



Reproduction in elephants

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Recent studies reveal that world-wide captive elephant population is not self-sustaining. The current world population of captive elephants results primarily through imports from Africa and Asia. The difficulty in establishing self-sustaining captive population is mainly due to low reproductive rate. There is high incidence of undetected reproductive disorders in the captive elephant population. Some of these disorders may be attributed to continuous oestrous cyclicity in nulliparous females of prime breeding age (18-30y). After approximately 10-15y of cyclicity with roughly 40 non-fertile ovulations, pathological alterations like uterine tumours (leiomyomas) and endometrial cysts (hyperplasia) often develop. These lesions usually remain undetected because of lack of symptoms (eg. oestrous cyclicity appears normal) or outward signs except that no pregnancy results from breeding.

Male genital system

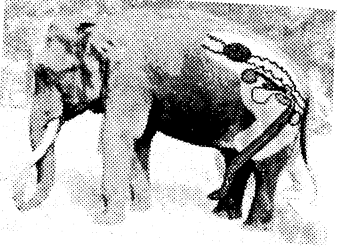
Testis

Just like in large marine mammals, the testes in elephants are placed inside the abdomen (testiconda). The testis of adult elephant weighs about 700-950 g and is wedge shaped. A single spermatic artery on either side supplies blood to the testis.

Efferent duct and Wolffian duct

The excurrent duct of the male elephant can be divided

into two parts; efferent duct and the Wolffian duct. The elephant has a poorly distinct epididymis. The elephant epididymis is very small compared to the testis. Additionally, the epididymis is not well demarcated from the rest of the genital duct in the elephant, making it difficult to locate. The usual length is 10 cm and width 1-2 cm. It is a moderately coiled structure. Wolffian duct is a much larger structure being about 1 mm in diameter initially and extremely coiled throughout the whole of its overall length of about 160 cm before opening into the ampulla.



Ampulla

The Wolffian duct opens by means of a small papilla into the ampulla. The ampulla lies ventral to the seminal vesicles to form two common ejaculatory ducts.

Accessory sex glands

All the three accessory sex glands, seminal vesicles, prostate and bulbo-urethral (Cowper's gland) are present in elephants. Seminal vesicles are two large thick walled sacs lying within the pelvic cavity and are fusiform in shape. The secretion is usually clear, watery and alkaline. Prostate is situated on the dorsal wall of the urethra posterior to the seminal vesicles. The glands are mostly in the form of two discrete lobes, one on either side of the urethra posterior to the seminal vesicles. Bulbo-urethral glands lie together on the dorso-lateral aspect of the urethra close to the ischial arch, dorsal to the curve of penis.

Penis

The length of the penis is about 4.5 feet, 15 inch in circumference and weighs about 7 kg. Glans penis is absent in elephants but the tip of the penis is more flat and resembles the hood of a snake. The corpus cavernosum penis is well developed which is divided into two halves by a thick septum. The opening at the ill-defined urethral process is 'Y' shaped, the two arms of the 'Y' being situated dorsally. No prepuce is seen in the elephants. There is a large paired levator penis muscle on the dorsal surface. The two levator penis muscles unite to form a common tendon which is inserted on the dorsum of the corpus cavernosum penis and is responsible for the 'S' shaped flexure of the penis at erection.



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Seminology

The semen is expelled from the genital tract in three fractions. The first fraction is the one that contains the maximum concentration of spermatozoa (2050 millions/ml) and the average volume is about 10.5 ml. The second fraction is less concentrated (1340 millions/ml) than the first one and the average volume is 17ml. The third fraction which is about 50-100 ml in volume, is distinctly yellow in colour due to contamination with urine and is low in spermatozoal concentration. The average pH of semen is 7.05.

Artificial insemination

Due to the precarious status of the Asian elephants in the wild, it is vital that further knowledge and techniques for captive elephant reproduction be developed if the species is to continue to exist. The implications of successfully collecting and preserving elephant semen are profound, especially when considered in the context of propagating the Asian elephants in captivity. The ability to transport semen to fertile elephant cows circumventing the severe logistical problems of transporting elephants for breeding purposes is essential. Using manual rectal stimulation, sperm rich samples can be obtained with out dilution of the fluids from the accessory sex glands and with out extensive training of the animal to accept this method of semen collection. The penis is stimulated to protrusion and erection by rectal massage of the pelvic portions of the urethra. During an ejaculatory response, massage is also directed to the area of the ampulla of the ductus deferens. Since semen collection by electro-ejaculation involves anaesthesia-associated risk, manual manipulation/massage technique is preferred. But the most limiting factor is that semen collection by manual manipulation is possible only with trained bulls. Another disadvantage is that semen collection by massage technique does not elucidate the status of the accessory glands. Trans-rectal ultrasonographic imaging provides a less invasive means for locating and measuring reproductive structures that are the basis for reproductive assessment in elephants.

Musth and anti-androgens

Adult male Asian elephants and both sexes of African elephants manifest usually a physiological and behavioural phenomenon known as musth. The symptoms and behavioural changes of musth usually last for one to three months or some times up to 5 months and the intensity varies in pre-musth, full musth (violent musth) and post-musth phases. The androgen level in the blood usually increases considerably during the period of musth and it is stated to be the reason for the increased aggressive behaviour in musth elephants. Reduced aggression in castrated bull elephants further supports this concept. Based on this hypothesis trials were carried out with oral

administration of an anti-androgen (Flutamide) to reduce the aggression in animals in musth and the results are encouraging.

Female genital system

A characteristic feature of the female reproductive tract is the long uro-genital (vestibule) canal which extends down through the perineal region to carry the vulva to a position on the belly of the animal, anterior to the hind legs and similar to that of the male genital opening. The whole genitalia weigh about 25 kg.

Ovaries

The ovaries are large, rounded, slightly lobulated and placed in bursa and located near the kidneys. The average ovarian measurement is 7 x 5 x 2.5 cm. They are almost completely enfolded by an expansion of the fimbrial funnel of the fallopian tube which forms an ovarian sac, of which outer wall is covered with peritoneum. It is anchored to the uterine horn by the ovarian ligament and the body wall anteriorly by the suspensory ligament. The ovarian sac is widely open medially and is divided into inner and outer compartments. The outer compartment of the ovarian sac is fimbriated while the inner compartment is lined with peritoneum.

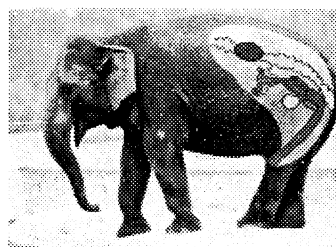
Fallopian tubes

In adult Asian elephant, the length of the fallopian tube is about 35 cm, the diameter at the fimbriated end is 4 mm and at the utero-tubal junction is 1 mm. Lumen at this point is very small and the muscularis forms a thick collar around the lumen.

Uterus

Consists of a well developed uterine body and two uterine horns. The horns themselves fuse caudally and then open into the common lumen of the body of the uterus. The walls of the uterus are thick. The os uterus is well defined, narrow and carried in a relatively massive papilla which projects in to the vaginal cavity. On examination of a uterus recovered on post-mortem of an adult cow elephant, the uterine body was found to be 12 cm long and the right and left horns were 75 and 65 cm long respectively. The length of cervix was 24 cm. It opened into the body in front and rear into the vagina by narrow openings. Its lumen was straight with longitudinal folds of mucous membrane. Mucous membrane on the floor of the uterus was also thrown into longitudinal folds.

The uterine cornua were observed to meet each other at right angle at the median plane as seen in equidae. Both the horns united posteriorly and merged with the body of the uterus giving a false appearance of the body





being longer in size. Each horn opened into the body of the uterus by a variable slit of 1.5 cm in length. An inter-cornual ligament was also observed on ventral aspect.

Vagina, Vestibule and Clitoris

The vagina measures about 60 cm in length. The vaginal wall is thin and highly flexible. The passage from the vagina to the uro-genital canal (vestibule) is widely open and the urethral orifice opens as a simple opening on the ventral wall of the tract. The clitoris in elephant is very long and big measuring about 30-60 cm in length and 1.5-2kg in weight.

Oestrous cycle

The oestrous cycle of Asian and African elephant is 13-16 weeks in duration with an 8-10 week luteal and 4-6 week non-luteal phase. The previous concept was that a cow elephant comes into heat once in every 3 weeks. One unique aspect of the elephant oestrous cycle is the presence of two surges of luteinising hormone (LH) during the non-luteal phase. The two surges are quantitatively and qualitatively indistinguishable and occur consistently 19-22 days apart. Ovulation and subsequent rise in progesterone are observed only after the second LH surge and is termed the ovulatory LH surge (ovLH). The function of the first, anovulatory LH surge (anLH) is unknown. It may be significant, though, that these surges are 3 weeks apart, apparently supporting the hypothesis that waves of follicular activity occur at this frequency. Unfortunately analysis of circulating oestrogens have not borne out this pattern, because concentrations are low and fluctuate with no clear pattern phase. The adaptation of ultrasonography to examine the elephant reproductive tract provides a new perspective for further investigating the dynamics of reproductive hormonal relationships in both male and female elephants.

The observed maturation and ovulation of only one Graafian follicle per cycle, in addition to the formation of luteal structures resembling corpora lutea suggest that an active endocrine mechanism exists in elephants to prevent multiple ovulation while still providing adequate luteal support. The presence and functional significance of multiple corpora lutea on the elephant ovary has long been a mystery. On average six to eight luteal structures are observed at any one time, some containing ovulation stigma (30-40%), whereas others do not. From the ultrasonography of ovary it is now apparent that multiple luteal structures do form during the ovarian cycle, with only one corpus luteum in response to the ovLH surge. If the non-ovulatory luteal structures are the result of luteinisation of follicles from the first wave, it is not clear why these structures are not steroidogenic. However the appearance of accessory corpora lutea 1-5 days before the ovLH surge

coincident with the preovulatory rise in progesterone suggests that at least some of this steroidogenic activity may be independent of the ovLH surge. The observation that all luteal structures regressed at the end of the luteal phase eliminates the possibility that multiple corpora lutea are the result of accumulated structures from cycle to cycle as previously suggested.

Mating behaviour and act of copulation

Prior to the actual act of copulation there is prolonged courtship behaviour accompanied by rumbling noise. Urine, temporal gland discharge etc. are tested by the partners as these materials contain certain pheromones. The male takes special attention in making contact with the uro-genital orifice and then places his trunk into his mouth after each contact. The vaginal secretions from the uro-genital tract stimulate the vomero-nasal organ establishing a flehmen like response in elephants. Cow elephant may even fondle the erected penis of the partner. With these contact promoting and precopulatory behaviour male gets ready for mounting. Before actual mounting several false attempts are made. The female exhibits its arousal by standing response and by spreading its ears. The male mounts extending his forelegs over the back of the female, puts his legs close together and then attempts intromission. The swollen tip of the erected penis before intromission develops a marked 'S' shaped flexure. The penis is quite mobile and the male makes no pelvic movements, but rather the uro-genital tract opening is sought by a series of vigorous up and down movements of the penis. When the uro-genital opening is contacted by the tip of the penis, it is pulled back and the penis is inserted into it with a series of up and down jerks. Intromission is very brief being about 30-40 seconds and the depth of intromission is less than one foot. The duration of the coitus will be about 1-2 minutes. The total quantity of semen ranges from 50-100 ml, which is mixed with viscid gelatinous material of egg white consistency. Following first mating the male is ready for second mating after half to one hour. Mating may be repeated 4-6 times a day and may last for 3-4 days.

Signs of pregnancy, gestation length and parturition

Signs of pregnancy during early period of gestation are not marked. Foetal movements can be visualised in the abdominal area from twelfth month of gestation onwards. Towards the end of gestation mammary glands become more firm and enlarged and on pressing watery to waxy type secretion oozes out through the teats. The average gestation length is 19-21 months. During the later stages of pregnancy, the pregnant female becomes more lethargic and seeks secluded places. Cervical mucus is observed 12-14 hours before parturition. Usually birth takes place during night and rarely during day in domesticated ones. Signs of abdominal pain and discomfort will be shown two

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