

## The ovarian and uterine arteries in the chinchilla (*Chinchilla lanigera*)

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### ABSTRACT

The purpose of this study was to describe arteries supplying the ovaries and uterus in the chinchilla. Five healthy adult female chinchillas were used. In order to reveal the arterial network by dissecting under a stereoscopic microscope, latex coloured with red ink was injected through the common carotid artery. The ovaries of the chinchilla are supplied by the *arteriae ovaricae* which formed end-to-end anastomoses with the cranial termination of the *arteria uterina*. Soon after leaving the *aorta abdominalis*, the *arteriae ovaricae* extended 2–3 mm caudolaterally, then released 1 branch and extended caudally and bifurcated into 2 further branches. One of these supplied branches to fat tissue. The other branch coursed caudally and anastomosed with the *arteria circumflexa ilium profunda* and dispersed into fat tissue. The *arteria ovarica* further subdivided into 2 *rami ovaricae*. The origins of the uterine arteries were exclusively from the left *arteria iliaca externa*. The *arteria uterina* gave a branch to the *arteria umbilicalis* and consecutive branches which supplied to the ureter, urinary bladder and cranial aspects of the vagina. It also gave rise to 2–3 branches to the cervix and further supplied 10–12 meandering branches to the uterine horns. The *arteria uterina* gave rise to many tortuous arteries to the uterus and provided 2 further branches to the ovary.

**Keywords:** anatomy, artery, chinchilla, ovaries, uterus.

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### INTRODUCTION

*Chinchilla lanigera* is a rodent species belonging to the family Chinchillidae<sup>10</sup> and originates from the central Andes in Chile, Peru and Bolivia in South America<sup>15</sup>. They are kept for fur, as pets or laboratory animals<sup>20</sup>.

The female genital organs of mammals consist of ovaries, fallopian tubes, a uterus and a vagina. The ovaries lie on the dorsal wall of the abdominal cavity and caudal to the kidneys<sup>3,5,14</sup>. The ostium is the funnel-shaped opening of the fallopian tubes. *Fimbriae tubariae* extend as fingerlike projections from the edge of the ostium. The fallopian tubes are small, short and highly coiled, extending between ovaries and uterus. In rabbits the uterus is divided into 2 completely separate uterine horns that open caudally into the vagina through a single cervix that projects into the vagina<sup>14</sup>. Similarly, the uterus of the chinchilla is duplex and the uterine horns open by 2 lateral slit-like structures<sup>22</sup>.

Vascularisation of the uterus and ovaries

in Lagomorpha, rodents and domesticated animals is described in detail in many textbooks<sup>3,5,13,14</sup>. The *arteria ovarica* runs along the dorsal abdominal wall into the mesovarium and the right artery crosses the *vena cava caudalis* ventrally. It gives rise to the *ramus tubarius* which lies in the mesosalpinx, and supplies the uterine tube by means of several meandering branches in mammals<sup>16</sup>. In many species, including pigs, hamsters, rats and rabbits, the ovarian and uterine arteries anastomose near the ovary to provide a dual or parallel supply<sup>15</sup>. The ovarian artery is generally assumed to supply the ovaries and also the uterus<sup>9,13</sup>. The *arteria ovarica* arises from the *aorta abdominalis* in mammals and rodents. The *arteria uterina* originates from the *arteria umbilicalis* and runs through the mesometrium in rabbits, pigs and ruminants<sup>3,16</sup> whereas the uterine artery stems from the external iliac artery in horses<sup>16</sup>.

Our literature search on the arterial vascularisation of ovaries and uterus in the chinchilla was unrewarding. Thus, this paper describes the course and anastomosis of the *arteria uterina* and *arteria uterina* in the chinchilla.

### MATERIALS AND METHODS

Five healthy, adult female, non-pregnant chinchillas (*Chinchilla lanigera*) obtained

from the Center for Experimental Medicine, Research and Application, Afyon Kocatepe University, Turkey, were used in this study. The live body weight of chinchillas varied between 450 g and 500 g. The animals were euthanased by the methods described by Flecknell<sup>7</sup>. Regulations of the ethical committee of Afyon Kocatepe University were followed. Following euthanasia, 1 ml of heparine sodium (Nevparin, Mustafa Nevzat, Istanbul, Turkey) was immediately injected *via* the jugular vein to prevent blood coagulation. Animals were bled by cutting the jugular vein. The vessels were flushed with warm isotonic saline solution until the tissues were blanched. Latex coloured with red ink was injected through the *arteria carotis communis*. The cadavers were fixed in 10% formaldehyde solution for 24 hours at room temperature. To observe the *arteria ovarica* and the *arteria uterina*, the broad ligament and the peritoneal tissue adjacent to the ventral midline of the abdominal cavity were dissected carefully under a stereo-microscope. The photographs were taken using a digital camera (Sony DSC F-717, Japan).

The latest edition of the *Nomina Anatomica Veterinaria* was used for the terminology<sup>17</sup>. The figures in Popesko *et al.*<sup>19</sup> were also used as a guide for the nomenclature.

### RESULTS

The ovaries were exclusively supplied by the *arteria ovarica*. These arteries originated either from the *aorta abdominalis* (Figs 1a, 4a) at about the level of the origin of the *arteria renalis* or slightly caudal to it. (Figs 1b, 4b). The right *arteria ovarica* (Figs 1c, 4c) and the left *arteria ovarica* (Figs 1c', 2e, 4c') arose from the aorta 3 mm caudal to the *arteria renalis*.

Each of the *arteria ovarica* passed obliquely caudad across the ventral surface of the psoas muscle and the ureter. The ovarian rami formed meandering branches 2–3 mm from the aorta. Soon after leaving the *aorta abdominalis*, the *arteria ovarica* extended caudolaterally for a distance of approximately 2–3 mm, then produced 1 thin branch, which extended caudally and subdivided into 2 branches (Figs 1d, 4d). The course of these 2 branches was straight. One of these supplied rami to the fat tissue and the

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other branch ran caudally and anastomosed with the *arteria circumflexa ilium profunda* and dispersed into fat tissues in this region. The *arteria ovarica* gave off 2 *rami tubarii* (with an angle of 30° between them) (Figs 2a, 4e), and then continued as the *ramus uterinus* (the main trunk). One of the branches (cranial branch) of *ramus tubarius* extended to *fimbriae tubariae* (Figs 2b, 4h) and infundibulum of the fallopian tubes. The other branch (caudal branch) from the *ramus tubarius* extended to the hilus of the ovary (Figs 2c, 4i) and produced 2–3 branches while entering the hilus. Before entering the hilus of the ovary, the caudal branch anastomosed with 1 branch coming from the uterine artery. The *ramus uterinus* ran more caudally to form a major end-to-end anastomosis with the cranial termination of the *arteria uterina* (Figs 2d, 4f).

The *aorta abdominalis* bifurcated into the left and right *arteria iliaca communis* (at the level of 5th and 6th lumbar vertebrae) (Figs 3a, 4p), each of which further subdivided into the external and internal iliac arteries. *Arteria iliaca communis* continued in a caudolateral direction on the dorsal aspect of the uterus. It bifurcated into the *arteria iliaca externa* and the *arteria iliaca interna* within 7 mm on the right and 9 mm on the left beyond the aorta (Figs 3b,c, 4q, 4r). The *arteria uterina* originated from the external iliac arteries (Figs 3d, 4s). Initially, the *arteria uterina* gave off a branch to the *arteria umbilicalis* (Figs 3e, 4t) and supplied 1 branch to both the ureter (Fig 2 3f, 4o), urinary bladder (Figs 3g, 4n) and cranial aspects of the vagina. The uterine artery passed medially toward the cervix where it gave rise to 2–3 branches to the cervix (Figs 3h, 4m). The *arteria uterina* then continued cranio-medially on the lateral border of the uterus. Here, it supplied 10 to 12 meandering branches (each contained 3–4 arteries) (Figs 2h, 4g) to the caudal ( $n = 2$  or 3 arteries) (Figs 3i, 4l) and cranial aspects of the uterine horns ( $n = 8$  or 9 arteries) (Figs 2g, 3j, 4k). A bundle emerged from the posterior end of the ovary and continued to the anterolateral end of the uterus (*ligamentum ovarii proprium*) (Figs 2f, 4j). The *arteria uterina* gave origin to many tortuous arteries which supplied blood to the uterus. The *arteria uterina* gave off 2 further branches to the ovary. One of the branches extended to the mesovarium (subdivided into a thin ramus that merged with the *ramus tubarius*). The other branch extended to the *isthmus tubae uterinae*.

## DISCUSSION

This study demonstrated that the ovarian and uterine arteries, throughout their

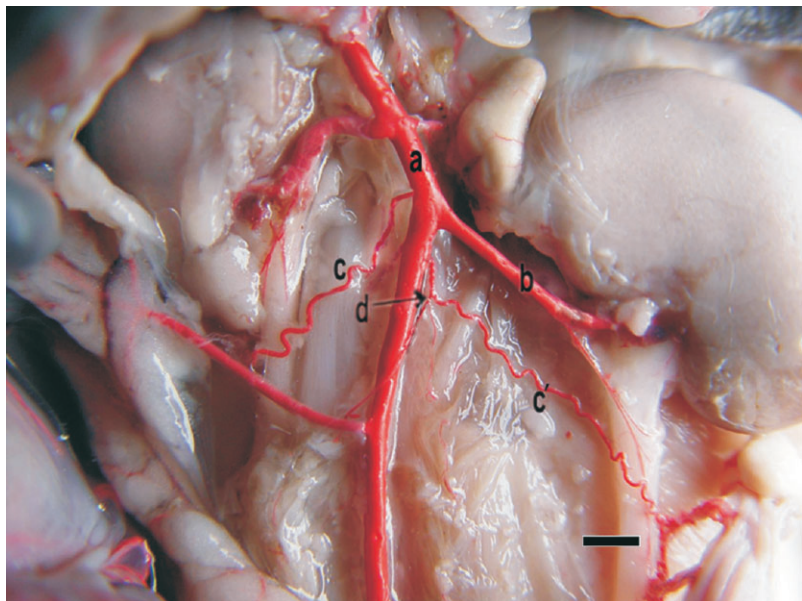


Fig. 1: Ventral view of the *arteria ovarica*, course and origin from the *aorta abdominalis* (*Chinchilla lanigera*, female, non-pregnant). a, *Aorta abdominalis*; b, *arteria renalis*; c, right *arteria ovarica*; c', left *arteria ovarica*; d, thin branch of ovarian artery (supplying fat tissue). Scale bar = 5 mm.

course, were in close apposition, and sometimes showed various degrees of coiling in the chinchilla. This close anatomical relationship was described previously in other species, such as guinea-pigs<sup>9</sup>, rats<sup>13</sup>, rabbits<sup>11,18</sup>, mice<sup>6</sup>, primates such as Rhesus monkeys<sup>8</sup> and baboons<sup>21</sup>.

The *arteria ovarica*, in the chinchilla, originated from the *aorta abdominalis* about 2–3 mm from the caudal aspects of right and left *arteriae renalis*. However, in guinea pigs, the *arteria ovarica* originated either from the aorta at about the level of origin of the *arteria renalis*, direct branches of *arteria renalis*, or common trunks with

*arteria renalis* and in some cases formed anastomoses with branches of the *arteria renalis*<sup>9</sup>. In rabbits, it arose from the *aorta abdominalis*, immediately behind the origin of the inferior mesenteric artery<sup>3</sup>, whereas it left the abdominal aorta slightly caudal to the *arteria renalis* in mice<sup>6</sup>, New Zealand rabbits<sup>11</sup> and in rats<sup>2,23</sup>. Each of the ovarian arteries after emerging from the *aorta abdominalis*, divided into 2 branches, the caudal branches served the Fallopian tubes and uterine horns, and the cranial branch mainly supplied blood to the ovary in guinea pigs<sup>4,8,9</sup>, rats<sup>4,8</sup>, mice<sup>6</sup> and in New Zealand rabbits<sup>11</sup>. Similar

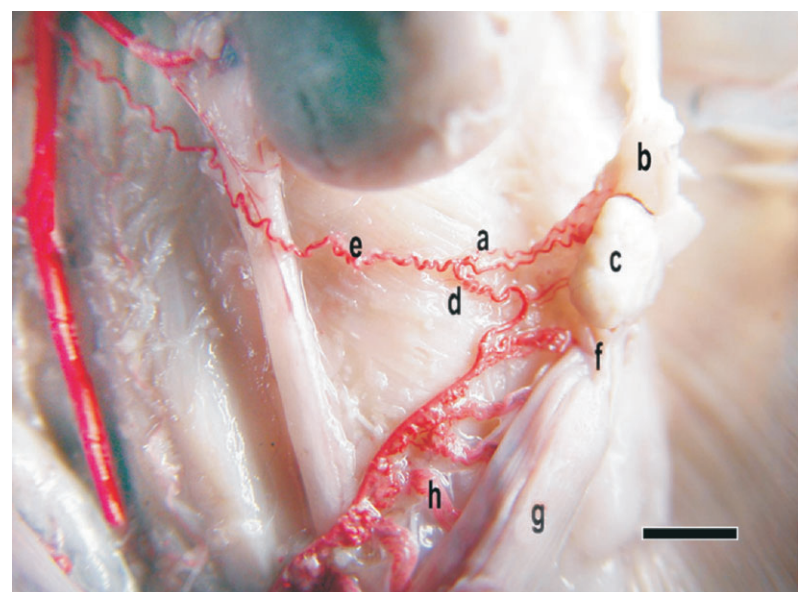


Fig. 2: Ventral view of the left ovarian and uterine arteries and anastomosis with each other (*Chinchilla lanigera*, female, adult, non-pregnant). a, *Ramus tubarius*; b, *fimbriae tubariae*; c, *ovary*; d, *anastomosis between arteria ovarica and arteria uterina*; e, left *arteria ovarica*; f, *Ligamentum ovarii proprium*; g, *cranial aspects of the uteri*; h, *meandering branches of the arteria uterina*. Scale bar = 5 mm.



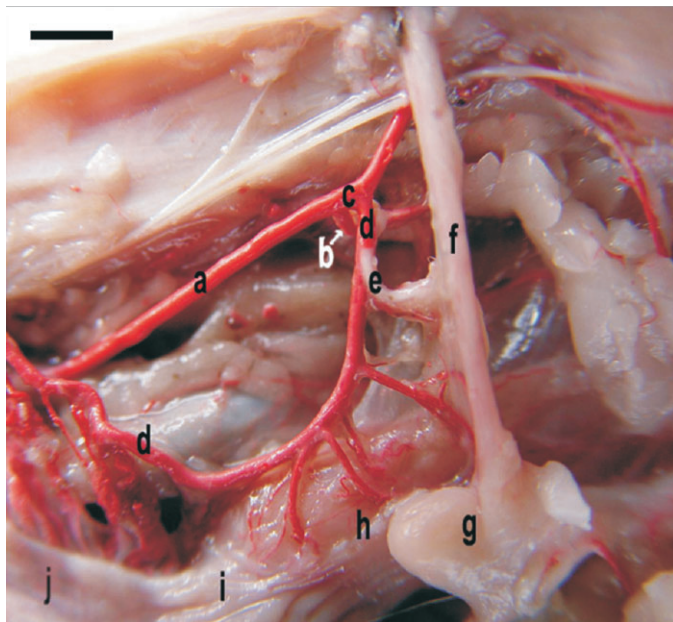


Fig. 3: Origin of the uterine artery and its branches, view from the ventral (left side) (*Chinchilla lanigera*, female, adult, non-pregnant). Ureter and *arteria uterina* was displaced laterally. a, *Arteria iliaca communis*; b, *arteria iliaca interna*; c, *arteria iliaca externa*; d, *arteria uterina*; e, *arteria umbilicalis*; f, ureter. g, *vesica urinaria*; h, *cervix uteri*; i, caudal aspects of the uteri; j, cranial aspects of the uteri. Scale bar = 5 mm.

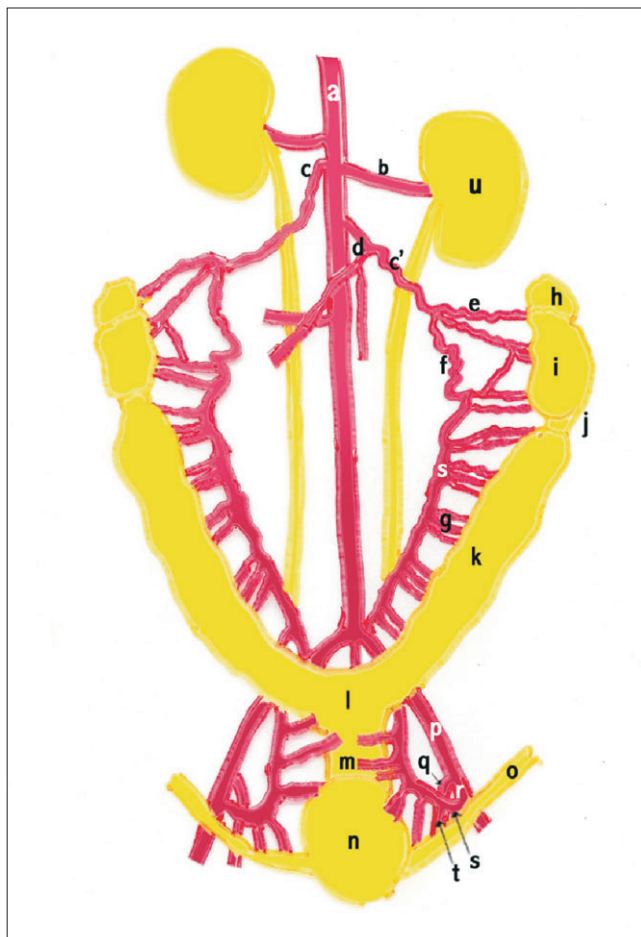


Fig. 4: Schematic drawing of ventral view of the *arteria ovarica* and *arteria uterina* in the chinchilla. a, *Aorta abdominalis*; b, *arteria renalis*; c, right *arteria ovarica*; c', left *arteria ovarica*; d, thin branch extended caudally of ovarian artery; e, *ramus tubarius*; f, anastomosis between the *arteria ovarica* and the *arteria uterina*; g, meandering branches of the *arteria uterina*; h, *fimbriae tubariae*; i, ovary; j, *ligamentum ovarii proprium*; k, cranial aspects of the uteri; l, caudal aspects of the uteri; m, *cervix*; n, urinary bladder; o, ureter; p, *arteria iliaca communis*; q, *arteria iliaca interna*; r, *arteria iliaca externa*; s, *arteria uterina*; t, *arteria umbilicalis*; u, kidney.

structures were observed in our study. The *arteria ovarica* produced 1 branch which extended caudally and subdivided into 2 rami. One of these supplied blood to fat tissue, the other branch went caudally and anastomosed with the *arteria circumflexa ilium profunda* and dispersed into fat tissue in this region. Later, the *arteria ovarica* subdivided into the *ramus tubarius* and the *ramus uterinus*. According to Hossain and O'Shea<sup>9</sup>, in the guinea pig the *ramus tubarius* produced a total of 5 or 6 small, tightly coiled rami before reaching the hilus of the ovary, 3 or 4 of which entered the hilus; in the chinchilla the *arteria ovarica* produced 2 *rami tubariae*, 1 of which reached to the hilus of the ovary and the other ran to the *fimbriae tubariae* and infundibulum of the Fallopian tubes.

In chinchillas, the *arteria uterina* originated exclusively from the external iliac artery, while it arose from the *arteria vaginalis* (arising from the *arteria iliaca interna*) in guinea pigs<sup>19</sup> and coendou<sup>12</sup>, and was always the 1st branch of the *arteria iliaca interna* in rabbits<sup>1</sup> and mice<sup>6</sup>; but in rats the *arteria uterina* originated from the umbilical artery<sup>23</sup>. The *arteria uterina*, in chinchillas, produced the *arteria umbilicalis* and sent branches to the ureter, urinary bladder and cranial vagina. After the uterine artery passed medially toward the cervix (where it gave rise to 2–3 branches to the cervix), it supplied 10–12 bundles of arteries to the uterus. A similar pattern was reported in other rodents<sup>6,9</sup>. In chinchillas, an anastomosis between the *arteria uterina* and the *arteria ovarica* was observed as previously reported in species of rodents, such as guinea pigs<sup>9</sup>, rats, hamsters<sup>24</sup>, mice<sup>6</sup> and porcupines<sup>12</sup>.

In conclusion, the arterial vascularisation of the ovaries and the uterus was provided by the ovarian and uterine arteries in the chinchilla. Two branches, one arising from the the *arteria ovarica* and the other from the *arteria uterina* entered the hilus of the ovary. The *arteria uterina* originated from the *arteria iliaca externa*, and served as a source of blood supply to the ovaries through the anastomoses between the terminal ends of the uterine and ovarian arteries. It was hoped that the data generated here could be useful for those who are interested in surgery (especially in experimental studies), diseases, or clinical treatment of chinchillas.

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