Pacemaker as a Cause of Death
Pacemaker Failure in a Patient with ‘Sick Sinus Syndrome’ and Bradycardia

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1 Abstract

We report on a patient who at the age of 78 consulted his doctor with the classical symptoms of a ‘sick sinus syndrome’: dizziness, confusion, fatigue, and syncope. The diagnosis of a bradycardic sinus node dysfunction was confirmed by a cardiologist. After implantation of an anti-bradycardia pacemaker, the patient made a full recovery. Due to a worsening of his medical situation, the patient was admitted to hospital 4 years later. A cardial decompression with global cardiac insufficiency was diagnosed. When the patient died, he had been hospitalised for 8 weeks, his medical condition having been treated with drugs. The primary cause of death was stated as ‘cardiac decompensation’ in the death certificate.

An autopsy was performed by the resident pathologist; the pacemaker generator was left in place above the pectoralis muscle. During the required second post-mortem examination before cremation, the pacemaker was explanted. The electrode showed signs of stretching but was still connected to the generator. Telemetric interrogation of the pacemaker generator showed the battery to be depleted (EOL). No electrical output could be measured from the generator terminals. The generator functioned flawlessly after battery replacement.

It is highly probable, that the pacemaker-battery was depleted for the last couple of weeks before the patient’s death. Therefore, the absence of the cardiac pacing pulses has to be seen as the cause of the global cardiac insufficiency. Thus, the faulty pacemaker is the underlying cause of death; the death has to be classified as ‘not natural’. From a forensic point of view, a thorough investigation of an implanted pacemaker is of paramount importance in finding the precise cause of death.

Keywords

post-mortal diagnostics; pacemaker (PM); battery exhaustion
2 Abstrakt

Es wird der Fall eines Patienten berichtet, der sich vor 4 Jahren, im Alter von 78 Jahren mit den typischen Symptomen des so genannten 'Sick Sinus Syndrome' bei seinem Hausarzt vorstellte: Abgeschlagenheit, Verwirrtheit sowie Synkopen bei Sinusknotenfehlfunktion und therapierte den Patienten durch Implantation eines Herzschrittmachers, worauf sich der Zustand des Patienten normalisierte.

8 Wochen vor dem Tode verschlechterte sich der Zustand des Patienten so dramatisch, dass er zur stationären Behandlung eingewiesen wurde. Eine kardiale Dekompensation bei Globalinsuffizienz des Patienten bestätigte die Verdachtsdiagnose einer ausgeprägten Sinus-Bradykarde mit Synkopen bei Sinusknotenfehlfunktion und therapierte den Patienten durch Implantation eines Herzschrittmachers, worauf sich der Zustand des Patienten normalisierte.

4 The Case

At the age of 78—4 years prior to his death—the patient consulted his physician with the classical symptoms of the ‘sick sinus syndrome’ (SSS): dizziness, confusion, fatigue, and syncope. The diagnosis of a bradycardic sinus node dysfunction was confirmed by a cardiologist. According to the current guidelines for SSS disease, an anti-bradycardia pacemaker was implanted [7][8]. After the healing-in period, the patient made a full recovery.

Due to a worsening of his medical situation, the patient was admitted to hospital, 8 weeks prior to his death. A cardiac decompensation with a global cardiac insufficiency was diagnosed. The ECG showed no PM pulses, the heart rate was 40bpm. The patient was hospitalised for the last 8 weeks of his life. During this hospital stay attempts were made to treat his medical condition by sole use of anti-hypertensive drugs. In the death certificate, the primary cause of death was stated as ‘cardiac decompensation’ (fig.: 1§3).

An autopsy was performed by the resident pathologist. The pacemaker generator was left totally untouched in its place above the pectoralis muscle. During the required second post-mortem examination before cremation the pacemaker was explanted and anal-
4.1 Autopsy Results

At autopsy the following findings and diagnosis were stated by the investigating pathologist: High degree of atherosclerosis in the aorta as well as in the main arteries, with atherosclerotic plaques and ulcerated plots. Severe sclerosis of the coronary arteries with numerous atheromatous plaques some of which showed signs of calcification.

A 1 cm long stent was located in the arterial wall of the proximal section of the RIVA. Severe hypertrophy of the right ventricle.

The posterior papillary muscle showed signs of fibrosis. The scar of an old myocardial infarction, 1.5 cm in diameter, was located in the posterior wall of the left ventricle.

Histological examination confirmed the old myocardial scars, no signs of fresh myocardial infarction could be found. The lung exhibited widespread fibrosis with numerous tight clusters of asbestos bodies coated with beaded or highly segmented bulbous macrophages.

In the pathologist’s report a right ventricular decompensation was stated as the cause of death, based on the dilatation of the right heart and the significant fibrosis of the lung.

The pathologist’s diagnosis was not documented in the death certificate, as required by law.

4.2 Technical Examination

After explantation and securing of the electrodes the pacemaker was checked using the telemetric programmer.

The internal clock of most PMs is a free running counter, set to the time and date of the programmer at the beginning of every telemetric interrogation. With the internal clock of the programmers being nothing but the standard computer clock [9]—known for their notorious inaccuracy, commonly in the range of up to ±15 sec/day being equal to ±7.5 min/month [10]—large time-differences between the internal clock and the real-world time can accumulate. A further complication is due to the daylight-saving time, which is not handled in a standardized way and can result in abrupt 1h time-differences, when the internal clock is corrected.

Thus, special attention has to be paid to the time-difference, as it is only available at the beginning of a telemetric session and will be lost after the correction of the internal clock’s time. Only the time and date of the internal PM clock is changed—the time/date-stamp of the internally stored data is not changed accordingly [11]!

The observed time-difference was a couple of minutes, only.

All the acquired data were printed using the programmer to aid further study. The status report, termed ‘Programmed Parameter Summary Report’ is shown in figure 2.

The examined pacemaker—a Biotronik Dromos SR—has neither an arrhythmia detection function nor provisions for recording long-term EMGs. The only information provided is the battery depletion level as well as the electrode status (fig.: 3). The battery status was classified as EOL, i.e. depleted, by the telemetry data.

Thus, the presumed cause of death—a syncope with asystole—could not be proven by examination of the telemetric pacemaker data.
The electric measurements of the pacemaker’s output signal resulted in a voltage value different from the programmed one (0.5 V at 10 MΩ vs. 2.4 V at 3 kΩ), whereas the frequency was still at the programmed 60 ppm.

By use of a diamond-bladed saw, the titanium casing of the pacemaker was opened and a new lithium battery was connected (fig.: 4). After this procedure, the PM functioned flawlessly, pointing towards the depleted battery as sole cause of malfunction.

4.3 Assessment

The battery of the pacemaker was depleted just 4 years after implantation. It seems very probable that the pacemaker was non-functional on admission to the hospital 8 weeks before the patient’s death. Thus, the lack of pacing would be the cause of the global heart insufficiency.

The medical staff of the hospital overlooked the old pacemaker due to an unfortunate chain of events: The initial examination was performed by a junior student, there were no PM pulses in the ECG, the intern did not attend the x-ray demonstration, the radiologist did not mention the PM in his diagnosis.

The patient was still suffering from the sick sinus syndrome and therefore needed the pacemaker to treat his bradycardia. The cardiac decompensation, which incidentally led to the global insufficiency, was a result of the bradycardia. Even using the most modern anti-hypertensive medication, a cardial recompensational mechanism could not be achieved. Implantation of an anti-bradicardia pacemaker is the treatment of choice for sick sinus syndrome [7][8]. An exchange of the pacemaker generator with its depleted battery for a new one would have cured the patient, even when taking into account the fibrosis of the patient’s lung.

The failure of the pacemaker is the most probable cause of death; the death should have been classified as ‘not natural’.

5 Conclusion

The case presented shows, that the cause of death was not correctly stated even though a detailed history was taken, and a clinical examination as well as an autopsy was performed—the pathologist didn’t care for the pacemaker at all.

A telemetric examination of the pacemaker would have exposed the view to the depleted battery and its role in the patient’s death. Thus, one has to state that, in patients with an implanted pacemaker, an assessment of the cause of death has to include an examination of the PM’s role in the death. This examination is a necessary means of quality assurance and has to include an analysis of the telemetrically accessible PM-data as well as a full autopsy, with careful investigation of the PM system.
References


