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A Comprehensive Review of Physiological Aspects of *Apana Vata*

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ABSTRACT

Among five types of *vata dosha*, *apana vata* plays an important role in controlling many systems of body viz. reproductive system, urinary system, excretory system and parturition. *Acharya* name these functions as *Mutra dharana and nishkramana* (Holding and voiding of urine), *Shakrita dharana and nishkramana* (Holding and voiding of feces) *Artava dharana and nishkramana* (Menstruation) *Shukra dharana and nishkramana* (Holding and emission of semen), *Garbha dharana and nishkramana* (Holding and expulsion of fetus), *Garbha srijana* (expulsion of fetus).The primitive micturition reflex brought out by the central integrating in the sacral spinal cord can be taken as the *apana vata's* action on urinary system. *Apanavata* performs its function of defecation by Myenteric plexus and activation of pudendal nerve during defecation reflex.For ejaculation (*shukranishkramana*) three types of nervine controls viz. lumbar sympathetic trunk (LIL2) causing the rhythmic contractions of muscles of vas deferens the seminal vesicles and prostate, sympathetic impulse causing relaxation of detrusor muscle and contraction of internal sphincter inhibiting the micturition and parietal branch of pudendal nerve (S2S4) causing rhythmic contraction of perineal muscles facilitating ejaculation represent the *apanavata* physiology. For parturition (*garbhanishkraman*) two theories viz. uterine distension theory and Freguson reflex theory represent the *apanavata* physiology.

KEYWORDS

Apanavata, Mutradharana, Nishkramana, Garbhanishkramana, Purishadharana, Shukranishkramana

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INTRODUCTION

In ayurveda at many places *prana* and *apana* have been mentioned togetherwhich signifies that both *prana* and *apana vata* have equal significance[1]. As *prana vata* is important due to its function of soothing or gratifying the body, *apana vata* is also imporatnt due its nature of making body free from vitiated products of digestion. As the word *apana* literally mean to carry away it has been synonymously used for expiration and for excretion.

Apana vata is a subdivision of *vata dosha*. Sites of *Apana vata* and *vata dosha* as described in texts are similar e.g. *basti, purishadhan, kati, pakvashaya, shroni* and *guda*. *Pakvashaya* is the common prime location of *apana vata* as well as *vata dosha*. From here, *apana vata* keeps control over its functions in *bastimedhradi* area. *Prerana* (excretion) and *dharana* (retention) of *mala, mutra, shukra* and *artava* are the cardinal functions of *apana vata.*All subdivisions of *vata* get strength from *pakvashayastha vata,* and move in their respective parts of body to perform their physiological functions.Excessive vitiation of *apana vata* can lead to vitiation of *pakvashya* and therefore direct vitiation of main *vata dosha*. *Vata* is the prime among the three dosha and is able to vitiate other *dosha*. Hence stabilized *apana vata* keeps optimum physiology of other types of *vata*and chief *vata dosha*also while abnormal one can lead to the pathological states of main vata dosha and its subtypes. Hence considering the magnitude of *apanavata* its physiologicalaspectshave been discussed in the present research paper.

AIMS AND OBJECTIVES

To comprehend the physiological characteristics of *apana vata* from ayurveda as well as contemporary point of view

MATERIALS AND METHODS

This is a literary study in which classical ayurveda and modern texts have been exhaustibly consulted to meet the objective

REVIEW

Dosha perform their functions through their inherent characteristics or *guna*. *Apana vata* being subtype of *vatadosha*possesses the qualities of chief *vata dosha* viz. *laghu, ruksha, sukshma, chala, sukshma, vishada* and *khara.* Among these *Chala guna* is responsible forits excretory function.The normal functions of *apana vata* according to various classical texts of *ayurveda* are tabulated below[2]

Table 1 Karmaof*apana vata*

Sr. No.	Functions of *apana vata*
1	*Mutra dharana and nishkramana* (Holding and voiding of urine = micturition)
2	*Shakrita dharana and nishkramana* (Holding and voiding of feces = defecation)
3	*Shukra dharana and nishkramana* (Holding and emission of semen = ejaculation)
4	*Artava dharana and nishkramana* (Menstruation)
5	*Garbha dharana and nishkramana* (Holding and expulsion of fetus = parturition)
6	*Artava srijana* (Excretion of menstrual blood)
7	*Garbha srijana* (expulsion of fetus)

Role of apana vata in physiology of urinary system:

***A. Mutra nirman* (Formation of Urine):**

Urine is the waste product formed during the digestive process of food. *Pachaka pitta* under the influence of *samana vata* digests the food materials and separates the essential parts from the waste products. *Samana vata* and *pachaka pitta* discriminate the ingredient of *mutra* in the digestive system. These components of urine are absorbed into blood from alimentary tract through *maladhara kala* with the effect of *samana vata*. Circulating urinary contents are collected into *basti (*kidney) through the minute invisible orifices of *mutravahanadis (*nephrons*)* constantly, just as water permeates into earthen pot, while kept in water. This process requires *apana vata dosha* to be in balanced state[3].

The *guna* of *vata dosha* playing role in formation of urine can be understood as follows:

Sukshma guna aids in filtration process in the kidney through the semi permeable cell membrane. *Laghu* and *ruksha guna* perform the *soshana karma* of the *apana vata* in *basti*, i.e. in the distal convoluted tubules of the kidney most of the water contents are reabsorbed *(soshana).*

B. Mutra dharana (retention of urine): The formed urine stays in bladder by *ruksha* and *sheetaguna*of apana vata till it gets excreted. During the filling phase the bladder pressure is low and sphincter pressure is high. The bladder pressure is almost zero when it is empty and rises rapidly to 5mm by addition of small volume of urine but further addition of urine does not rise the pressure because of its capacity of distension. When the bladder attains the threshold level of about 200ml of fluid i.e. *mutra dharana*the pressure rises abruptly exceeding the sphincter pressure.

***C. Mutra nishkramana* (excretion of urine):** As the bladder fills, the sensory signals from the bladder stretch receptors are conducted to the sacral segment of spinal cord through the pelvic nerves. Then the reflex reverses to the bladder through the parasympathetic nerve fibres initiating

the contraction of detrusor muscle causing the fall in the pressure in the internal sphincter. When the bladder pressure reaches a threshold volume, micturition is initiated by diaphragm and abdominal muscles causing the relaxation of external uretheral sphincter. Ancient acharya have clearly indicated the excretion of urine through the *urethra* under the effect of *apana*. *Chala guna* of *apana vata* results in *vikshepana* of urine from kidney to bladder and also from bladder to exterior *(mutravega).* If inconvenient to pass urine the cortical centre sends down an impulse by which the micturition reflex is inhibited. So that the detrusor relaxes, the sphincter contracts and the desire disappear very well resembling to *mutra vegadharna*. Though when the amount of urine exceeds the threshold limit of bladder the micturition desire becomes irresistible. The primitive micturition reflex brought out by the central integrating centre in the sacral spinal cord can be taken as the *apana vata's* action, while the influence of higher centers on micturition can be described under the functions of *prana vata.*

Hence the process of micturition is accomplished with the stimulation of both somatic and autonomic nerves which are regulated by *apana vata.* If at all these are damaged the control on micturition is lost and a condition of autonomic bladder i.e. incontinence of urine (*apanavataviagunya)* ensues**.**

Functions of *apana vata* related to *shakrit dharana* and *nishkramana*:

Shakrit (feces) is also one of the *malas* which is solid in consistency and formed from *kittamsha* of the *ahara*. Functions of *purisha* are *Upastambha/ avashtambha* i.e. it supports or maintains the body[4]. The other function is *Vayu dharana and agni dharana* i.e they support the place where they stay i.e. *pakvashya* hence they support the *vayu* since pakvashaya is the prime location of *vata dosha*. They support *agni* as *shoshana karma* of *purisha* is performed by *agni* in *pakvashya*.

Ingested food after being processed at different stages reaches *kshudrantra* where it is analyzed into two parts by *vivechana* action of *samana vata*[5]and *kitta* part reaches the *sthulantra* for elimination. Here the *kittamsha* is subjected to the action of the *pureeshadhara kala*where the fluid part is dried up by the *agni* present there and the remaining part is transformed into solidified form and excreted by the action of *apana vata* through the *guda*[6]

Therefore, in Ayurveda, the holding of feces in the pakvashaya (large intestine) and excretion of feces through *guda* is the function of *apana vata*. In modern science, the holding and excretion of feces is dependent on intestinal motility which is

controlled by various nervous component. Myentric plexus initiates the intrinsic reflex i.e. arrival of feces distends the rectum which leads to stimulation of afferent signals. The intensification of this reflex is done by parasympathetic fibres in Nervi erygentes. Activation of Nervi erigentes leads to propulsive wave extending from descending colon to the rectum and relaxation of internal sphincter. Activation of pudendal nerve during defecation reflex leads to contraction of external anal sphincter. Due to similarity in actions, *apana vata* and these nervous components can be interrelated to each other or it can be inferred that *apana vata* performs its task by these nervous tracks.

Functions of *apanavata* related to *shukra dharana* and *nishkramana:*

Shukra is the seventh *dhatu* which is formed by essence formed from the food after its proper digestionas a result *rasa raktadi dhatu* are produced in sequential order[7].After digestion of *majja dhatu* the essence part *shukra* is formed. On its further metabolism nothing comes out as its by product. Thus it is the purest of all *dhatus* and is present all over the body just as cream is present in milk and juice in sugarcane imperceptibly [8].

Copulation is the basic behavior which is aimed to preserve the race and is genetically imprinted. According to ancient science, during copulation (*streepurusha samyoga*) by contact (spinal factor) and during states of excitation of man by thinking, viewing or hearing (cerebral factors)*vrishana*(testes), the basic organs of *shukra vaha strotas*(male genital tract) under the effect of *shukradhara kala (testosterone hormone)* generates *beeja rupa shukra (sperms).* This *shukra* while traversing through the *shukravaha strotas* reaches urethra and is ejaculated in the yoni of female by*shepha (penis)*, another basic organ of *shukravaha strotas* by the impulse of *apana vata*[9].This impulse of apana vata can be explained through the various neural mechanisms involved in the process of semen ejaculation (*shukra nishkramana*). The whole act comprises of erection, emission and ejaculation. Erection the enlargement and stiffening of the penis is initiated by sensory stimulation of glans penis, which contains special sensitive sensory end organ systems. Afferent stimulus pass from the glans penis via sympathetic pudendal nerve (S2-S4) then through the sacral plexus into the sacral part of spinal cord and ultimately to undefined areas of brain. Emission, the movement of the semen into the urethra is a sympathetic response. Sensory nerve impulses pass the glans penis reach the sacral part of spinal cord and travel to the integrating centre in the upper lumbar segments of the spinal

cord. A massive stimulus through the hypogastric nerve initiates the contraction of smooth muscles of vas deferens and seminal vesicles promoting the secretions to enter into the prostatic urethra. Ejaculation, the propulsion of semen out of urethra at the time of orgasm requires three types of nervine controls viz. Lumbar sympathetic trunk (LIL2) which causes the rhythmic contractions of muscles of vas deferens the seminal vesicles and the prostate. Sympathetic impulse causes relaxation of detrusor muscle and contraction of internal sphincter inhibiting the micturition. Parietal branch of pudendal nerve (S2S4) causes rhythmic contraction of perineal muscles facilitating ejaculation.

Functions of *Apana Vata* related *to Artava Dharana* and *Nishkramana*:

Menstruation is a cyclical process in which regular discharge of blood and mucosal tissue from the inner lining of the uterus occurs through the vagina under the influence of vata[10].Vata dosha accomplishes the menstrual phase through the dhamani. *Dhamani* word is synonyms with the artery. Hence the spasm in the straight stem of arterioles as a causative phenomenon of bleeding during menstruation gives an indication that *vata dosha* acts through *dhamani*. This type of *vata dosha* is *apana vata* as pelvic area belongs to *apana vata's* region. Modern physiology also explains the role of nervous system in menstruation by its action on the uterine vessels. In modern science though it is established that withdrawal of hormones leads to endometrial breakdown which results in menstruation, yet another important feature of menstruation is the contraction and constriction of the spiral arteries. The ischemia causes necrosis and disintegration of the superficial zone of endometrium[11]. The cause of spasm of these spiral arteries at the end of secretory phase is not clear according to modern physiologists [12]. Few facts establishing the relationship of nervous control and uterine blood vessels are worth considering. Female genital organs receive both sympathetic and parasympathetic nerves supplies. The sympathetic system consists of presacral nerve and its branches while parasympathetic system consists of sacral fibres from S2, S3 and S4 which supply to all the pelvic organs including uterus[13]. The dual nerve supply to viscera i.e. sympathetic and parasympathetic efferent efferents determines the state of activity of a particular organ at a particular time [14].The smooth muscles of blood vessels are supplied by sympatheic fibers whose stimulation results in vasoconstriction of uterine blood vessels. The effect of sympathetic stimulation on uterus is variable and depends on estrogen and

progesterone secretions. In addition over activity of sympathetic nerves and imbalance in autonomic nervous system as a cause of dysmenorrhea supports the role of nervous system on menstruation [15].

Functions of *Apana Vata* related *to Garbha Dharana* and *Nishkramana* (Parturition)

***A. Dharana* karma**:

The fetus continuously grows in the womb up to full term and then naturally it is delivered. The *dharanakarma* of *apana vata* is responsible for the normal retention of fetus in womb for a certain period viz. as up to 10 months (minimum 9 months)[16]while *Acharya*Sushruta has given the minimum time limit of 9 months and maximum of up-to12 months[17].

During this antenatal period besides retaining the fetus, the balanced *apana vata* also results in the growth of fetus by cellular divisions and moulding the shape of embryo [18]while imbalanced one leads to morbidities of fetus e.g. desiccation and reduced growth of fetus leading to postmaturity[19]Hence,balanced *apanavata* holds the fetus until it becomes full term and during this period bestows the fetus with optimum growth and development.

B. Nishkramana karma* (Parturition*):

Ancient acharya have explained the expulsion or delivery of fetus with indue time by the *nishkramana karma* of balanced*apana vata*[20]. When the descent of fetus occurs, pain in pelvic region appears indicating the impending labour. At the time of delivery there is pain all over the waist and back, frequent passing of feces and urine and also discharge of mucus from vagina. This pain along with bearing down efforts is mainly helpful in delivery of fetus[21]. Acharya have given tremendous importance to the labor pain so as to instruct the mother for straining to achieve uncomplicated delivery of fetus . They have regarded this pain as *prasuti maruta* as it aids the delivery of baby which is none other than *apana vata*[22]

The precise mechanism of labour is obscure in modern literature. The theories of contemporary science supporting the ancient sage's wisdom regarding onset and progress of labour are here as under:

a. Uterine distension: It explains the stretching effect on the myometrium by the growing size of fetus and liquor amnii triggers the estogen induced α receptors of the postganglionic nerve fibres in and around the cervix and the lower part of the uterus.

b. Freguson reflex: stretching or irritation of cervix causes entire body of uterus to contract and these weak contractions trigger a neurogenic reflex

through the paraventricular and supra optic nuclei of the hypothalamus that causes the posterior pituitary gland to secrete more oxytocin which intensifies the uterine contractions.

As the fetus is moving towards the cervix by vigorous contractions of uterus, stimuli from cervix spontaneously secrete more quantities of oxytocin which causes each succeeding contraction greater than the preceding contraction. This positive feedback initiates a vicious cycle which proceeds to completion of labour[23]. Uterine contractions are the mainstay for the onset, progress and completion of labour. The nature and course of these contractions resemble more or less to the *avi* caused by *prasuti maruta* by the ayurveda scholars. Throughout pregnancy there is a rhythmic involuntary spasmodic uterine contraction (Braxton Hicks contractions), which are painless and have no effect on dilatation of cervix. This can be explained as the normal *vata* activity (*dharana* effect of *vata*) on uterus throughout pregnancy. The character of contractions changes with the onset of labour i.e. become more powerful intermittent and are associated with pain in hypogastrium, thighs and back *(sashula jaghane).* The cause of pain is stretching of the structures adjacent to uterus including neighboring ganglia or ischemia. Simultaneously retraction of uterine contractile system occurs. This contraction and retraction leads to formation of lower uterine segment and dilatation and effacement of cervix, aids in descent of presenting part of fetus and thus help in ultimate expulsion of fetus[24]. Thus delivery of fetus is accomplished by the downwards thrust offered by uterine contractions *(avi)* supplemented by voluntary contraction of abdominal muscles called 'bearing down efforts *(pravahana)* against the resistance offered by bony and soft issues of the birth canal.

DISCUSSION

Apana vata is more significant among other types of *vata* as it shares the common prime location *pakvashaya* along with *basti* etc. other locations with the *vata dosha*.. The excretory function of *apana vata* is highlighted more than its *dharana* function. The urge of excretion *(vega)* of *mutra, purish* and *shukra* and its implementation is given far importance by ancient sages so as to avoid the diseases occuring due to there holding (*apanavata* vitiation) [24]. *Acharya* though have not explained the mechanism in detail yet the term*vega*hints towards the excretory reflexes i.e. micturition reflex, defaecation reflex, ejaculatory reflex etc.

The function of *mutra dharana* is executed by *rooksha and sheeta guna of vata dosha*.

The function of *mutra nishkramana* (micturition) is performed by the *chala guna* of *apana vata*. Due to this *guna* the *vikshepana* of urine from kidney to bladder and from bladder to exterior (*mootravega*) occurs. In modern physiology the micturition process is under nervine control. The process of micturition is accomplished with the stimulation of both somatic and autonomic nerves. If at all these are damaged the control on micturition is lost and a condition of autonomic bladder i.e. incontinence of urine ensues. Hence the similarity of functions of nerve control of micturition relates it to the functional state of *apanavata.*

In Ayurveda science the holding of feces in the *pakvashaya* (large intestine) and excretion of feces through *guda* is the function of *apana vata*. In modern science the holding and excretion of feces is dependent on intestinal motility which is controlled by various nervous component viz. Myenteric plexus initiates the intrinsic reflex i.e. initiation of afferent signals by rectum on its distension by arrival of feces. Intensification of this reflex by parasympathetic fibres in nervi erygentes. Activation of nervi erigentes leads to propulsive wave extending from descending colon to the rectum and relaxation of internal sphincter. Activation of pudendal nerve during defecation reflex leads to contraction of external anal sphincter. Due to similarity in actions, *apana vata* and these nervous components can be interrelated to each other or it can be inferred that *apana vata* performs its task by these nervous tracks.

The process of *shukra nishkamana* (ejaculation) is aided by *apanavata* andgenerally involves multilevels and their description reflects the role nervous system at every stage. Male sexual act by which the sperms are deposited into the vagina depends on the integrity of many parts of nervous system and the testosterone. It comprises of erection, emission and ejaculation. Ejaculation *(shukranishkramana)* which is the propulsion of semen out of urethra at the time of orgasm requires three types of nervine controls viz. as lumbar sympathetic trunk (LIL2) causing the rhythmic contractions of muscles of vas deferens the seminal vesicles and prostate, sympathetic impulse causing relaxation of detrusor muscle and contraction of internal sphincter inhibiting the micturition and parietal branch of pudendal nerve (S2S4) causing rhythmic contraction of perineal muscles facilitating ejaculation.

Apanavata's function of *artava nishkramana* leads to the confusion that whether it means expulsion of ovum

(ovulation) or expulsion of menstrual blood (menstruation). This is because of use of '*artva'* word in relation to menstruation as well as ovulation. Since woman's healthy reproductive physiology is principally characterized by her monthly regular menstruation so the *apanavata's* function of *artava nishkramana* appears more relevant with regard to menstruation. *Vata dosha* accomplishes the menstrual phase through the *dhamanee*. *Dhamanee* means arteries, the spasm in the straight stem of arterioles as a causative phenomenon of bleeding is similar to the action of *vata* through *dhamanee*. This *vata dosha* is none other than *apana vata* as this area belongs to *apana vata's* region. Hence *apana vata* influences the menstruation as nervous system acts on the uterine vessels. Few facts establishing the relationship of nervous control and uterine blood vessels is as under.

Female genital organs receive both sympathetic and parasympathetic nerves supplies. The sympathetic system consists of presacral nerve and its branches while parasympathetic system consists of sacral fibres S2 S3 S4 which supply to all the pelvic organs including uterus[25].The dual nerve supply to viscera i.e. sympathetic and parasympathetic efferents determines the state of activity of a particular organ at a particular time [26]. The smooth muscles of blood vessels are supplied by sympatheic fibres whose stimulation results in vasoconstriction of uterine blood vessels. The effect of sympathetic stimulation on uterus is variable and depends on estrogen and progesterone secretions[27]. Besides, irregular uterine activity in dysmenorrhea due to increased stimulation of sympathetic nerves and imbalance in autonomic nervous system signifies the role of nervous system on menstruation [28]. Mode of action of *apana vata's* function in menstrual cycle can be evaluated e.g. *chala guna* assists in *vikshepana* of ovum from the ovary through the fallopian tube. If fertilization takes place then *dharana* of *garbha* (embryo) is assisted by its *sheeta guna.* If fertilization doesn't occur the shedding of the endometrial wall i.e. *vikshepana karma* is aided by its *chala guna*. Spontaneous stoppage of menstrual bleeding i.e. *Shoshana* of the *artava* at the end of bleeding phase is accomplished with the help of its *rooksha* and *khara guna*. Equilibrium in these *guna* maintains the woman's reproductive physiology while discrepancy in these *guna* makes the *apana vata* function abnormally (*apana vaigunya*).

The *dharana karma* of *apana vata* is responsible for the normal retention of fetus in womb for a certain period. *Acharya* Charaka has limited this period upto 10

months (minimum 9 months)while *acharya* Sushruta has given the minimum time limit of 9 months and maximum of 12 months. The abnormal state of *apana vata i.e.* prolonged *dharana* action beyond prescribed time limits leads to postmaturity of fetus[29].Balanced *apana vata* retains the fetus until it becomes fulterm and during this period bestows the fetus with optimum growth and development. The labor pain initiated by *apana vata* along with bearing down efforts *(avi)* is mainly helpful in delivery of fetus. *Acharya* have given tremendous importance to the labour pain so as to instruct the mother for straining to achieve uncomplicated delivery of fetus [30]. They have regarded this pain as *prasuti maruta* as it aids the delivery of baby which is none other than *apana vata*. Among hypothesis regarding causes of initiation of labour pains, the two theories viz. uterine distension theory in which stretching effect on the myometrium by the growing size of fetus and liquor amnii triggers the estogen induced α receptors of the postganglionic nerve fibres in and around the cervix and the lower part of the uterus and Freguson reflex theory in which stretching or irritation of cervix causes entire body of uterus to contract and these weak contractions trigger a neurogenic reflex through the paraventricular and supra optic nuclei of the hypothalamus that causes the posterior pituitary gland to secrete more oxytocin which intensifies the uterine contractions, support the ancient sage's wisdom regarding onset and progress of labour. These contractions are the mainstay for the onset, progress and completion of labour. The nature and course of these contractions resembles more or less to the *avi* caused by *prasutimaruta* as described by the ayurveda scholars.

CONCLUSION

Apana vata is more significant among other types of *vata* as it shares their common prime location i.e. *pakvashaya* along with *basti* etc. other locations of the *vata dosha*.The functions of *apana vata* include *mutra dharana* and *nishkramana(*micturitionreflex*)*, *shakrita dharana* and *nishkramana(*defecation reflex*)*, *shukra dharana* and *nishkramana (*ejaculatoryreflex*)*, *artava dharana* and *nishkramana (*menstruation*)*, *garbhadharana*and *nishkramana (*parturition*)*.The contemporary science explains this phenomenon by various nervetracks which can be interpreted as the functions of *apana vata*.

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