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# An Anatomical Study of Coronary Dominance Patterns in Human Hearts - a South African Sample

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## ABSTRACT

**Introduction:** coronary arterial dominance is an important variant in coronary circulation which can affect the cardiac supply, influence development of collateral arteries and increase incidence of coronary arterial diseases. Individuals with co-dominance of the right coronary or left coronary arteries have been widely reported based on the branching of the coronary artery to form the posterior interventricular artery. Left dominance has been associated with ischaemia, increased long term mortality in patients with acute coronary syndrome. The study sought to investigate the patterns of dominance in the origin of the posterior interventricular artery.

**Material and Methods:** an observational cross-sectional study was done on 44 embalmed adult hearts in the Department of Human Biology, University of Cape Town, that are used for academic training. The hearts were carefully dissected to expose the coronary arteries from their points of origin to termination. Coronary arterial dominance was determined on the basis of the coronary artery that gave rise to the posterior interventricular artery and supplied the inferior 1/3rd of the interventricular septum.

**Results:** coronary arterial dominance was observed and documented. The median age was 57.5 years. Right dominance was observed in 81.5% cases, left dominance 15.9% and co-dominance 2.3%. Coronary dominance was independent of sex and age. No significant differences were found in coronary arterial dominance in the present study and other published literature.

**Conclusions:** the findings from the study will add to existing knowledge on coronary artery variations and dominance patterns, which may be helpful to cardiologists and radiologists in performing procedures like coronary angioplasty and bypass surgeries.

**Keywords:** Coronary arterial dominance; Variation; Posterior interventricular artery; Coronary artery.

## Introduction

The right coronary artery (RCA) and the left coronary artery (LCA) are the two main developed arteries supplying the heart. They are positioned like a crown on the heart (Anbumani *et al*., 2016). The right coronary artery emerges from the anterior aortic sinus at 90°, while the larger left coronary artery arises at a slightly lower angle from the left posterior aortic sinus (Vilallonga, 2003; Ellis and Mahadevan, 2010). The left main coronary artery (LMCA) bifurcates into the anterior interventricular artery and the circumflex artery (Villa *et al*., 2016). Trifurcations have been observed in left coronary artery resulting in the anterior interventricular artery, median artery and circumflex artery (Anbumani *et al*., 2016). The posterior 1/3 of the interventricular septum is normally supplied by the posterior interventricular branch which anastomoses with the interventricular branch of the left coronary artery at the apex of the heart. The anterior interventricular artery supplies the anterior 2/3 of the interventricular septum (Gilroy, 2013).

Differentiation of vascular progenitors, vascular growth (vasculogenesis and angiogenesis) and arteriovenous specification and patterning are important aspects of coronary arterial formation (Pires-Gomes and Perez-Pomares, 2013). The progenitor cells giving the future epicardium also results in the coronary arteries which then move towards the aorta and invades its wall (Carlson, 2009). Therefore, coronary vessels grow into an already formed and beating heart.

The term "coronary preponderance" or "dominance" was proposed based on the origin of the posterior interventricular artery (Schlesinger, 1938; Schlesinger, 1940; Pitt *et al*., 1963; Das *et al*., 2010). In a right-dominant circulation, the right coronary artery (RCA) supplies the posterior portion of the interventricular septum and gives off the posterior interventricular artery (PIVA). Whereas in a left-dominant circulation, the left circumflex (LCX) artery supplies the posterior interventricular septum. In a co-dominant circulation, supply of the posterior interventricular septum is shared by the RCA and LCX (Parikh *et al*., 2012). Approximately 70% of a general population would be right dominant, 15% left dominant and 15% balanced or co-dominant (Gilroy, 2013). The pattern of coronary dominance has been found to be one of the most common non-modifiable coronary variant studied (He


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*et al.*, 2017). Earlier reports (Schleslinger, 1940; Pitt *et al.*, 1963) indicated that the coronary pattern of dominance is fixed throughout life and it is unchanged even with hypertrophy.While findings vary in statistical power, no difference has been found in dominance pattern with sex and age (Vasheghani-Farahani *et al.*, 2008; Abuchaim *et al.*, 2009; Fazlul Aziz Mian., 2011; Pal *et al.*, 2016). Coronary variability in the different geographic areas could be explained by minor genetic differences in growth factors (Walker and Webb, 2001; Loukas *et al.*, 2013).

Variations in the anatomy of coronary arteries can affect blood supply to the heart, influence the development and distribution of atherosclerosis, and impact prognosis (Nordon and Rodrigues Junior, 2012). Impairment of cardiac function and sudden death in young, seemingly healthy people has been attributed to coronary arterial variations (Allwork, 1987). In hearts showing left coronary arterial dominance or no-dominance, the left coronary artery had to supply the entire interventricular septum, thus increasing pulse pressure in the left coronary artery hence increased incidence of coronary artery disease (Kumar, 2016). Left dominance has been found to be a useful predictor of long term mortality in patients with acute coronary syndrome, even after adjustments for variables like age, sex and comorbidities (Goldberg *et al.*, 2007).

Right dominance has also been found to be linked with high development of collateral arteries in the circumflex and right coronary arteries (Ajayi *et al.*, 2017). Coronary collateral arteries serve as alternative passageways for blood flow to the myocardial tissue supplied by the obstructed artery in obstructive coronary artery disease (Ajayi *et al.*, 2017). Right dominant patients have also been reported to be susceptible to the three-vessel disease, independent of age, sex, cigarette smoking, hypertension, diabetes and obesity (Vasheghani-Farahani *et al.*, 2008).

Coronary artery diseases (CAD) are becoming a global problem, with developing countries experiencing a surge in non-communicable diseases (Gohain and Saikia, 2015). Coronary arterial dominance is therefore an important variant worth offering better understanding of coronary arterial diseases and possible interventions. There are limited studies on the prevalence of coronary arterial dominance in Africa (Saidi *et al.*, 2002).

The study sought to investigate patterns dominance in the origin of the posterior interventricular artery in cadaveric specimens in South Africa.

## Materials and Methods

An observational cross-sectional study was done on 44 embalmed adult cadaveric heart specimens in the Department of Human Biology, University of Cape Town that are used by medical students for academic training during the period of May to June 2017. All cadaveric samples were conveniently selected and none of the specimens were excluded as all had a visible trace of coronary arteries' origin and termination points despite some showing hypertrophy and having had bypass surgeries.

The cadaver collection comprised donor program sample; exclusively caucasians of European descent and unclaimed bodies mainly of indigenous Black Africans and Mixed ancestries. The Department of Human Biology register had 3 subgroups (White, Black and Coloureds). In the present study, the Whites were categorized as of European ancestry, Blacks as Black Africans and Coloureds as Mixed ancestry, withstanding the cultural and social complexities in classification of the population groups (L'Abbe *et al.*, 2011).

The chest wall removal, opening of the pericardium and severing the roots of the great vessels to remove the heart was done by medical student during practical sessions following the anatomy dissection manual (Alexander, 2017). Visceral pericardium and sub-epicardial fat were carefully removed using forceps and scalpel, avoiding damage to the coronary arteries. To further expose the coronary arteries, the veins were removed. All tissues and cadaveric materials cut during dissection were kept at table/body number corresponding bowl for storage until cremation with the whole body remains.

The coronary arteries were traced from origin to termination to determine coronary arterial dominance. In order to ensure validity in observations of coronary arterial dominance, an operational definition was adopted. Coronary arterial dominance was defined as the artery that gave rise to the posterior interventricular artery (PIVA) and supplied the inferior 1/3$^{rd}$ of the interventricular septum, which could either be the right, left or both coronary arteries (Sabnis, 2013;https://radiopaedia.org/articles/coronary-arterial-dominance). Variations in coronary arterial dominance were observed and recorded in a data collection sheet. Sample photographs were taken for further confirmation of the dominance pattern. All specimens were numbered in correspondence to retrievable demographic data captured in the cadaver register by the technical staff in Department of Human Biology. Intra-observatory and inter-observatory measures were done to ensure reproducibility in the observations and documentation of patterns of coronary arterial dominance.

Statistical Package for Social Sciences (IBM SPSS statistics 24) was used to analyze data. Simple descriptive statistics (median, Interquartile ranges) were used for the only numeric (age) variable as it was a non-Gaussian distribution. Categorical variables were presented as counts and percentages. Fisher's exact test was used to compare categorical variables (sex and age categories) with coronary arterial dominance. Coronary arterial dominance results were compared with findings from published literature using Z-score test. The level of significance was set at 0.05.

Ethical approval had already been granted to the University of Cape Town for medical education and research by the state. All specimens were handled in an ethical and humanely manner as outlined in the University body donation program. All records collected were kept secure and photographs taken did not bear traceable identifiers of the bodies.

## Results

Out of a total of 44 specimens, 56.8% (n=25) were males, while 43.2% (n=19) were females. The median age at the time of death was 57.5 years (interquartile range 37.8-76.8 years). The minimum age was 22 years and maximum 99 years at the time of death. The 2017 collection had high number of individuals of European ancestry (52.3%, n=23) followed by the Mixed ancestry (34.1%, n=15) and the Black African (13.6%, n=6). A high percentage aged 60 years and above were of European ancestry, 95.2%, (n=20). Each population subgroup had a high prevalence of right dominance. Ancestry subgroups were created to enable description of the study sample and no further analysis were done on the subgroups due to the complexities in classification of the subgroups and disproportionate representation of the subgroups. Table 1 summarises the baseline characteristics stratified by coronary arterial dominance.

Age was reported as median and interquartile ranges as it was not normally distributed. The categories used are in no way suggesting biological variation. N/ n=Sample size of interest.

The prevalence of coronary arterial dominance in the study sample is presented in Figure 1. There were 81.8% (n=36) right dominant, 15.9% (n=7) left dominant and 2.3% (n=1) co-dominant. In the present study, right dominance was observed to be high in all cases irrespective of sex and age. However, computations using Fisher's exact test revealed no statistical significance (P>1.00) between sex, age and coronary arterial dominance.

There was a high number of right dominant specimens for both sexes; Males (n=20) and females (n=16). Left dominance found in 4 males and 3 females. The only co-dominant in the study was a male. The age distribution was skewed towards older individuals at the time of death. The patterns of dominance were observed in individuals aged 60 and above at the time

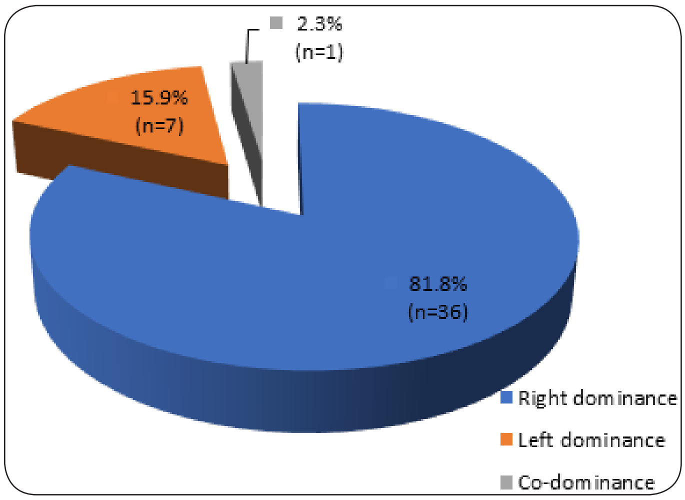


**Figure 1.** Prevalence of patterns of coronary arterial dominance in the study sample (N=44).

**Table 1.** Characteristics of the study sample stratified by coronary arterial dominance.

| Characteristic | Right dominance N | % | Left dominance N | % | Codominance N | % | Total (N=44) N | % |
|---|---|---|---|---|---|---|---|---|
| **Sex** | | | | | | | | |
| Male | 20 | 55.6 | 4 | 57.1 | 1 | 100 | 25 | 56.8 |
| Female | 16 | 44.4 | 3 | 42.9 | - | - | 19 | 43.2 |
| **Total** | **36** | **100** | **7** | **100** | **1** | **100** | **44** | **100** |
| **Age** | | | | | | | | |
| ≤ 39 | 9 | 25 | 2 | 28.6 | - | - | 11 | 25 |
| 40-59 | 10 | 27.8 | 2 | 28.6 | - | - | 12 | 27.3 |
| 60+ | 17 | 47.2 | 3 | 42.8 | 1 | 100 | 21 | 47.7 |
| **Total** | **36** | **100** | **7** | **100** | **1** | **100** | **44** | **100** |
| **Ancestry** | | | | | | | | |
| Black African | 5 | 13.9 | 1 | 14.3 | - | - | 6 | 13.6 |
| European ancestry | 18 | 50 | 4 | 57.1 | 1 | 100 | 23 | 52.3 |
| Mixed ancestry | 13 | 36.1 | 2 | 28.6 | - | - | 15 | 34.1 |
| **Total** | **36** | **100** | **7** | **100** | **1** | **100** | **44** | **100** |

Age was reported as median and interquartile ranges as it was not normally distributed. The categories used are in no way suggesting biological variation. N/ n=Sample size of interest.

of death (Table 1).

Photographs of right dominance are shown in Figure 2.a-c from 3 hearts specimens. They depict some of the observed variations under right dominance. Figure 2.a shows a single branch forming the PIVA and another extending beyond the crux of the heart to the left ventricle. Figure 2.b depicts 4 parallel branches from the RCA running in the posterior interventricular sulcus. The last of the representative photographs (Fig 2.c); the right coronary artery runs in the coronary sulcus with the first of its 4 branches forming the posterior interventricular artery.

Examples of left dominance variations are shown in Figure 3. A-c, taken from 3 specimens. Figure 3.a shows 3 parallel branches of the circumflex artery running in the posterior interventricular sulcus, with the middle branch going further down the apex of the heart. The second specimen (Fig 3.b) show 3 branches from the circumflex artery, with only the middle branch forming the PIVA. The last branch goes further into the immediate right ventricle from the posterior interventricular sulcus. Figure 3.c has 2 branches from the circumflex artery. The first branch supplies the left ventricle, while the last branch forms the PIVA.

Co-dominance was observed in one heart as shown

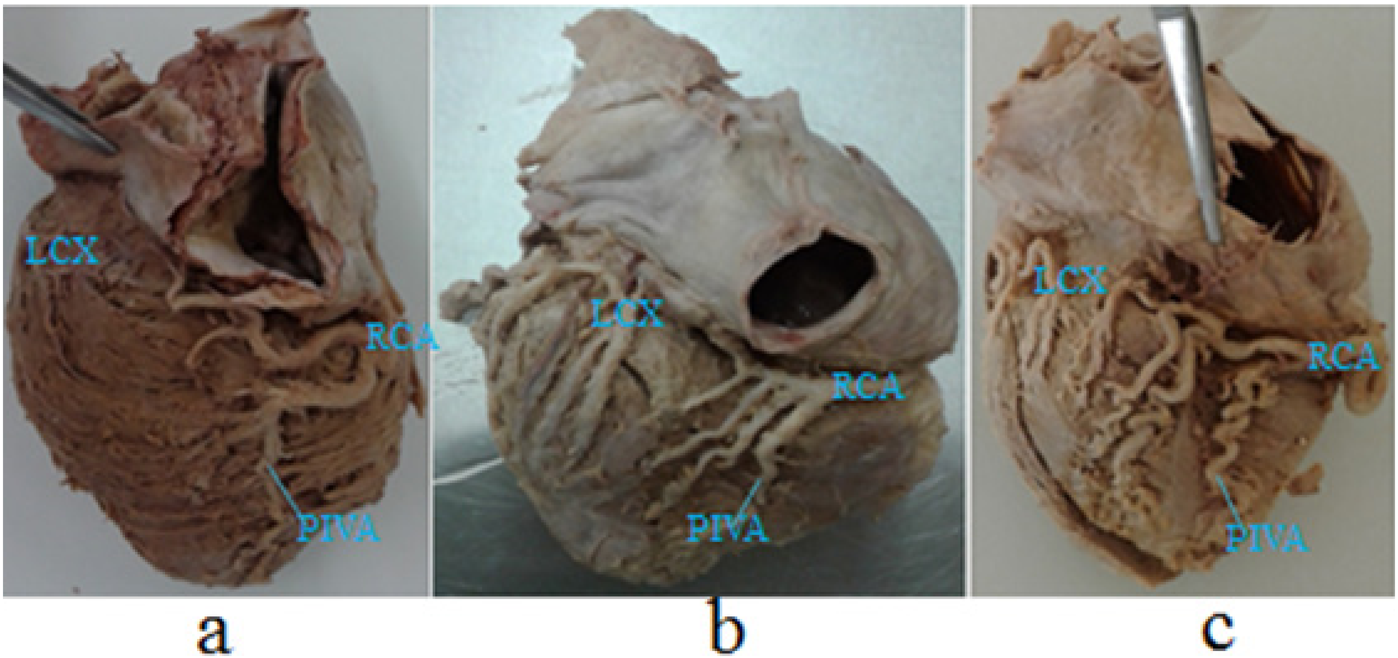


**Figure 2.** a-c Representative photographs of variants of right coronary arterial dominance. Posterior view.

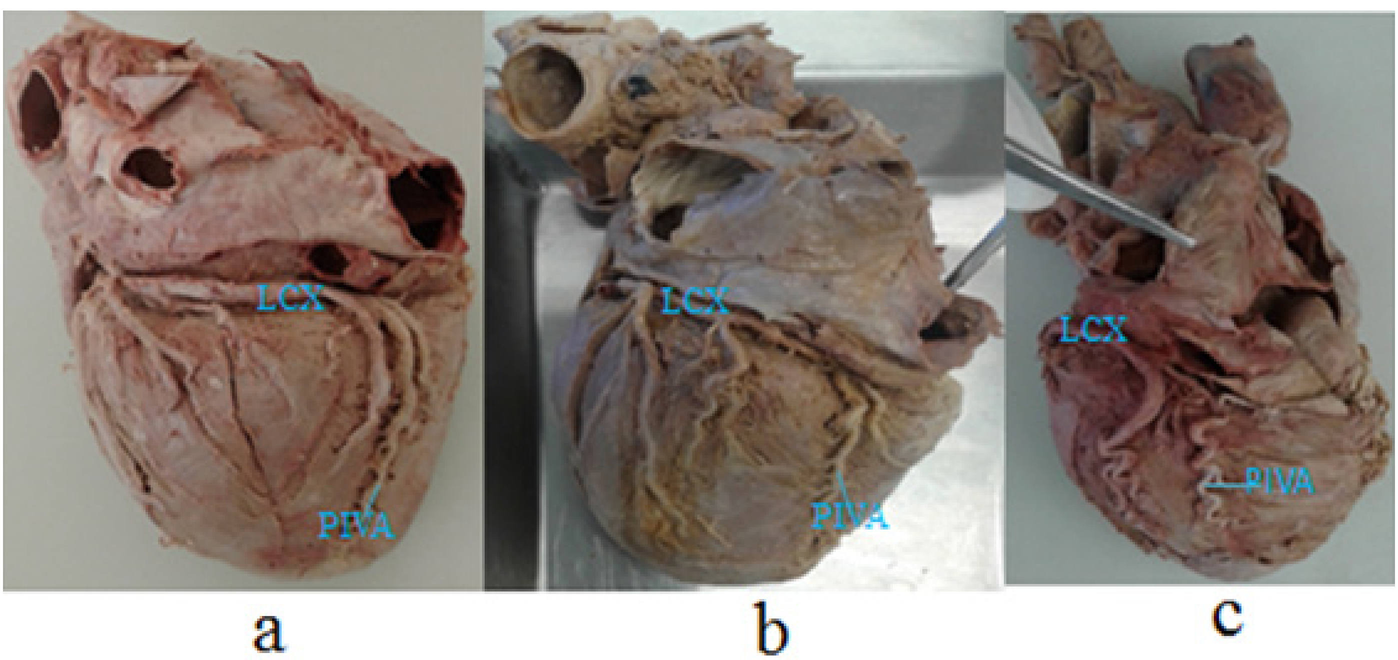


**Figure 3.** a-c Representative photographs of variants of left coronary arterial dominance. Lateral-Posterior view. LCX = left circumflex artery, PIVA = posterior interventricular artery

in Figure 4. Ai-ii. The LCX runs obliquely towards the posterior interventricular sulcus before it could reach the crux of the heart and branches to supply the inferior 1/3rd of the posterior interventricular septum. The narrower RCA runs in the coronary sulcus until it reaches the crux of the heart and form PIVA, midway in the posterior interventricular sulcus it penetrates the myocardium. The artery was accidentally cut as the myocardium was being dissected to follow the artery to its termination point (Fig 4. Ai-ii).

The high number of European ancestry may be indicative of body donation tendencies of the population group (Cornwall *et al*., 2012). Comparing their study on the Brazil population and other populations, Nordon and Rodrigues Junior (2012) concluded that the existence of differences in race or ancestry and distribution of anatomic variations in coronary arteries is not in any way plausible. Variations in coronary dominance by demographic characteristic could be explained by the cadaveric selection biases in studies. Nonetheless, possible genetic and environmental influences cannot be ruled out. Due to the disproportionate number of the population subgroups and sociocultural complexities in classifying the population groups, no further discussion would be done beyond study characteristics using ancestry.

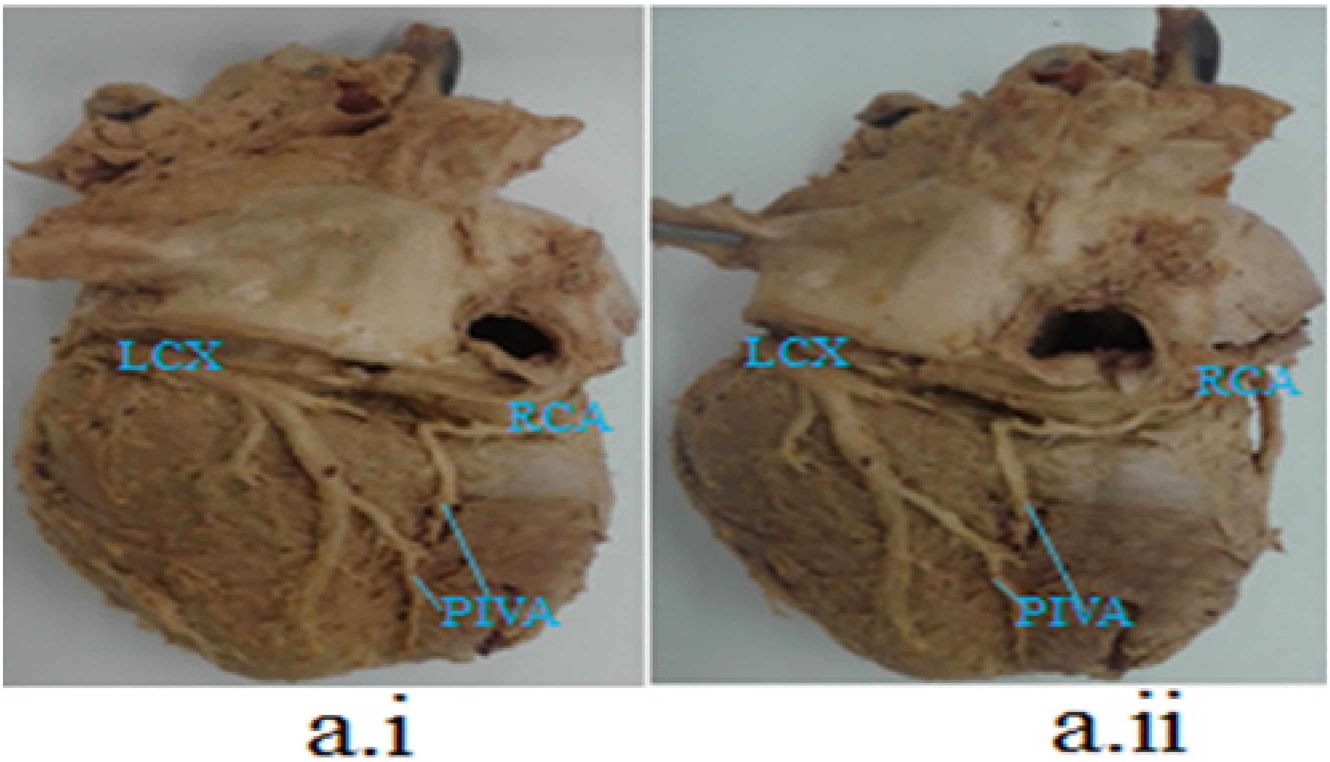


**Figure 4.** ai-ii Representative photographs of co-dominance. Posterior view. LCX = left circumflex artery, PIVA = posterior interventricular artery, RCA = right coronary artery

## Discussion

Interventions in coronary artery diseases need a good understanding of human coronary arterial circulation and variation. The present study sought to determine coronary arterial dominance patterns, establish if there are differences between demographics; specifically sex and age in the specimens and compare the findings with the results published from other studies. In this study, coronary arterial dominance pattern was found to be comparable to those from other studies in literature as shown in Table 1.

Right dominance was found in 81.8% (n=36) cases, left dominance 15.9% (n=7) cases and 2.3% (n=1) co-dominant (Fig 1). There were more males, 56.8% (n=25), than females 43.2% (n=19). Majority of the males, 80% (n=20) were right dominant. A similar trend was observed in female cadaveric specimen, 84.2% (n=16). The study population had 47.7% (n=21) aged 60 and above and comprising majority European ancestry, 95.2% (n=20) (Table 1).

The prevalence of right dominance was higher among older individuals (60+ years, 47.2%) at the time of death (Table 1). In a study done by Knaapen *et al.* (2013), a higher prevalence of right dominance was observed among individual older than 75 years at the time of death, but no statistical analysis was done to find out if age was significantly associated with coronary dominance. In the present study, all cross tabulations for coronary dominance with sex and age yielded a Fisher's exact probability significance of more than 0.05 (P=1.00), hence a non-existent association of coronary dominance with sex and age for the study sample. Despite the low sample size and a few cases of expected frequencies in the cross tabulations, the results are consistent with what other authors obtained in dominance pattern analysis with sex and age (Vasheghani-Farahani *et al.*, 2008; Abuchaim *et al.*, 2009; Fazlul Aziz Mian., 2011; Pal *et al.*, 2016).

The patterns of dominance identified in this study are within the ranges reported in both angiographic (imaging) and anatomical dissection studies from other countries (Table 2). The proportion of right dominance from angiographic studies was 60.5%-91%, and slightly higher proportions were observed from dissection studies (70%-91.5%). In the present study, right dominance was 81.8%. The proportion of left dominance in the comparative literature was 6.8%-19.5% and (8%-22%) for angiographic and dissection studies respectively (Table 2). In the present study, 15.9% were left dominant. Co-dominance was not found in some findings from published literature (Nordon and Rodrigues Junior, 2012; Gebhard *et al.*, 2015; Kumar, 2016). The co-dominance proportions for the present study (2.3%), were within the literature observed proportions for both angiographic (0%-20%) and dissection (0%-8%) findings. There were no differences (P>0.05) in coronary arterial proportions between the present study and the selected South African angiographic study by Ajayi *et al.* (2013) and anatomical dissection study done in India by Pal *et al.* (2016).

The present study findings are consistent with all findings of studies in read literature except two dissection methods studies reporting new categories; coronary arterial no-dominance and right coronary arterial great dominance (Agrawal and Arya, 2016; Kumar, 2016). Three angiographic based studies reported percentages of left dominance and co-dominance similar to this study (Goldberg *et al.*, 2007; Fazlul Aziz Mian *et al.*, 2011; Knaapen *et al.*, 2013). The angiographic study done in South Africa by Ajayi *et al.*, 2013; presented findings close to the present study of; 81.5% right dominance, 15.2% left dominance and 3.3% co-dominant. It is evident that right dominance is always the most frequent variant irrespective of the technique used and sample size (Table 1 and 2).

Comparative findings from the literature in Table 2 shows left dominance as the second highest dominant pattern except for three (3) study findings (Goldberg *et al.*, 2007; Fazlul Aziz Mian *et al.* 2011; Knaapen *et al.*, 2013). Co-dominance prevalence was the lowest with some authors recording no observations (Nordon and Rodrigues Junior, 2012; Gebhard *et al.*, 2015; Kumar, 2016). From the literature, higher proportions of co-dominance were observed at 8.2%, 20% and 9.7% by (Goldberg *et al.*, 2007.,Fazlul Aziz Mian *et al.*, 2011., Knaapen *et al.*, 2013). In the present study only 2.3%, (n=1) was co-dominant.

**Table 2.** Selected studies from literature depicting coronary artery dominance patterns and techniques used.

| Author | Region (N) | Method used | RD | Dominance LD | (%) Co/BLD | ND |
|---|---|---|---|---|---|---|
| **Imaging** | | | | | | |
| 1. Vasheghani-Farahani *et al.*, 2008 | Iran (12558) | | 84.2 | 10.9 | 4.8 | - |
| 2. Parikh *et al.*, 2012 | USA (207926) | | 82 | 10 | 8 | - |
| 3. Goldberg *et al.*, 2007 | Canada (27289) | | 83.6 | 8.2 | 8.2 | - |
| 4. Gebhard *et al.*, 2015 | ** (6382) | | 91 | 9 | - | - |
| 5. Gebhard *et al.*, 2017 | Germany (2002) | | 87.9 | 6.8 | 5.3 | - |
| 6. Knaapen *et al.*, 2013 | Netherlands (1620) | | 81.2 | 9.1 | 9.7 | - |
| 7. Fazlul Aziz Mian *et al.*, 2011 | Pakistan (200) | | 60.5 | 19.5 | 20 | - |
| 8. Ajayi *et al.*, 2013 | South Africa (151) | | 81.5 | 15.2 | 3.3 | - |
| **Dissection** | | | | | | |
| 9. Pal *et al.*, 2016 | India (50) | | 70 | 22 | 8 | - |
| 10. Agrawal and Arya, 2016 | India (50) | | 86 | 8 | 2 | 4 |
| 11. Kumar, 2016 | India (288) | | 83(0.7)* | 16 | - | 0.3 |
| 12. Abuchaim *et al.*, 2009 | Brazil (25) | | 72 | 20 | 8 | - |
| 13. Nordon and Rodrigues Junior, 2012 | Brazil (50) | | 91.5 | 8.5 | - | - |
| **14.Present study** | **44** | | **81.8** | **15.9** | **2.3** | **-** |

RD: Right dominance. LD: Left dominance. Co/BLD: Codominance/balanced. ND: No-dominance. * Right coronary arterial great dominance. ** Canada,Germany, Italy, Korea, Zwitzerland, United States of America.
Present study compared with Ajayi *et al.*, 2013: RD (Z=0.05, P=0.96), LD (Z=0.11, P=0.91), Co (Z=0.35, P=0.73) and Pal *et al.*, 2016: RD (Z=1.33, P=0.18), LD (Z=-0.75, P=0.45), Co (Z=-1.23, P=0.22).

Findings of coronary dominance patterns from the present study compares well with the angiographic study done in Kwazulu-Natal by Ajayi *et al.* (2013). There seem to be differing views in the determination of coronary arterial dominance that is not clearly right or left dominance. The differences in the determination of coronary arterial dominance could be due to lack of reference to a standard operational definition of coronary arterial dominance, observational biases in classification, pathological conditions, statistical modeling and possibly, techniques used. The present study noted variations in the number of branches among hearts that were right dominant, left dominant and one specimen showing co-dominance as shown in sample representative photographs (Figs 2.a-c; 3.a-c; 4ai-ii), which are consistent with the standard classification proposed by Schlesinger (Schlesinger, 1938; Schlesinger, 1940; Pitt *et al.*, 1963; Das *et al.*, 2010).

In their study, He *et al.* (2017), grouped co-dominance and right dominance subjects when using coronary dominance as predictor of long term-mortality, leading to possible perceptions that co-dominance is not important and over-representation of right dominance. Instances where coronary arterial dominance could not be determined well due to pathological conditions like Chagas's disease; a mix of dominance patterns could have been left among the undetermined specimens (Nordon and Rodrigues-Junior, 2012).

Even though the three (right dominant, left dominant and co-dominant) categories of coronary dominance have been widely used, some authors have proposed additional categories of right coronary arterial great dominance and coronary arterial no dominance (Agrawal and Arya, 2016; Kumar, 2016). In the study by Pal *et al.* (2016), observed specimens with branches of both the right coronary artery and the left circumflex artery running in or near the posterior interventricular groove were classified as co-dominant. It is possibly, on such premises that some authors proposed a fourth category of coronary arterial no-dominance (Kumar, 2016; Agrawal and Arya, 2016). In their classification of dominance patterns, Agrawal and Arya (2016) reported 4% of heart specimen without the posterior interventricular artery, hence coronary arterial no-dominance. Where there was no posterior interventricular artery, the diaphragmatic aspect of the heart was supplied by a network of small branches from the RCA and LCX running obliquely (Agrawal and Arya, 2016).

Table 2 shows the four categories of coronary dominance patterns proposed by Kumar (2016); right coronary arterial dominance (83%), right coronary arterial great dominance (0.7%), left coronary arterial dominance (16%) and coronary arterial no-dominance (0.3%). The right coronary arterial great dominance was described as the category in which the left coronary artery did not reach the back of the heart, with only the right coronary artery present and traversing the entire length of the coronary sulcus (Kumar, 2016). The description would also be applicable for left coronary arterial great dominance thus possibly adding another category (left coronary great dominance).

Notwithstanding the fact that Kumar (2016) is a relatively recent study, the idea of right coronary arterial great dominance is not new. Earlier reports (Hadziselimovic, 1982;Loukas *et al.*, 2009) explained the existence of an extremely dominant right coronary artery, where the branches of the right coronary artery would supply all the inferior wall of the left ventricle. This extremely dominant right coronary artery was still maintained as right dominance (Hadziselimovic, 1982;Loukas *et al.*, 2009). The right coronary arterial great dominance or extremely dominant right coronary arteries are possible variants of the right coronary artery similar to the one observed in the present study (Fig 2.c). The specimen shows hypoplasia of the left circumflex artery and extensive branches of the right coronary artery supplying the posterior interventricular septum and a large portion of the left ventricle (Fig 2.c).

The absence of coronary artery running in the posterior interventricular sulcus has been designated coronary arterial no-dominance (Kumar, 2016). In coronary arterial no-dominance, the left and right coronary arteries continue as individual posterior ventricular arteries before crossing the crux of the heart on both sides of the posterior interventricular septum (Kumar, 2016). The preference to use coronary arterial no-dominance was on the basis of the assertion that co-dominance or balanced type of coronary arterial pattern is impossible in nature (Kumar, 2015; Kumar 2016).

It is important to put into context the existence of coronary arterial no-dominance (Allwork, 1987). Where the left or right coronary artery reaches the crux of the heart, the remainder of the posterior septum will be supplied by either the descending branches from both the left and right coronary arteries or by a network of obliquely orientated small branches of the two main arteries, in such instances there is no posterior interventricular branch and it is known as co-dominance or balanced type (Allwork, 1987). In co-dominance pattern, the posterior branch is either bilateral or absent (Allwork, 1987). The classification of specimens with no coronary artery running in the posterior interventricular sulcus as coronary arterial no-dominance and co-dominance (Allwork, 1987; Kumar, 2016) requires the adoption of a new type of classification in order to have a clear and distinct co-dominance. Co-dominant specimen in the present study showed the posterior interventricular sulcus with almost half its length shared between the branches of the circumflex and the right coronary artery (Fig 4.ai-ii). The heart specimen (Fig 4.ai-ii) qualify to be called co-dominant in accordance with the operational definition that was adopted.

Differences in coronary arterial classification could lead to erroneous comparisons, adding to already established reliability concerns with cadaveric observational studies (Wilke *et al.*, 2015). In the present study, dominance was defined as the coronary artery that gave rise to the posterior interventricular (descending) artery and supplied the inferior 1/3rd of the interventricular septum, which could either be the right, left or both coronary arteries (Sabnis, 2013; https://radiopaedia.org/articles/coronary-arterial-dominance).

It is also important to interpret the results from the study in the context of the techniques used in determining coronary arterial dominance. In this study, the dissection technique was used in cognizance of its limitations and precautions were taken not to destroy or miss coronary arteries which penetrated the myocardium. The absence of unusual classifications (no-dominance and coronary arterial great dominance) in angiographic findings used for comparison is indicative of its limited mistakes in determining coronary arterial variations (Altin *et al.*, 2015; Gebhard *et al.*, 2015; Villa *et al.*, 2016).

## Conclusion

The operational definition and classification of coronary arterial dominance used in the study, with detailed methodological steps and supporting evidence in the form of photographs, are important in achieving reproducibility of the findings. In this study, right dominance (81.8%, n=36) was the most common dominance pattern, followed by left dominance (15.9%, n=7) and co-dominance (2.3%, n=1) consistent with other findings in literature. Dominance pattern is independent of sex and age in the study sample.

On the basis of comparative literature and reported differences in the naming and classification of variations in coronary arteries, which included right coronary arterial great dominance, extremely dominant right coronary artery and coronary arterial no dominance, it is proposed that the standard classification of; right coronary arterial dominance, left coronary arterial dominance and balanced or co-dominance be retained, but with an additional category of coronary arterial no-dominance.

Variations in the pattern of dominance of the coronary arterial supply are important anatomically, especially when interventions like angioplasty and bypass surgeries are to be done.Though less prevalent than right dominance, left dominance and co-dominance have been found to be associated with increased mortality in patients with acute coronary syndrome.

The present study will contribute to knowledge in coronary arterial variations in the Western Cape area and the South African population.

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## Mini Curriculum and Author's Contribution

1. KS Mpolokeng and GJ Louw :Project development
2. G Tanthuma, KS Mpolokeng and GJ Louw :Protocol development
3. G Tanthuma :Data collection and management
4. G Tanthuma, KS Mpolokeng and GJ Louw :Manuscript writing and editing

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