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A Vertebral Fracture During Cardioversion for Atrial Fibrillation: A Case Report and Revision of the Literature

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Learning Point of the Article:

Vertebral fracture is a rare but possible complication during ECV for AF.

Abstract

Introduction: Cardioversion for atrial fibrillation (AF) is considered a well-known and safe procedure. However, there are potential complications described associated to this procedure. Bone sequalae or fractures are not cited in consent forms neither in Italy nor in the United States. Nevertheless, cases of vertebral fractures have been reported after multiple defibrillations for ventricular tachycardia and all these cases involved relatively young patients.

Case Report: We present the case of a 44-year-old Caucasian male patient with no comorbidities who underwent cardioversion to restore sinus rhythm from AF. The patient complained of acute dorsal back pain immediately after the cardioversion procedure. The patient informed the cardiologist about the back pain, but no clear explanation for the symptom was provided. Three weeks later, the patient underwent a magnetic resonance and was subsequently diagnosed with a cardioversion procedure-related sixth thoracic (T6) vertebral body fracture.

Conclusion: Vertebral compression fracture should be included in the differential diagnoses for severe back pain after cardioversion procedures. Investigation with standard X-ray or, in doubt, with a magnetic resonance imaging of the painful segment is advisable. In addition, this possible complication should be considered in the informed cardiological consent for the cardioversion procedure even though extremely rare.

Keywords: Vertebral fracture, electrical cardioversion, atrial fibrillation, acute back pain.

Introduction

Electrical cardioversion (ECV) has been extensively used to treat patients affected by supraventricular and ventricular tachycardia since its first application in 1959. This procedure presents a low, but not negligible risk of complications. Systemic thromboembolism, hypotension, bradyarrhythmias, life-threatening ventricular tachycardia, major bleeding, and pulmonary edema can occur in patients undergoing elective or urgent ECV [1-3]. Notably, bone injuries or fracture-related sequelae are routinely not considered in differential diagnosis in patients presenting with back pain after cardioversion. This oversight may contribute to inadequate assessment and management of these conditions. Furthermore, this latter complication is not cited in consent forms neither in Italy nor in the United States, despite a few cases of vertebral fractures are reported in literature.

Case Report

We report the case of a 44-year-old Caucasian male patient (187

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Figure 1: Sagittal view of the dorsal spine on T1 weighted MRI sequence. MRI T1 weighted. Sagittal view of dorsal spine. Aquired three weeks after discharge from the hospital.

Figure 2: Sagittal view of the dorsal spine on T2 weighted MRI sequence. MRI T2 weighted. Sagittal view of dorsal spine. Aquired three weeks after discharge from the hospital.

cm height, 78 kg weight) without any significant medical history presented to the Emergency Department complaining about palpitations and dyspnea. Electrocardiography showed the presence of high-rate AF without hemodynamic impairment. Blood examinations were performed at admission: aspartate and alanine aminotransferase, creatine, bilirubin, potassium, sodium, amylase, lipase, C reactive protein, leukocytes, hemoglobin, and platelet levels were within limits (Table 1).

An initial rate control approach with beta intravenous metoprolol was performed and the patient was admitted to the Cardiology Department. He underwent transthoracic and transesophageal echocardiography that excluded the presence of major cardiac structural abnormalities or intracavitary thrombosis. Thereafter, the cardiologist planned and performed an ECV by use of a single biphasic 100 J direct current (DC) shock with anteroposterior leads position after appropriate sedation (intravenous five mg midazolam bolus).

The patient complained of acute back pain just after the first cardioversion procedure. Pain was partially responsive to standard painkillers and worsened in standing position with partial bilateral thoracic irradiation. Regarding the pain progression, the patient began experiencing rachialgia immediately after recovery from anesthesia on the day of the first procedure; this pain persisted and worsened following the second and third cardioversions, which were associated with two cardiac ablations performed in the following days. The patient was discharged from the hospital after the third cardioversion with complete resolution of the AF and no evidence of procedure-related complications.

Persisting the dorsal pain after hospital discharge, the general practitioner prescribed a magnetic resonance imaging (MRI) of the painful thoracic spine. Three weeks after discharge, MRI revealed a T6 (sixth thoracic) vertebral body fracture (Figs. 1-3). Given the timing between the cardioversion procedure and the onset of pain, the fracture was considered a post-cardioversion procedure complication. It was a wedge-shaped fracture with superior endplate major involvement and bone edema. No posterior vertebral body wall interruption occurred and the patient was completely free from neurological symptoms.

Treatment with bisphosphonates and cholecalciferol supplements was initiated. After 3 months of conservative treatment, the pain disappeared, leaving a temporary residual paravertebral muscular contracture. The patient is a non-smoker with no bone disorders, aside from slight osteopenia observed in computerized bone mineralometry, and no previous history of spine fractures or back pain. He was not on any medication before AF. His past medical history includes fractures from significant trauma (nasal septum, cheekbone, third finger of the hand) and cervical radiculopathy 20 years ago, which had resolved. Furthermore, he has previously not experienced any back pain. No falls or trauma were reported during the hospital stay.

Discussion

The patient of this case report was treated for AF by use of a single biphasic 100 J DC shock and began to experience thoracic rachialgia just after the first cardioversion procedure. After 3 weeks of persisting pain, MRI revealed a T6 vertebral fracture. Since ECV was the only anamnestic feature that could be potentially correlated, we hypothesized an association between the vertebral fracture and a massive muscular contracture induced by the ECV that was performed on the patient three weeks earlier.

DC cardioversion shock can be delivered by monophasic or biphasic current. The shock can be synchronized with the peak of the QRS complex (synchronized cardioversion) in case of supraventricular arrhythmias or stable ventricular tachycardia.

Figure 3: Sagittal view of the dorsal spine on T2 weighted MRI sequence. MRI T2 weighted. Sagittal view of dorsal spine. Aquired three weeks after discharge from the hospital.

Blood examination	Levels	Reference range
AST, U/L	17.0	2.0–45.0
ALT, U/L	16.0	2.0–35.0
Total bilirubin, mg/dL	0.74	0.5–1.2
Potassium, mmol/L	4.1	3.5–5.2
Sodium, mmol/L	143	136.0–146.0
CRP, mg/dL	<0.1	0.0–0.5
Lipase, U/L	30.0	21.0–67.0
Amylase, U/L	37.0	<100.0
Leukocytes, (n/10^{9}L)	9.5	4.0–10.0
Hemoglobin, g/dL	16.7	13.2–17.3
Platelets, (n/10^{9}L)	335.0	140.0–440.0

AST: Aspartate aminotransferase; ALT: Alanine aminotransferase, CRP: C reactive protein

Table 1: Blood test upon emergency department admission.

In case of non-synchronized DC shock, the procedure is defined as electrical defibrillation. Many studies demonstrated that biphasic shock waveforms presented a more favorable efficacy and safety profile compared to monophasic shock [4-6]. ECV can be performed by positioning the electrical pads in anteroposterior or anterolateral position [7,8]. The use of anteroposterior electrode position has been associated with higher rates of successful ECV in the literature [9]. Overall, cardioversion is considered a safe procedure. However, some complications are described and should be explained to the patients through a consent form. Notably, sequelae related to bone injuries or fractures are not taken into account in differential diagnosis in patients presenting with back pain after cardioversion and are not cited in consent forms neither in Italy nor in the United States.

The occurrence of a thoracolumbar compression fracture in a cardioverted otherwise healthy patient, with no predisposing factor for bone weakness, is documented in literature in only two complete and accessible case reports described by Koda in 2020 and Wilsmore in 2018. In his case, Koda reported that a single 200 J DC shock was performed with pads placed on anteroposterior sites in order to treat AF with elevated ventricular rate [10]. In the other report, Wilsmore documented the administration of a single biphasic shock during ECV for AF [11]. Cases of vertebral fractures were also reported in a different clinical context that is multiple defibrillations for ventricular tachycardia [12,13]. All these cases involved relatively young patients without any major orthopedic or systemic risk factor for spontaneous bone fractures. Moreover, this rare complication occurs both after monophasic and biphasic shocks and it appears to have no relation with the energy applied during the shock.

Few case reports in literature describe fractures involving upper limbs (more common) and lower limbs caused by electrical discharge [14-17]; this mechanism is typical in HV (high voltage) electric shock because more likely to happen [18], although fractures caused by LV (low voltage) are described [19]. In a not therapeutic case report, vertebral fracture has been related to the electric weapon used by police enforcement [20]. Few case reports regarding fractures associated to electric shock exist in literature, although they are not fully accessible [21-23]. Many authors describe the mechanism as a prolonged and uncontrolled contracture of muscles that leads to the compression fracture, mainly in fragile (e.g., children) and osteoporotic patients. Moreover, there is the evidence that tetanic muscle spasm in seizures can cause fractures. Other known complications in seizures or electric shocks are glenohumeral dislocation, even bilateral. The spastic reflex induced by electric energy during cardioversion may account for superior vertebral endplate fracture with anterior wedging and posterior wall integrity, that is the significant finding in Koda's and Wilsmore's case reports as well as in our patient. The flexion contracture mechanism acts on the anterior wall of the vertebra; differently from the well-known mechanism of axial

compression occurring when the force of impact is vertical along the axis of the spine, as in a fall onto the feet or buttocks.

The risk of fracture depends on voltage amplitude and frailty of the patients, nevertheless a low voltage energy can cause fracture in young and healthy patients. Our case and what reported in the literature suggest that a post-procedure X-ray should be considered in all patients with back pain who have undergone a cardioversion procedure. If the X-ray is negative for fracture, an MRI should be prescribed if the patient continues to complain of back pain. Neurological involvement must be ruled out since has been reported in literature, even though extremely rare [10].

Regarding patient's information, existing the possibility of such complications, it should be taken into account in the informed consent for cardioversion even though extremely rare.

Conclusion

Vertebral compression fracture is a rare yet possible complication after ECV. The risk of fracture depends on the voltage amplitude and frailty of the patients. Nevertheless, a low voltage energy can cause a vertebral fracture even in young and healthy patients. Furthermore, even though very rare, vertebral fracture should be taken into account as a consequence of cardioversion for AF. This leads to the consideration that an X-ray in patients with back pain who have undergone cardioversion is advisable. Vertebral compression fracture should be included in the differential diagnoses for severe back pain after cardioversion procedures. In such cases, the patient should be investigated with a standard X-ray or, in doubt, with an MRI of the painful segment. In addition, this possible complication should be considered in the informed cardiological consent for the cardioversion procedure even though extremely rare.

Clinical Message

In the case of acute back pain after cardioversion procedure, the patient should be studied with a standard X-ray and, in the doubt, an MRI for detecting a very rare but possible vertebral compression body fracture. Such complication should be considered and mentioned in the informed cardiological consent for cardioversion.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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