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Case report

# What is unsought will go undetected – Myocardial bridging on postmortem computed tomography

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ABSTRACT

We present a case of myocardial bridging seen on unenhanced postmortem computed tomography (PMCT). This case illustrates the potential contribution of PMCT in diagnosing sudden cardiac death, which is not restricted to coronary artery calcifications and pericardial effusions. The importance for the expert reading PMCT examinations to have all relevant case information and a specific forensic question is further discussed.



## 1. Introduction

Myocardial bridging is defined as an anomalous course of a segment of a major epicardial coronary artery running intramurally through the myocardium beneath a muscle bridge [1]. The most common vessel involved is the mid left anterior descending artery [1,2].

The medical relevance of myocardial bridges is a controversial topic in the literature [3,4]. Many claim bridging might be a possible cause of myocardial infarction or sudden death [5], whereas others reject this opinion, or at least question its relevance [6,7].

According to the literature, the prevalence of the phenomenon varies depending on the method used to reveal it in each study. In angiographic studies myocardial bridging is detected in 1.5–25% of the cases, whereas in autopsies the presence of this entity goes up to 80% [1,5]. According to Möhlencamp, myocardial bridging is present in one third of the adult population [8]. There is general agreement that there is no difference regarding prevalence among men and women [1,4,9]. The thickness of the myocardial bridge can be 1–10 mm [8]. During the last years, new techniques such as Computed Tomography (CT) Angiography [10–13] and Dual Source CT [14] were used to detect myocardial bridges. Imaging examinations are only performed on symptomatic patients, so the incidence of myocardial bridging could differ from that of the general population. Moreover, classic angiography is not sensitive enough to detect short and thin bridges [15].

Imaging techniques in the postmortem setting are becoming routine procedures in more and more forensic institutes around the world. Postmortem CT (PMCT) is the most wide spread cross-sectional imaging modality, as postmortem magnetic resonance (PMMR) imaging requires very expensive equipment and PMCT angiography (PMCTA) is in widespread use [16,17]. However, the majority of postmortem studies investigating cardiovascular disease (other than coronary calcification), involve either PMCTA or PMMR [18–23].

Here we present a case of a myocardial bridging, detected on non-contrast postmortem CT and discuss the implications of this observation.

## 2. Case description

A 74 year old male was found dead in his office by co-workers. The medical history revealed a recent visit to his family physician because of exercise-induced stomach pain. The physician attributed these

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symptoms to cardiovascular disease rather than gastro-esophageal-reflux and ordered a coronary angiography. The patient, however, refused further testing or medication. The decedent was brought to our institute for further investigations. Based on the medical history and case circumstances, no autopsy was ordered by the legal authorities and the corpse only underwent PMCT examination, according to our institute's standard protocols.

## 3. Imaging

PMCT was performed on a dual-source CT scanner (Flash Definition, Siemens, Forchheim, Germany). Scan parameters were: tube voltage 120 kVp, automatic dose modulation software (CARE dose 4D, Siemens, Forchheim, Germany), slice thickness 1.0 mm, increment 0.6 mm using the soft-tissue kernel. Multiplanar reformations were performed at a multimodalitiy workplace (LEONARDO, SynGo, Siemens Medical Solutions) and final read-out was carried out on a PACS station (Picture and Archiving Communication System, Sectra, Linköping, Sweden). PMCT images were reviewed by a forensic pathologist and a radiologist (both with three and a half years of experience in postmortem imaging). Three dimensional reconstructions of the heart were made with segmentation software (Amira, Visage Imaging, Germany) [24,25].

## 4. Findings

PMCT revealed mild calcification of all three main coronary arteries. There was myocardial bridging of the left anterior descending artery (LAD); approximately 2.2 cm after its origin from the main left coronary artery (LCA) the LAD took an intramyocardial course for approximately 3 cm (Figs. 1 and 2).

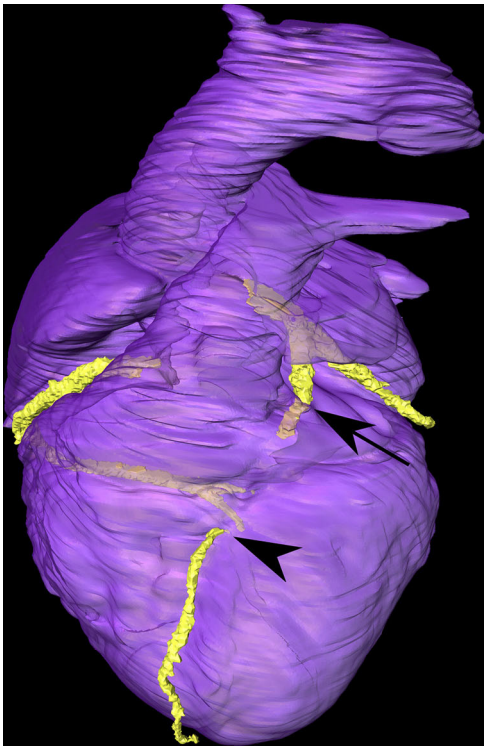

**Fig. 1.** Three dimensional reconstruction of the heart and the coronary vessels after manual segmentation. The myocardium is shown semi-transparent so that the diving segment of the left anterior descending (LAD) artery can be seen (arrow). After a 3 cm intramural course, the segment arises again on the epicardium (arrowhead). The vessel segment within the myocardium was not visualized and was therefore not segmented.

The coronary artery segment underneath the myocardial bridge was hardly visible, because it was not calcified and not contrasted. However, the entry point into the myocardium and the exit from it were clearly detectable.

In addition, PMCT revealed no signs of trauma; there was an aneurysm of the left popliteal artery with a maximal diameter of 1.8 cm, and a large ($7 \times 5.3 \times 3$ cm) thyroid cyst with a partially calcified wall.

## 5. Discussion

This report describes the detection of myocardial bridging on non-contrast postmortem computed tomography. Myocardial bridging has so far been neglected in the literature on post-mortem cross-sectional imaging. However, myocardial bridging is a forensically relevant finding in cases of sudden cardiac death. In addition, it can be detected on non-contrast PMCT.

Despite the controversial discussions regarding both prevalence [4] and significance [6] of myocardial bridging, there is general agreement that myocardial bridging may trigger sudden cardiac death [5]. The impact of myocardial bridging on coronary angiography has been nicknamed the “milking effect”. The milking effect describes narrowing of the vascular segment underneath the myocardial bridge with concomitant widening of the vascular segment proximal to the myocardial bridge during systole. Thus, myocardial bridging causes a retrograde flow phenomenon, ultimately resulting in plaque formation at the entry sides of the bridged coronary segment [8,14]. Many clinical symptoms like angina, myocardial ischemia, myocardial infarction, left ventricular dysfunction, myocardial stunning, paroxysmal AV blockade, as well as exercise-induced ventricular tachycardia and sudden cardiac death are thought be potential consequences of myocardial bridging [8].

It is impossible to ascertain conclusively whether myocardial bridging was the source for the decedent's exercise-induced discomfort and sudden death. However, a connection between the two seems highly probable. It is conceivable that further examination, including PMMR, PMCTA and traditional autopsy would have been able to link the presence of myocardial bridging to an acute myocardial infarction.

This case illustrates that the role of PMCT in the investigation of sudden cardiac death is not limited to the description of calcified plaques or pericardial effusions. If used properly, non-contrast PMCT may provide a range of findings related to cardiovascular disease and thereby contribute significantly to the investigation of the cause of death.

To this date, myocardial bridging has not yet been reported on post-mortem cross-sectional imaging and it is important to note that this diagnosis was made on non-contrast PMCT. This observation stands in contrast to the fact that myocardial bridging is thought to occur in one third of the adult population [8]. This discrepancy suggests that the presence of myocardial bridging is often overlooked on postmortem cross-sectional imaging. Thus, this case also highlights another, often neglected but highly important aspect of postmortem imaging; a typical whole-body PMCT dataset consists of more than 3000 single CT images. In order to deal with this amount of images, radiologists and pathologists reading PMCT must not only have a systematic approach to the images, but they must know what they are looking for. It is fundamentally important that the imaging expert is familiar with the case history prior to reading a PMCT. The more he or she knows of a case, the better will he or she be able to detect and correctly interpret all findings relevant to the case. The imaging expert must also possess thorough knowledge of both normal and abnormal postmortem