



# Incidence and Predictors of Cardiomyocyte Injury in Elective Coronary Angiography

Philipp Kreuzinger, MD,<sup>a</sup> Karin Wildi, MD,<sup>a,b</sup> Raphael Twerenbold, MD,<sup>a</sup> Maria Rubini Gimenez, MD,<sup>a,b</sup> Tobias Reichlin, MD,<sup>a</sup> Cedric Jaeger, MD,<sup>a,b</sup> Petra Hillinger, MD,<sup>a,b</sup> Jasper Boeddinghaus, MD,<sup>a</sup> Thomas Nestelberger, MD,<sup>a</sup> Christian Puelacher, MD,<sup>a</sup> Fabio Stallone, MD,<sup>a,b</sup> Katharina Rentsch, PhD,<sup>c</sup> Stefan Osswald, MD,<sup>a</sup> Raban Jeger, MD,<sup>a</sup> Christoph Kaiser, MD,<sup>a</sup> Christian Mueller, MD<sup>a</sup>

<sup>a</sup>Department of Cardiology and Cardiovascular Research Institute Basel, University Hospital Basel, Switzerland; <sup>b</sup>Department of Internal Medicine, University Hospital Basel, Switzerland; <sup>c</sup>Laboratory Medicine, University Hospital Basel, Switzerland.

## ABSTRACT

**OBJECTIVE:** Coronary angiography is considered to be a safe tool for the evaluation of coronary artery disease and performed in approximately 12 million patients each year worldwide. The aim of our study was to investigate the frequency and predictors of cardiomyocyte injury in patients undergoing elective coronary angiography.

**METHODS:** A total of 749 consecutive patients who were scheduled to undergo elective coronary angiography were prospectively analyzed. High-sensitivity cardiac troponin T concentrations were measured both before and after elective coronary angiography (without intervention). Acute cardiomyocyte injury was predefined as an absolute increase in high-sensitivity cardiac troponin T of at least 7 ng/L (if also fulfilling a relative change of >20%).

**RESULTS:** Acute cardiomyocyte injury was observed in 101 patients (13.5%, 95% confidence interval [CI], 11.1-16.2). It was independently associated with aortic valve stenosis (odds ratio [OR], 5.4; 95% CI, 3.0-9.8;  $P < .001$ ), age (OR, 1.05; 95% CI, 1.02-1.08;  $P < .001$ ), female sex (OR, 3.5; 95% CI, 1.8-6.8;  $P < .001$ ), contrast volume (OR, 1.006; 95% CI, 1.001-1.012;  $P = .019$  per 10 mL of contrast volume), documented cardiomyopathy (OR, 2.5; 95% CI, 1.0-6.0;  $P = .045$ ), and mitral regurgitation (OR, 2.3; CI, 1.0-4.9;  $P = .033$ ). In contrast, operator experience and extent of coronary artery disease were not found to be associated with acute cardiomyocyte injury.

**CONCLUSIONS:** Cardiomyocyte injury accompanies elective coronary angiography in 1 of 8 patients. Sex, age, contrast agent volume, and ventricular disease, rather than the extent of coronary artery disease, independently predict cardiomyocyte injury. Further research aiming to reduce the incidence of cardiomyocyte injury seems warranted.

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**KEYWORDS:** Coronary angiography; Myocardial infarction; Myocardial injury; Predictors of cardiomyocyte injury

Coronary artery disease is the leading cause of death in developed countries and responsible for approximately one third of all deaths.<sup>1,2</sup> Percutaneous coronary intervention is a therapeutic procedure that has been refined during the last 4 decades and is used widely to treat acute or chronic

coronary artery disease.<sup>2-7</sup> In contrast to percutaneous coronary intervention, in elective coronary angiography—a pure diagnostic procedure—myocardial injury/infarction is considered to be an exceedingly rare event occurring in less than 0.1% of procedures.<sup>8,9</sup> Accordingly, coronary angiography is considered to be a safe tool for the evaluation of coronary artery disease and performed in approximately 12 million patients each year worldwide.<sup>1,2,10-30</sup> Given the enormous number of procedures performed each year and its rather low yield in the United States and other countries,<sup>30</sup> we aimed to prospectively investigate potential subclinical harm associated with coronary angiography.

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Requests for reprints should be addressed to Christian Mueller, MD, Department of Cardiology, University Hospital Basel, Petersgraben 4, CH-4031 Basel, Switzerland.

E-mail address: [Christian.Mueller@usb.ch](mailto:Christian.Mueller@usb.ch)

Recently developed high-sensitivity cardiac troponin assays allow the precise quantification of cardiomyocyte injury and the detection of small myocardial infarctions missed by the previous generation of assays.<sup>11-13</sup> The adverse impact on long-term mortality of these small myocardial infarcts is well established in the setting of spontaneous events.<sup>13</sup> On the basis of observations in a pilot study,<sup>14</sup> we hypothesized that elective coronary angiography may result in cardiomyocyte injury in a higher number of patients as previously thought. The aim of this study was to use the most extensively validated high-sensitivity cardiac troponin assay available, which was introduced into clinical care in Europe in 2010, to investigate the incidence and possible predictors of periprocedural cardiomyocyte injury after elective coronary angiography.

## MATERIALS AND METHODS

### Patients

Consecutive stable patients scheduled to undergo elective coronary angiography at the University Hospital Basel, Switzerland, in 2012 and 2013 were assessed prospectively with a quality assurance program to document the incidence of periprocedural cardiomyocyte injury. High-sensitivity cardiac troponin measurements were performed twice: before and after undergoing coronary angiography. Patient flow is illustrated in **Figure 1**. Patients were included in this analysis if the high-sensitivity cardiac troponin concentration could be documented both before and after undergoing elective coronary angiography. Patients were included regardless of the baseline concentration of high-sensitivity

cardiac troponin. Patients in whom coronary angiography was followed by percutaneous coronary intervention; patients with severe renal dysfunction (estimated glomerular filtration rate  $<30$  mL/min/1.7); patients with major periprocedural complications, such as overt acute myocardial infarction or cardiac tamponade; and patients in whom the measurement of high-sensitivity cardiac troponin was performed too soon after elective coronary angiography ( $<2$  hours) were excluded. The ethic committee waived the need for a specific consent for this scientific analysis of the quality assurance project. All patient and procedural details were obtained from the hospital records.

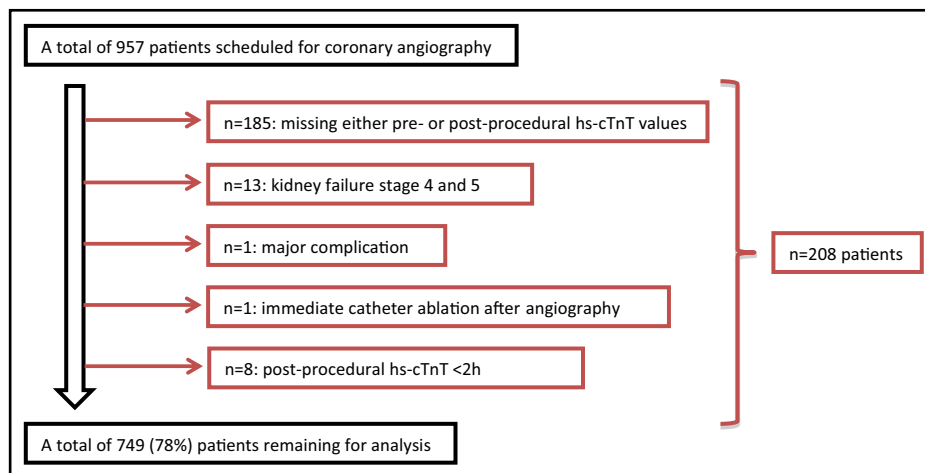
### Procedures and Definition

Coronary angiography was performed according to current guidelines and mainly using the femoral approach (in 96%).<sup>8,9</sup> In 85 patients (93%) with aortic

valve stenosis, a second catheter was used for retrograde catheterization of the aortic valve for measuring the aortic pressure gradient. Three different iodine-containing contrast agents were used: iomeprol 300 mg/mL (542 patients; 72.4%), iopromid 300 mg/mL (201 patients; 26.8%), and iodixanol 320 mg (2 patients; 0.3%). In 4 patients (0.5%), the contrast agent could not be verified. Major complications were defined as death, acute myocardial infarction, stroke, and cardiac tamponade and were assessed for all patients through case analysis of the subjects hospital files. After undergoing coronary angiography, patients were monitored for 24 hours. Estimated glomerular filtration rate was calculated with the Modification of Diet and Renal

### CLINICAL SIGNIFICANCE

- We challenge the current concept that periprocedural myocardial infarction/injury is a rare event during elective coronary angiography.
- We report 4 findings that provide novel insights regarding iatrogenic harm induced during elective coronary angiography: Sex, age, contrast agent volume, and ventricular disease, rather than the extent of coronary artery disease, independently predict cardiomyocyte injury.



**Figure 1** Patient flow.

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