Anatomical variation of arterial supply to the rabbit spleen

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ABSTRACT. The rabbit, which is widely used as an experimental animal and is also popular as a companion animal, has a flat and elongated spleen with the longitudinal hilus running along its visceral surface. The spleen receives via the hilus an arterial supply that is essential for splenic nutrition and normal functioning. However, the distribution and variation of the arteries to the spleen have not been studied in detail. This study investigated anatomical variations of splenic arterial supply in 33 New Zealand White rabbits with a colored latex injection into arteries. We also examined whether the length of the spleen correlated with the number of the splenic branches of the splenic artery. The splenic artery always arose as the first independent branch of the celiac artery and ran along the splenic hilus to usually provide 6 (range, 3 to 10) splenic branches to the spleen. There was a moderate correlation (R=0.6) between the number of splenic branches and the longitudinal length of the spleen. The splenic branches often arose as a trunk or trunks in common with short gastric arteries. The number of common trunk(s) was usually 1 (range, 0 to 4). The data showed that the pattern and number of arterial branches to the spleen varied according to the individual animal, suggesting that such variations should be considered when performing experimental and veterinary surgical treatments in rabbits.

KEY WORDS: angiology, artery, macroscopic anatomy, rabbit, spleen

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The morphology of the spleen differs according to specific mammalian species [8, 15]. The spleen in the rabbit, which is widely used as an experimental animal and as a companion animal [1], is a flat and elongated organ with the longitudinal hilus running along its visceral surface [9].

The spleen receives an arterial supply through the branches of the splenic artery to support its nutrition and function, but the macroscopic description of the arterial pattern in rabbits often varies within the literature. For example, it is reported that the splenic artery arises as one of the trifurcated branches of the celiac artery [17] or as the first independent branch of the celiac artery [1, 2, 14]. In rodents, which are the closest relative to the lagomorph, the origin of the splenic artery varies in each species. For example, whereas in the rat [10], dormouse [18] and Mediterranean pine vole [20], the splenic artery usually arises as one of the trifurcated branches of the celiac artery, this artery usually arises as the first independent branch of the celiac artery in the hamster [7], muskrat [6], wood mouse [11] and degu [19] or as the second independent branch in the North American beaver [5]. Another pattern is seen in the guinea pig [4, 16], where the splenic artery usually arises as a common trunk with the left gastric artery. Furthermore, in most of the rodents above, the origin of the splenic artery sometimes varies depending on individuals within each species [4–7, 10, 11, 16, 18–20]. These studies in rodents suggest that there may be individual variations in the branching pattern of the splenic artery from the celiac artery in the rabbit.

The splenic artery provides splenic branches that enter the spleen through its hilus [2, 17]. Although some ramification patterns of these branches have been described in a previous rabbit study by Bednářová and Malinovský [3], their descriptions are vague and inconclusive. For example, in their study [3], the pattern that they observed most frequently was that the splenic artery provided one ramus dorsalis and one ramus ventralis. However, they did not define each ramus definitively nor described its region of distribution. Furthermore, they mentioned that 2 to 10 branches issued from rami dorsalis and ventralis, but the branching pattern of these rami was not clarified.

Therefore, the goal of the present study was to characterize more critically the anatomical variations of arterial supply to the rabbit spleen macroscopically via a colored latex injection. We also examined whether the length of the spleen correlates with the number of the splenic branches.

MATERIALS AND METHODS

We used 28 male and 5 female New Zealand White rabbits (weight, 2.5–3.0 kg), purchased from Tokyo Laboratory Animal Science Co (Tokyo, Japan). The present study was approved by the Research Ethical Committee for Animal Experimentation of the Tokyo University of Agriculture and Technology.

The rabbits were sacrificed with intraperitoneal injection of sodium pentobarbital (60 mg/kg) and then perfused with fixative containing either 4% paraformaldehyde and 0.05% glutaraldehyde or 10% formalin. In the fixed cadaver in the dorsal position, some of their left ribs were removed to facilitate thoracic aortic incision, through which a cannula...
The present study characterizes in great detail the individual anatomical variations of the arterial supply to the spleen in the rabbit. In all rabbits examined, the splenic artery was the first independent branch of the celiac artery. However, Bednárová and Malinovský [3] demonstrated that the splenic artery but the hepatic artery was the first branch in 1 out of 30 cases that they examined. This one rabbit is considered to be an exceptionally rare case, because other previous reports in the rabbit [1, 2, 14] consistently showed that the splenic artery was the first branch of the celiac artery, in agreement with our present results. In rodents, there are individual and/or species variations; the splenic artery is usually the first independent branch of the celiac artery in the Mediterranean pine vole [20], muskrat [6], wood mouse [11] and degu [19], frequently not the first independent branch in the dormouse [18], and never in the North American beaver [5] and guinea pig [4, 16].

We found the common trunk(s) of the splenic branches with short gastric arteries in 85% of the rabbits examined in this study (Fig. 3B). The number of the common trunk(s) varied from 0 to 4, with 1 common trunk (37%) being the most frequent. Abidu-Figueiredo et al. [1] did not describe such common trunks, whereas Bednárová and Malinovský [3] mentioned the existence of at least 1 “stem” in some of their cases, though their description was vague. These differences may be due to the possibility that Abidu-Figueiredo et al. used another breed of New Zealand rabbits, such as New Zealand Red [12], and Bednárová and Malinovský [3] used breeds other than the New Zealand White. In two studies in rodents (dormouse [18] and degu [19]), which are the closest relative to the lagomorph, it was reported that a trunk of the splenic artery gave off branches to the dorsal portion of the spleen and to part of the left visceral surface of the stomach. Similar trunks or “parent” branches that provide the splenic branches and short gastric arteries are also described in the dog [15]. These trunks in rodents and dogs correspond to the common trunk observed in the rabbit in the present study.

In the chinchilla [13], one trunk, which is called the gastrosplenic artery, supplies the dorsal spleen and the greater curvature of the stomach and the other, which is called the splenic artery, supplies the central and the ventral spleen. However, these trunks branch off from the celiac artery at the same level. It is considered that these two trunks in the chinchilla may correspond to one common trunk of the splenic artery with a short gastric artery in the rabbit.

The number of the splenic branches varied from 3 to 10 with 6 branches (25%) being the most frequent number among the rabbits examined in this study. However, Abidu-Figueiredo et al. [1] studied 30 New Zealand rabbits (weight, 2.5 kg) and obtained different results in that the number of the splenic branches varies from 1 to 5 with 3 branches (33.3%) being the most frequent. In the rat, whose spleen is shaped similar to that of the rabbit [10], it is reported that the number of splenic branches was 5 to 8 [10]. This finding is similar to that from our study, wherein 76% of the rabbits have 5 to 8 splenic branches.
We found a moderate correlation between the dorsoventral length of the spleen and the number of splenic branches ($R=0.6$, $P=0.008$). However, there was no correlation between the length and the number of the common trunk(s) or between the number of splenic branches and the number of common trunk(s). Furthermore, the number of these branches and common trunk(s) does not relate to their branching pattern. Therefore, arterial variations demonstrated by the
The present study should always be taken into account when performing experimental or veterinary surgery in rabbits.

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