# Variations of The Coronary Arteries in The Population of Sohag Governorate

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## ABSTRACT

**Background:** The coronary arteries differ greatly in their number, origin, and course. According to that, the dominance of the coronaries was found to be either "right dominance" in the case of the posterior interventricular artery arising from the right coronary artery, Whereas "left dominance" if the posterior interventricular artery comes from the left coronary artery. "Co-dominance" occurs when both the right coronary artery and the left circumflex artery gives a posterior interventricular artery. Many other variations are widely studied and their importance varies greatly according to their clinical consequences especially when they become manifest. Also, a well-known study of each case differs greatly in the decisions taken by cardiologists before any invasive procedure. The aim of this research is to study some variations of the coronary arteries and to evaluate the prevalence of coronary artery dominance in the population of Sohag governorate.

**Subjects and Methods:** Coronary angiography of cases attended at Cardiac Catheterization Laboratory at Sohag University Hospital.

The total number of cases examined was 596 cases (480 males and 116 females) of different age groups ranging from (30-70) years. Statistical analysis of the data was done.

**Results:** The dominance of the coronaries is mainly right either in the females or in the males. There is a significant statistical difference in the age groups between 30-40 yrs and 40-70 yrs but there was no significant statistical difference in the age group above 70 yrs. The incidence of congenital anomalies was (9.4%) among the whole study group.

**Conclusion:** The study demonstrates the clinical anatomy of the coronaries and very useful in understanding coronary angiograms.

**Keywords**: Coronary arteries, Dominance, Variations, Congenital anomalies, Coronary angiography

## Introduction

Variations in coronary arteries may be due to: sex, age, the conducting system of the heart, gene, race, geography, climate, nutrition. *(1)* studied the coronary anatomy anatomic variations. The most common variant is in the distribution pattern of the right and left coronary arteries which are known as the dominance of coronary arteries *(2)*.

Several major variations in the basic distribution pattern of the coronary arteries do occur *(3)*. There is a hemodynamic significance in some of them which may result in myocardial ischemia or even sudden death *(4)*. The information on coronary variations is very important before any invasive operation in a coronary artery diseased patient. Also, there is a high risk of sudden death from transient closure of an anomalous artery or due to increased blood flow during exercise especially among athletes *(5)*.

There are some variations in the arterial supply of the sinoatrial and atrioventricular nodes too. In the majority of cases, the right coronary artery supplies these 2 structures but in some cases, the circumflex branch of the left coronary artery supplies these structures *(6)*.

Increased risk of sudden death may be due to the high take-off angle of the right coronary artery *(7)* as it may be arising from the aorta above the right sinu-tubular junction or from the left anterolateral aspect of the aorta *(8)*. It is commonly to be discovered clinically when it is difficult to insert the catheter in the ostium of superior rising right coronary artery *(9)*.

Myocardial bridging is a condition in which a coronary artery makes a tunnel through the myocardium rather than being on top of it. It  is frequently encountered but it is not associated with important hemodynamic changes *(10)*

**Aim of the Work:** To evaluate the prevalence of coronary artery dominance and some other anatomic variants in the population of Sohag Governorate.

**Patients and Methodology**
This study was done on patients who attended at Cardiac Catheterization Laboratory at Sohag University Hospital.

**Patients:** This retrospective examination of patients' medical records between February 2018 and August 2019 from the Cardiac Catheterization Laboratory at Sohag University Hospital in Egypt. Including a review of 596 cases (480 males and 116 females) of different age groups ranging from (30-70) years.

**Methodology:** 1. After taking medical history & performing a physical examination and laboratory tests patients with an indication for coronary artery angiography were informed of coronary angiography procedure details. After obtaining informed consent, patients without contraindications to undergo the procedure were transferred to Catheterization Lab for diagnosis and treatment.

2. Angiography using G-armed stand and digital imaging, Percutaneous Coronary Intervention technique. We insert a catheter which is a fine tube into the femoral artery in the thigh of the patient and we pass it through the external iliac then to the common iliac artery to reach the abdominal aorta. Then it is moved up to thoracic aorta and from it to the origins of coronaries. We inject a contrast material to veins then saline is injected simultaneously we take sections of the heart showing the coronary arteries. The left coronary system was visualized using at least four different projections and the right coronary system was visualized using at least 2 projections. All images were recorded on a digital system & collected images were assessed to fully visualize the coronary artery anatomy.

3. Assessment and classification of patients:

- The coronary angiography report was written and double-checked by 2 independent interventional cardiologists.

- Based on the coronary angiography results, variations of coronary artery anatomy such as coronary dominance, origin from separate Ostia were assessed. Coronary artery anomalies in their course and origin, myocardial bridging were also checked.

- Patients were divided into left dominance groups where the posterior interventricular artery was from the left circumflex artery & Right dominance group where the posterior interventricular artery was from the right coronary artery. Co dominance group,

the posterior interventricular artery was from both left circumflex and the right coronary artery.

- The basic anatomic classification method was used to classify patients with coronary artery congenital anomalies & patients were divided into 3 groups of anomalies in course and origin.

- Finally, the prevalence of data on coronary artery variations & anomalies was registered.

4. Statistical analysis of data was done using the statistical package of social sciences program (SPSS) software.

- Descriptive statistics were performed and frequencies were collected.

- Analysis of variance & the Chi-square (Pearson) test with graphical figures were used to compare between the subgroups of coronary artery dominance. Also, to determine whether there was a significant difference between males and females in the dominance of coronary arteries.

## RESULTS

### According to the table (1):

1. The total number of cases examined: 596 cases, of them 420 (70.5%) showed right coronary dominance, 128 (21.5%) showed left dominance, while the remaining 48 (8.1%) cases showed co-dominance. These results are proved to be highly significant statistically ($P < 0.001$).

2. The number of male cases:480 cases of them 324 (67.5%) cases showed right dominance, 108 (22.5%) cases showed left dominance, and the remaining 48 (10%) showed co-dominance. These results are proved to be highly significant statistically ($P < 0.001$).

3. The number of female cases:116 cases of them 96 (82.8%) cases showed right dominance, 20 (17.2%) cases of them showed left dominance. No cases were found to show co-dominance these results are proven to be highly significant statistically ($P < 0.001$).

### According to table (2):

1. The total incidence of congenital anomalies was (9.4%) 56 cases among our study group, 38 cases showed myocardial bridging during systole representing the most common anomaly found (67.8%) of total anomalies and (6.4%) out of 596 cases.

2. High take off right coronary artery was found in 16 cases (2.7%) among our study group.

3. Separate Ostia was found only in 2 cases representing (3.6%) among anomalies and (0.3%) among the study group.

**Table (1): Distribution of side of dominance according to sex.**

| Side | Right | | Left | | Co | | $X^2$ | P |
|------|-------|-------|------|-------|------|------|-------|------|
| Sex | No | % | No | % | No | % | | |
| Males | 324 | 67.5 | 108 | 22.5 | 48 | 10 | 31.49 | <0.001 |
| Females | 96 | 82.8 | 20 | 17.2 | 0 | 0 | 17.42 | <0.001 |
| Total | 420 | 70.5 | 128 | 21.5 | 48 | 8.1 | 46.76 | <0.001 |

N.B: CO = Co-dominance
The level of significance according to the level of P-value as follows: P > 0.05 non-significant
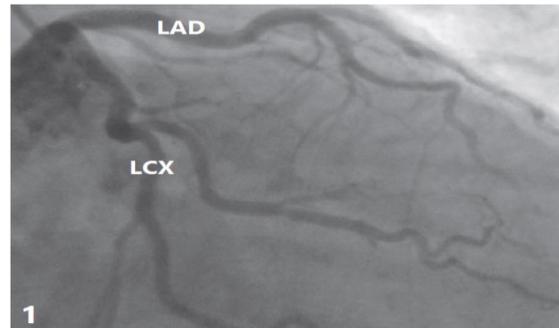 P ≤ 0.05 significant *  P ≤ .001 highly significant**
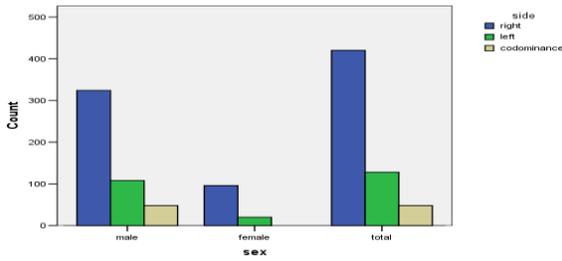
**Histogram (1)**: side of dominance according to sex

| anomalies | Number of cases | %Among anomalies | %Among study group |
|---|---|---|---|
| **Myocardial bridging** | 38 | 67.8 | 6.4 |
| **Separate ostia** | 2 | 3.6 | 0.3 |
| **High take-off** | 16 | 28.6 | 2.7 |

**Table (2)**: Total incidence of congenital anomalies was 9.4% (56 cases) among the group
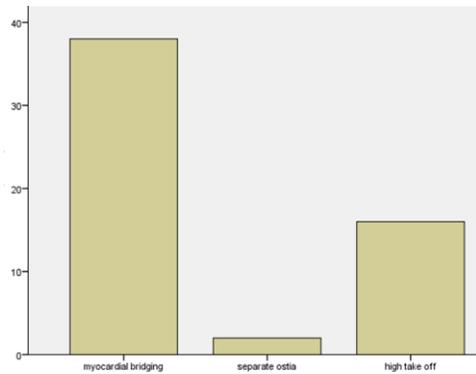


**Histogram(2)**: Incidence of congenital anomalies



**Figure 1:** A coronary angiography of a 62 years old male, the right anterior oblique caudal view showing the separate origin of the left anterior descending artery and left circumflex artery from the left aortic sinus.
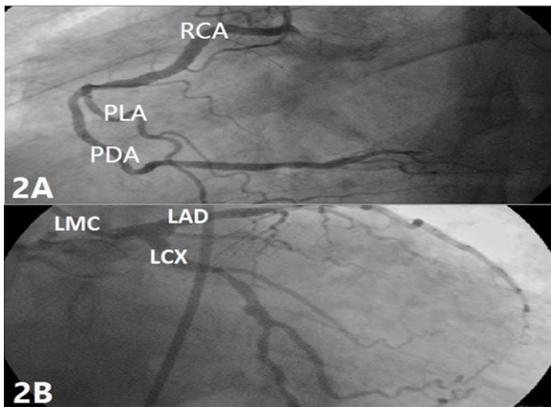


**Figure 2**: 2A: coronary angiography of 65 years male patient, left anterior oblique cranial view showing right coronary dominance. 2B: Left anterior oblique caudal view of the same patient showing left main coronary, LAD, LCX.
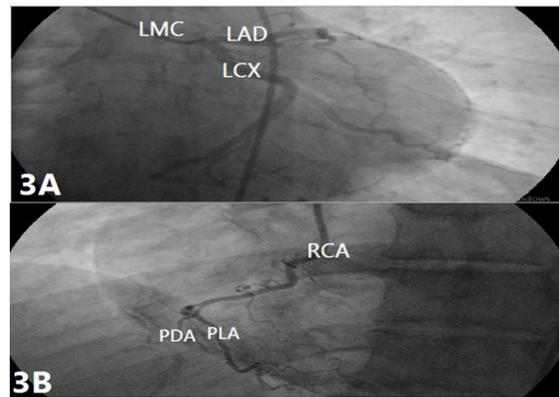


**Figure 3**: 3A: Coronary angiography of 66 years male, right anterior oblique caudal view, showing left dominance.
3B: left anterior oblique caudal view of the same patient to show the right coronary.
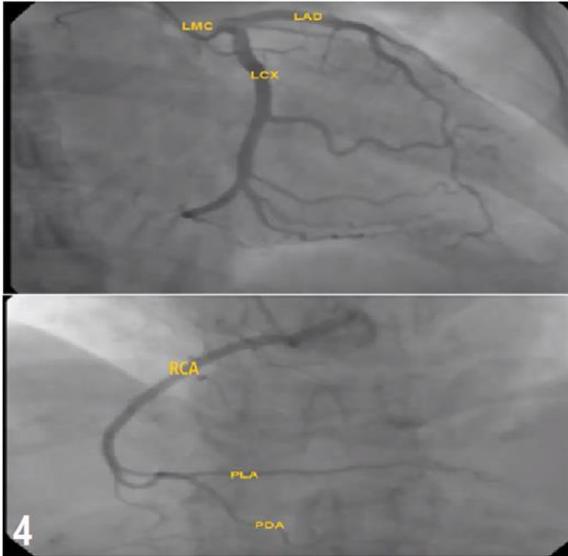
**Figure 4:** Coronary angiography of 60 years old male, left anterior oblique cranial view showing that the posterior interventricular artery arises from the circumflex branch of the left coronary artery and also from right coronary artery (case of co-dominance).
RCA: Right coronary artery / PLA: posterolateral artery
PDA: posterior descending artery
LAD: left anterior descending coronary artery / LCX: circumflex coronary artery
LMC: left main coronary artery

## Discussion

The results of this study showed that the coronary arteries have many variations, the dominance is mainly right with high significance statistically either in the total number of cases or in males or females. This agrees with *(11), (12)* who suggests that right dominance is more common than left dominance. On the other hand *(13)* suggests that 70% of people have a larger left coronary and that it gives the posterior interventricular artery.

It is noticed that the co-dominant cases numbers are the least in total numbers of cases either in males or in females. This shows disagreement with the results of *(1)* who stated that the dominance of the right coronary artery was present in 70% of cases, the dominance of left coronary artery 11.9% and co-dominance 18.1%. This may be due to differences between numbers, age or race of cases examined. Our research revealed that the right coronary artery dominance is more common than the left coronary dominance and co-dominance in all age groups taken.
-Cases subjected to coronary angiography in the age group (30-40)

years: 140 cases,104 cases (74.3%) showed the right dominance. 24 cases(17.1%) showed left dominance and 12 cases (8.6%) showed co-dominance. The results were found to be highly significant statistically (P < 0.01).
-Cases subjected to coronary angiography in the age group (40-70) years: 384 cases, of the 268 cases (69.8%) showed right coronary dominance. 92 cases (23.9%) showed left dominance and the remaining 24 cases (6.3%) showed co-dominance. These results were found to be highly significant statistically (P < 0.001).
We found that the number of male cases (480) was very high in comparison with female (116) this may due to the protective effect of estrogen hormone on the female cardiovascular system *(14)*.
-Cases subjected to coronary angiography in the age group (70 years and above): 72 cases, of them 48 cases(66.7%) showed the right dominance.12cases (16.7%) showed left dominance, and the remaining 12 cases(16.7%) showed co-dominance. These results were statistically non-significant.

It is also noticed that the age group 70-years the number and percentage of co-dominant cases are nearly the same as left dominant cases may be due to the revascularization process and appearance of collaterals as a compensatory mechanism in old age *(15)*. So, the function of the cardiac muscle is preserved.

Our study found coronary artery congenital anomalies in (9.4%) 54 cases out of 569 cases undergoing coronary artery angiography. This rate is much higher than other rates reported in other invasive angiographic reports, other studies reported that the incidence of coronary artery anomalies was (2.7%), the sample size was 1.950 cases *(11).*

The total incidence of myocardial bridging was (6.4%) of our study group, it represents (67.8%) among total congenital anomalies in the group and the most frequent congenital anomaly. So, it is considered a variation not an anomaly because of its high incidence. But it was regarded as a coronary artery anomaly in *(16)* a study conducted in Turkey that estimated the incidence of myocardial bridging to be (1-5%) in the general population.

This agrees with a study in Egypt that stated that the myocardial bridging was (16.8%) of the study group and (88.9%) among all congenital anomalies *(17)*. It also agrees with *(10)*who found myocardial bridging in (11.3%) of their population. But disagrees with *(18) who stated that* the myocardial bridging was (0.41%) among their study group.

The extent of arterial obstruction is estimated during systole to know the severity of the case, If it was less than 50% it is considered a benign condition but if increased to 70% anginal symptoms can result. As most of the coronary blood flow occurs during diastole, the narrowing during systole which is caused by myocardial bridging not expected to cause impaired perfusion of the myocardium, ischemia or angina *(17)*.

In our study, (100%) of myocardial bridging found in LAD, involving the mid-segment in most cases &only few cases involving the distal segment or mid to distal segments.

In comparison with larger studies which stated that separate origin of LAD & LCX from left sinus with absent left main coronary was the most common congenital anomaly *(19),* Our research found the incidence of separate Ostia was (3.6%) among anomalies and only (0.3%) of our study group.

## Conclusion

Some abnormalities in the origin of the coronary arteries from the aorta are considered to be minor variations. The majority of them are of few clinical consequences, these abnormalities become important only when some other atherosclerotic lesions become manifested clinically.

   The data of this work can be used as standards for Sohag population and for comparison with other studies.

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