, G. I. Human physiology. T.3: textbook / G. I. Kositsky. - 3rd ed. reworked and additional - Almaty: New book, 2021. - 152 p.

4. Normal physiology: textbook / Ed. Academician of the Russian Academy of Medical Sciences B.I. Tkachenko. -3rd ed., rev. and additional – M.: GEOTAR – Media, 2018.- 688 p. + wholesale. Disc (CD-ROM)

5. Esenbekova, Z. E. Course of lectures on normal physiology: textbook / Z. E. Esenbekova, T. N. Naumova, A. S. Alipbekova. - 3rd ed. add. and processed - Bishkek: [b. i.], 2019. - 365 p.

6. Normal physiology: textbook / Ed. L. Z. Telya, N. A. Agadzhanyan; M-in image. and science of the Russian Federation. Rec. State Budgetary Educational Institution of Higher Professional Education "First Moscow State Medical University named after I.M. Sechenov." - M.: "Litterra", 2015.

additional:

1. Situational tasks for the course of normal physiology: teaching aid /V. K. Kasymbekov [and others]. - Almaty: Evero, 2016. - 144 p.

2. Mindubaeva, F. A. Guide to practical classes in physiology [Text]: educational manual /. - Almaty: Evero, 2016. - 208 p.

In Kazakh language:
basically:

1. Babsky E.B, Babskaya N.E. Human physiology: Textbook 1-2-3 volumes.-Evero, 2015.

2. Normal physiology: textbook / Russian Ministry of Education; ed. etc. K. V. Sudakov; Goose. aud to the language and editor-in-chief. F. A. Mindubaeva. - ; I. M. Presented by the First MMSU named after Sechenov. - M. : GEOTAR - Media, 2015. - 864 pages. + el. Opt. disc

additional:

11. Kasymbekov, V. K. A set of situational problems on normal physiology: educational and methodological tool / V. K. Kasymbekov, R. E. Nurgalieva, A. T. Kaldybaeva. - Almaty: Evero, 2016. - 152 pages.

2. Kasymbekov, V. K. Physiological research methods: teaching-methodological tool / V. K. Kasymbekov, F. K. Balmagonbetova, A. T. Kaldybaeva. - Almaty: Evero, 2016. - 176 pages.

3. Satbaeva, Kh. K. Human physiology: textbook / Kh. K. Satbaeva, A. A. Utepbergenov, Zh. B. Nildibaeva. - 2nd head. corrected and supplemented. - Almaty: Evero, 2010. - 664 pages.

4. Saidakhmetova, A. S. Instructions for practical lessons in physiology: textbook / A. S. Saidakhmetova, S. O. Rakhizhanova. - Karaganda: AKNUR, 2016. - 260 pages.

5. Normal physiology: textbook / Russian Ministry of Education; ed. etc. K. V. Sudakov; Goose. aud to the language and editor-in-chief. F. A. Mindubaeva. - ; I. M. Presented by the First MMSU named after Sechenov. - M. : GEOTAR - Media, 2015. - 864 pages. + el. Opt. disc

6. Nurmukhambetuly, A. Russian-Kazakh medical (physiological) dictionary = Russian-Kazakh medical (physiological) dictionary: dictionary / A. Nurmukhambetuly. - Almaty: Evero, 2014. - 903 p.

6. Mindubaeva, F. A. Instruction for practical lessons in physiology: teaching-methodical tool / F. A. Mindubaeva, A. Kh. Abushakhmanova, A. Kh. Shandaulov. - Almaty: Evero, 2012. - 186 pages.

In English:

basically:

1. Babsky, Y. B. Human physiology. Volum 1.: textbook / Y. B. Babsky, Y. B. Babsky. - Almaty : "Evero" , 2017. - 308 p

2. Babsky, Y. B. Human physiology. Volum 2.: textbook / Y. B. Babsky, U. B. Babsky. - Almaty : "Evero" , 2017. - 296 p.

3. Babsky, Y. B. Human physiology. Volum 1.: textbook / Y. B. Babsky, Y. B. Babsky. - Almaty : "Evero" , 2017. - 260 p

4. Jain, A. K. Textbook of physiology [Text] : textbook. Vol. 1 / A. K. Jain . - 7 th ed. - Nev Delhi : Avichal publishing company, 2017. - 596 p. Перевод

5. Hall John E. Guyton and Hall textbook of medical physiology : textbook / John E. Hall. - Philadelphia : Elsevier, 2016. - 927 p.

6. Kharissova, N. M. Physiology of the digestive system : educational-methodical manual. - Almaty : Evero, 2015. - 428 p.

additional:

1. Smagulov , N. K.: textbook / N. K. Smagulov , N. M. Kharissova ; Ministry of public health of Republic of Kasakhstan; Karaganda state medical universitety. - Almaty : LLP "Evero", 2013.

Electronic resource:

1. Normal physiology [Electronic resource] : textbook / pod ed. B. I. Tkachenko. - 3rd edition, ex. and the ball. - Electronic text files. (53.1 Mb). - M. : GEOTAR - Media, 2017. - email. opt. disc

2. Human physiology. Atlas of dynamic drawings [Electronic resource]: textbook / K. V. Sudakov [etc.]; Kazakh language. aud. M. K. Bloody. - Electronic text files. (105 Mb). - M. : GEOTAR - Media, 2017. - 464p.

3. Normal physiology [Electronic resource]: textbook / Kazakh language. F. A. Mindubaeva; ed. K. V. Sudakov. - Electronic text files. (1.42 Mb). - M. : GEOTAR - Media, 2015. - 864 pages. Opt. disc

4. Kamkin, A. G. Atlas of physiology. B 2 t. T. 1 [Electronic resource] : учеб.пособие / A. G. Kamkin, I. S. Kiseleva. - Electronic text files. (58.4 MB). - M. : GEOTAR - Media, 2010. - 408 p. people opt. disc

5. Shandaulov A.H. The basis is general physiology https://mbook.kz/ru/index_brief/373/

6. Aizman, R. I. Physiology of a person: учеб. allowance / R. I. Aizman, N. P. Abaskalova, N. S. Shulenina. - 2nd ed., pererab. and ex. - M. : INFRA-M, 2018. - 431, [1] p. elib.kaznu kz

7. Georgieva S.A. Human physiology: S.A. Georgieva, N.V. Belinina, L.I. Prokofieva, G.V. Korshunov, V.F. Kirichuk, V.M. Golovchenko, LK Tokaeva. - Almaty: Evero, 2020. ill., 480 p. https://www.elib.kz/

8. Kasymbekov V.K. etc. Situational tasks on the course of normal physiology. Educational and methodological manual /V.K.Kasymbekov, R.E.Nurgalieva, A.T.Kaldybayeva and others - Almaty: Evero, -2020. - 144 https://www.elib.kz/

№	Name	Link
1	Electronic library	http://lib.ukma.kz
2	Electronic catalog - for internal users - for external users	 http://10.10.202.52 http://89.218.155.74
3	Electronic library of republican higher educational institutions	http://rmebrk.kz/
4	Electronic library of "Student Adviser" Medical University	http://www.studmedlib.ru
5	"Paragraph" information system Medicine" department	https://online.zakon.kz/Medicine
6	"Law" is an electronic source of legal information	https://zan.kz
7	Scientific electronic library	https://elibrary.ru/
8	«BooksMed» " electronic library	http://www.booksmed.com
9	«Web of science» (Thomson Reuters)	http://apps.webofknowledge.co
10	«Science Direct» (Elsevier)	https://www.sciencedirect.com

11	«Scopus» (Elsevier)	www.scopus.com
12	PubMed	https://www.ncbi.nlm.nih.gov/pubmed