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Original Research Article

SUPERNUMERARY RENAL ARTERIES: A CADAVERIC STUDY WITH THEIR EMBRYOLOGICAL AND CLINICAL CORRELATIONS

Apurba Patra *, Harsimarjit Kaur, Upasna, Usha Chhabra.

Department of Anatomy, Govt. Medical College, Patiala, Punjab, India.

ABSTRACT

Background: Classically, a single renal artery supplies each kidney after originating from abdominal aorta. Presence of accessory renal arteries are the most commonest variation of renal arterial supply.

Aims: The present cadaveric study was undertaken with the aim to study the incidence of accessory renal artery and to correlate these variations with their embryological and clinical perspective.

Material and Method: Material of this study comprised of 40 formalin fixed adult human cadavers (80 sides) irrespective of sex. These were dissected during routine abdominal dissection conducted for undergraduate medical students at the department of anatomy. The kidneys with their arteries were explored and traced up to their origin from abdominal aorta or any other source. The morphological variations of renal arteries were noted and photographed.

Results: We observed supernumerary renal arteries in 12/40 (30%) cases (20% of aortic origin, 7.5% of renal origin and 2.5% of superior mesenteric origin) on the right side and 15/40 (37.5%) cases (27.5% of aortic origin and 10% of renal origin) on the left side. Supernumerary renal arteries were observed to be entering the kidney through hilum, superior pole, and inferior pole.

Conclusions: Awareness of variations of renal artery is necessary to prevent catastrophes during several surgical interventions such as renal transplantation, abdominal aortic aneurismal repair and urological procedures and for angiographic interventions.

KEY WORDS: Supernumerary Renal Artery, Accessory Renal Artery, Hilum, Variations.

Address for Correspondence: Dr. Apurba Patra, House No: 15 E, Rajindra Medical Complex, New Lal Bagh Colony, Patiala, Punjab. India-147001. **E-Mail:** apurba.cnmc03@gmail.com

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INTRODUCTION

The kidneys are one amongest the vital organs in the human body. It is rich in blood supply, nearly 25% of the cardiac output passing through the renal arteries and are filtered by the kidneys [1]. Usually one renal artery arises from the anterolateral or lateral aspect of the abdominal aorta just below the origin of the superior mesenteric artery and enters the kidney through its hilum [2]. Classically it occurs in less than 25% cases [3,4]. Vascular anomalies related to the renal arteries are not uncommon. The commonest variation to the clssic anatomic description of renal arterial supply is the presence of accessory renal arteries [5], and the literature indicates that multiple renal arteries are found in 9-76% of cadavers [6]. Additional renal vessels are known as accessory renal artery (ARA) or supernumerary renal artery (SRA). These vessels are sometimes known as aberrant renal vessels [7]. We used the term supernumerary and analyze it in accordance with

Merklin classification [8]. We believe that prior knowledge of the variations of the renal artery has grown in importance with the advent of laparoscopic renal surgeries and donor nephrectomies and may help the surgeon in planning renal transplantation, repair of a bdominal aorta aneurysm, urological procedures, and also for angiographic interventions [9-11]. It becomes mandatory for the surgeons to understand the abnormality or variations in the renal vasculature [12]. Accessory arteries are clinically significant because they affect several operative procedures including nephrectomy and renal transplantation. Therefore, it is important for academicians, surgeons and radiologists to have sound knowledge of anatomical variations of renal artery. The present study was undertaken with the aim to study the prevalence of accessory renal artery and its clinical applicability. The possible aetiology of this variation has been explained embryologically.

MATERIALS AND METHODS

The study was conducted on forty formalin-fixed adult human cadavers irrespective of sex in the department of anatomy. During routine abdominal dissection conducted for medical undergraduates at the department of anatomy, the kidneys along with their arteries were explored and the morphological variations of renal arteries were noted.

During the course of dissection various abdominal viscera were removed and preserved as specimens for teaching purposes. We studied the origin of supernumerary renal arteries in accordance to the nomenclature of Merklin and Michels [8]:

1. Supernumerary renal arteries originating from the aorta

2. Supernumerary renal arteries originating from main renal arteries

3. Supernumerary renal arteries from other sources.

RESULTS

Supernumerary renal arteries were present in 12/40 (30%) cases (20% of aortic origin, 7.5% of renal origin and 2.5% of superior mesenteric origin) on the right side and 15/40 (37.5%) cases (27.5% of aortic origin and 10% of renal origin) on the left. The supernumerary renal arteries entered the kidney through hilum as hilar supernumerary renal artery [Figures 1, 2 and 4], through upper pole as upper polar supernumerary renal artery [Figures 2, 3 and 4], and through lower pole as lower polar supernumerary renal artery [Figures 5]. The finding with respect to origin, side, and mode of penetration to kidney is represented in Table 1.We found one case where supernumerary renal artery was originating from other source like superior mesenteric artery [Figure 1].

Fig. 1: Showing the Bilateral hilar supernumerary, on right side arising from SMA, on left side arises from Aorta.

Fig. 2: Left kidney showing hilar and superior polar supernumerary artery arising from renal artery.

Fig. 3: left kidney showing superior polar supernumerary artery arising from aorta.

Fig. 4: Right kidney showing hilar and superior polar supernumerary artery-arising from aorta.

Fig. 5: Right kidney showing Inferior polar supernumerary artery arising from aorta.

Table 1: Showing the incidence of supernumerary renal artery.

Number of renal artery	Right kidney (%)	Left kidney (%)	Total (%)
One artery	28/40 (70%)	25/40 (62.5%)	53/80 (66.25%)
Supernumerary renal artery	12/40 (30%)	15/40 (37.5%)	27/80 (33.75%)
(I) Aorta origin	8/40 (20%)	11/40 (27.5%)	19/80 (23.75%)
HSA	4/40	6/40	10/80
SPSA	3/40	5/40	8/80
IPSA	1/40	Nil	1/80
(II) Renal origin	3/40 (7.5%)	4/40 (10%)	10/80 (12.5%)
HSA	2/40	2/40	Jun-80
SPSA	1/40	2/40	Apr-80
IPSA	Nil	Nil	
(III) Any other (SMA)	1/40 (2.5%)	Nil	1/80 (1.25%)

DISCUSSION

The presence of accessory renal arteries is one of the most common urogenital variants [13]. It is well documented that the incidence of accessory renal arteries varies widely with ethnicity, ranging from 11.4% in Kenyans [14] to 59.5% in Indians [15]. The various types of (accessory, additional, supplementary, and aberrant) renal arteries, their positions, method of entry to the kidney, and segmentation were studied extensively by a number of authors [16, 17] but the generally accepted and precise terminology for these arteries has not been unified by the majority of authors [18]**.** As these arteries occupy a certain vascular area within the kidney and there is no anastomosis either with the branches of the main or with branches of segmental renal arteries, we preferred the terminology supernumerary for these arteries and classified them in accordance with Merklin and Michels [8]. They also classified these supernumerary renal arteries depending upon origin as supernumerary renal arteries originating from aorta, supernumerary renal arteries originating from the main renal artery, and supernumerary renal arteries originating from other arterial sources, but in their study none of the hilar supernumerary renal artery took origin from renal artery. In the present study out of 80 kidneys (40 cadavers) supernumerary arteries were found in 27 (33.75%) cases which was higher than that seen by Saldarriaga et al [19] (24.90%), Gupta et al [20] (28.33%), Kapoor et al [21] (12%). However it was lower than that described by Palmieri et al [22] (61.5%), Eisendrath et al [23] (45%), Rupert et al [24] (61%). Talovic et al [25] reported that in 30.76% cases supernumerary renal arteries originated from aorta and in 12.82% originated from renal arteries. Whereas in our study the supernumerary arteries originated from abdominal aorta in 47.5% cases, from the main renal artery in 17.5% cases and from other sources like superior mesenteric artery in 2.5% cases.

Embryological explanation of these variations has been presented and discussed by Felix [26]. In the developing human embryo the mesonephros, metanephros, adrenals and gonads are supplied by paired mesonephric arteries arising from the dorsal aorta [27]. The 3rd, 4th and 5th pairs of lateral mesonephric arteries supply the metanephros. The caudal branches usually disappear, leaving a single persistent renal artery. When more than one of these lateral mesonephric arteries persist, multiple accessory renal arteries result.

Knowledge of the presence and distribution of accessory arteries is of paramount importance

in renal transplantation. The presence of accessory arteries in a donor kidney is usually considered a contraindication to its use in transplant surgery [28]. Since these are end arteries, the accessory arteries must be reimplanted and this would require several anastomoses and a prolonged ischemic time, leading to a theoretically higher incidence of renal failure, graft rejection and reduced graft function [29].

Conflicts of Interests: None

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