

## Original Article

# Fibromuscular dysplasia of cardiac conduction system arteries in traumatic and nonnatural sudden death victims aged 0 to 40 years: a histological analysis of 100 cases

Fred Zack, Grit Kutter, Verena Blaas, Ann-Katrin Rodewald, Andreas Büttner\*

Institute of Forensic Medicine/Rechtsmedizin, Rostock University Medical Center, St.-Georg-Strasse 108, 18055 Rostock, Germany

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## ABSTRACT

**Background:** Since 1967, numerous case reports have described fibromuscular alterations of the sinus node artery and/or the atrioventricular node artery as a potential cause of death. However, the prevalence of these changes in a healthy population has only rarely been investigated systematically.

**Methods:** The arteries of the cardiac conduction system were studied systematically, by means of routine histology, in 100 cases of victims aged 0 to 40 years with a nonnatural cause of death.

**Results:** Microscopic alterations were seen in the walls of sinus node arteries in 52 out of 100 cases, in the walls of atrioventricular node arteries in 63/100 cases, and in the walls of small vessels in 60/100 cases.

**Conclusions:** The results demonstrate that microscopically detectable findings of the cardiac conduction system arteries similar to fibromuscular dysplasia do not indicate a defined disease and should not be considered as a cause of death when there are no macroscopic findings in the coronary arteries.

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## 1. Introduction

In several reports, luminal narrowing by fibromuscular dysplasia of the sinus and/or AV-node artery was found in examinations of unexplained deaths and, in many cases, was considered as the cause of death [1–13]. These cases were aged between 0 and 49 years; both sexes were affected [1–13]. However, there are no data on the frequency of fibromuscular proliferations of arterial walls in heart-healthy control groups.

## 2. Materials and methods

The present histological analysis included 100 hearts selected out of nonnatural deaths examined between 1995 and 2012 in the Institute of Legal Medicine at the Rostock University Medical Center. The use of these autopsy cases for scientific investigations was approved by the Ethics Committee of the University of Rostock, Germany.

The age of the deceased ranged from 0 to 40 years (mean age, 24.4 years). Seventy-five of these cases were male, and 25 were female. The postmortem interval did not exceed 72 h.

The preparation of the cardiac conduction system was performed by the method of Hudson [14].

After formalin fixation and paraffin embedding, the samples were cut into 4- $\mu$ m-thick consecutive slices and stained with hematoxylin–eosin and elastica–Domagk.

In some instances (e.g., artifacts), serial sections were prepared.

Since the degree of stenosis in conventional histological cross-section slices is overestimated by approximately 25% to 30% [15], the study was not performed morphometrically, but semiquantitatively with an Olympus microscope type BX51 and an Olympus camera type DP72. The proliferations of arterial walls were classified into four degrees of severity (Table 1).

## 3. Results

### 3.1. Sinus node artery

Fifty-two out of 100 cases revealed microscopic detectable fibromuscular proliferations of the sinus node arterial wall. The media was more frequently affected ( $n=42$ ) than the intima ( $n=16$ ). In six cases, both the intima and media were involved.

While in the intima mild proliferation of the walls could be observed in 14 cases, moderate proliferation in 2 cases and no severe proliferation, the media showed mild findings in 36 cases, moderate findings in 4 cases, and severe findings in 2 cases (Fig. 1A, B).

Examination of the intima in the age group from 0 to 20 years proved that only 3 out of 33 cases (9%) showed mild proliferations of the arterial walls, whereas, in the age group under 16 years ( $n=23$ ), no proliferation of the intima was discernable.

In contrast, in 12 out of 33 cases (36%), the age group from 0 to 20 years presented mild proliferations in the media. A wall thickening was already detected at the age of 2 years.

\* Corresponding author. Tel.: +49 381 4949900; fax: +49 381 4949902.  
E-mail address: andreas.buettner@med.uni-rostock.de (A. Büttner).

**Table 1**

Classification of findings in four groups (severities)

Group 1	No noticeable proliferations of arterial wall
Group 2	Mild fibrodysplastic or muscular proliferations of arterial wall Intima: proliferation detectable, no noticeable narrowing of the lumen Media: mild disproportion between media and lumen for the benefit of the tunica media
Group 3	Moderate fibrodysplastic or muscular proliferations of arterial wall Intima: proliferation clearly recognizable, noticeable narrowing of the lumen Media: moderate disproportion between media and lumen for the benefit of the tunica media
Group 4	Severe fibrodysplastic or muscular proliferation of arterial wall Intima: severe thickening of arterial wall, enormous narrowing of the lumen Media: severe disproportion between media and lumen for the benefit of the tunica media

Out of 25 examined female cases, 10 (40%) showed proliferations of the sinus node artery; out of 75 male cases, similar findings were seen in 42 (56%) cases.

### 3.2. Atrioventricular node artery

Out of 100 cases, 63 showed microscopically detectable proliferations of the AV-node artery walls. The intima was affected more

often ( $n=60$ ) than the media ( $n=11$ ). In eight cases, proliferations were detectable in both the intima and media.

While mild proliferation of the intima was recognizable in 45 cases, 11 cases of moderate and 4 cases of severe proliferations could be observed. The media showed mild proliferations in seven cases and moderate proliferation in four cases; no severe proliferation was found (Fig. 2A–D).

The examination of the intima in the age group 0 to 20 years revealed mild proliferations in 16 out of 33 cases (48%), with the youngest deceased being 1 year of age.

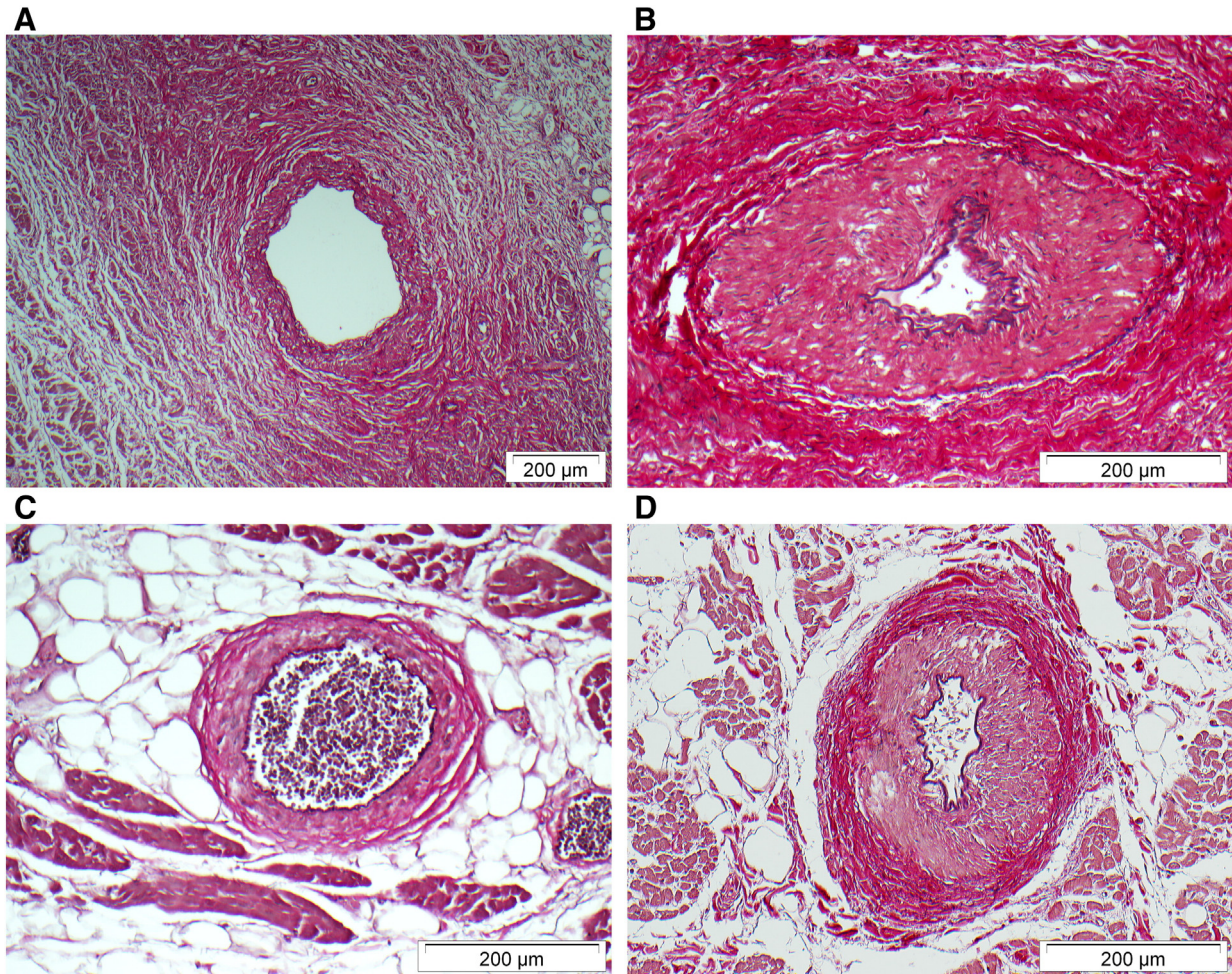
In contrast, 3 out of 33 cases (9%) of this age group showed mild ( $n=2$ ) or moderate ( $n=1$ ) proliferations of the media. A proliferation of the media was seen from the 14th year of life.

Out of the 25 female cases examined, 14 (56%) and, out of the 75 male cases, 49 (65%) had proliferations of the AV-node artery.

### 3.3. Small intramural arteries

From 100 cases, 60 showed microscopically detectable proliferations of small coronary arteries. The media ( $n=51$ ) was more often affected than the intima ( $n=21$ ). In 12 cases, the proliferations were detectable in both the intima and the media.

While there was a mild proliferation of the intima in 12 cases, a moderate one in 8 cases, and a severe thickening of arterial wall with luminal narrowing in 1 case, there were mild proliferations of the



**Fig. 1.** (A) Sinus node artery without notable proliferations of the arterial wall (40 years, female, cause of death: strangulation, elastica–Domagk stain). (B) Severe thickening of the tunica media of the sinus node artery (29 years, male, polytrauma, elastica–Domagk stain). (C) A small coronary artery without detectable proliferations (36 years, male, hanging, elastica–Domagk stain). (D) Moderate thickening of the media of a small coronary artery (31 years, male, polytrauma, elastica–Domagk stain).

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