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BCS Editorial

Early repolarisation – benign or early sign?

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Take Home Messages

- Early repolarisation pattern is a term describing J point elevation with slurring or notching.
- This pattern has been related to mildly increased risk of ventricular arrhythmias and sudden cardiac death.
- Early repolarisation syndrome can be diagnosed in patients with early repolarisation pattern on ECG with previous history of VF or sudden cardiac death.
- High risk features include changes seen in multiple leads, descending ST segments and J point elevation ≥ 2mm.
- Asymptomatic patients incidentally found to have early repolarisation pattern do not routinely require further investigation.

Introduction

Early repolarisation is a commonly seen ECG pattern, reported in 13% of population (1). According to the Heart Rhythm Society and European Heart Rhythm Association 2013 consensus paper (2), early repolarisation pattern (ERP) can be diagnosed if at least 1mm J point elevation can be seen in at least two contiguous inferior and/or lateral leads. J waves were first noticed during hypothermia and are commonly known as Osborn waves. They were then noted in young, fit people and were considered a juvenile pattern.

It was regarded a benign finding until a study by Haissaguerre (3) reported increased prevalence of ERP in patients with a history of idiopathic VF compared to the healthy population. This study started a debate on whether the commonly seen pattern meant increased risk of sudden cardiac death.

The presence of the J wave has been shown to increase the probability of VF from 3.4 in 100,000 to 11 in 100,000 (4). The fact that a commonly seen ECG variant may, however infrequently, correlate with potentially fatal consequences poses a significant dilemma.

The question has proven difficult to answer with some studies confirming Haissaguerre's finding but others failing to link ERP to increased arrhythmic risk (5-9).

About the author

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Definition of Early Repolarisation

One of the potential problems in ascertaining the risk associated with early repolarisation was the inconsistency in what is described as ERP. Some studies focused on ST segment changes and some on the J point. A 2015 consensus paper recently defined early repolarisation - the criteria moved away from the ST elevation and focused on the J point and the terminal part of the QRS. It was clarified that ST elevation without a slur or notch should not be termed early repolarisation (10). ECG changes in asymptomatic patients is described as ERP but patients with a history of VF or sudden cardiac death should be diagnosed as early repolarisation syndrome (**Figure 1**).

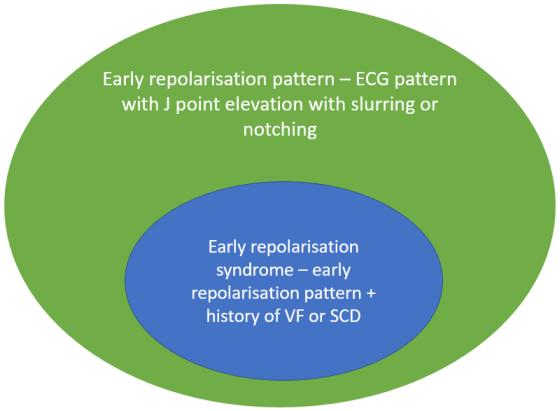

Figure 1. Definition of early repolarisation pattern and early repolarisation syndrome. Image produced by M Klis.
ECG = electrocardiogram; SCD = sudden cardiac death; VF = ventricular fibrillation.

Considering the difference between the reported high prevalence of ERP and the incidence of polymorphic VT and VF, ERP is likely a risk marker and not a diagnosis. This poses a question – is it possible to diagnose early repolarisation syndrome before arrhythmic events occur?

Types of ERP

In an attempt to answer this, three different patterns of ERP have been described (11). Type 1 is seen in lateral leads only and is the most benign pattern most commonly seen in young athletes. Type 2 affects both lateral and inferolateral leads and is associated with moderate risk. Type 3 is widespread and poses the highest risk of arrhythmic events.

Tikkanen *et al.* (12) divided patients with ERP pattern depending on the shape of the ST segment. Ascending ST segment was found to be benign but down sloping or horizontal ST segment was associated with increased risk (**Figure 2**). The Shanghai Score System has been proposed to diagnose early repolarisation syndrome based on ECG and history to identify high risk patients (**Figure 3**) (13).

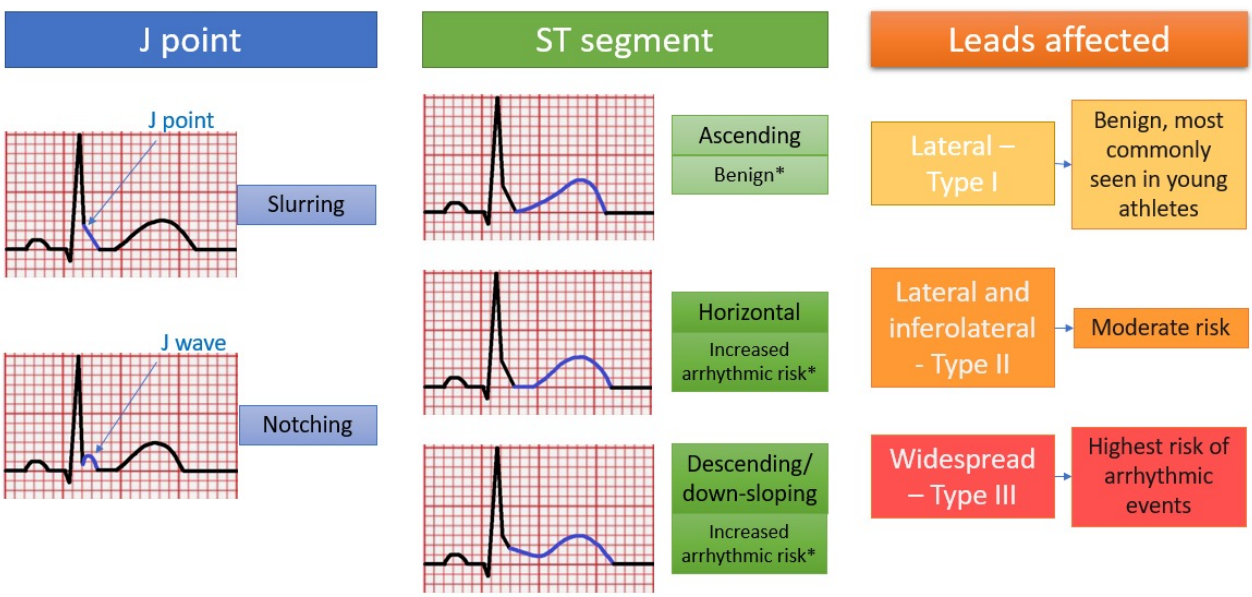

Figure 2. Patterns of J point and ST segment elevation in early repolarisation pattern (12). Image produced by M Klis.

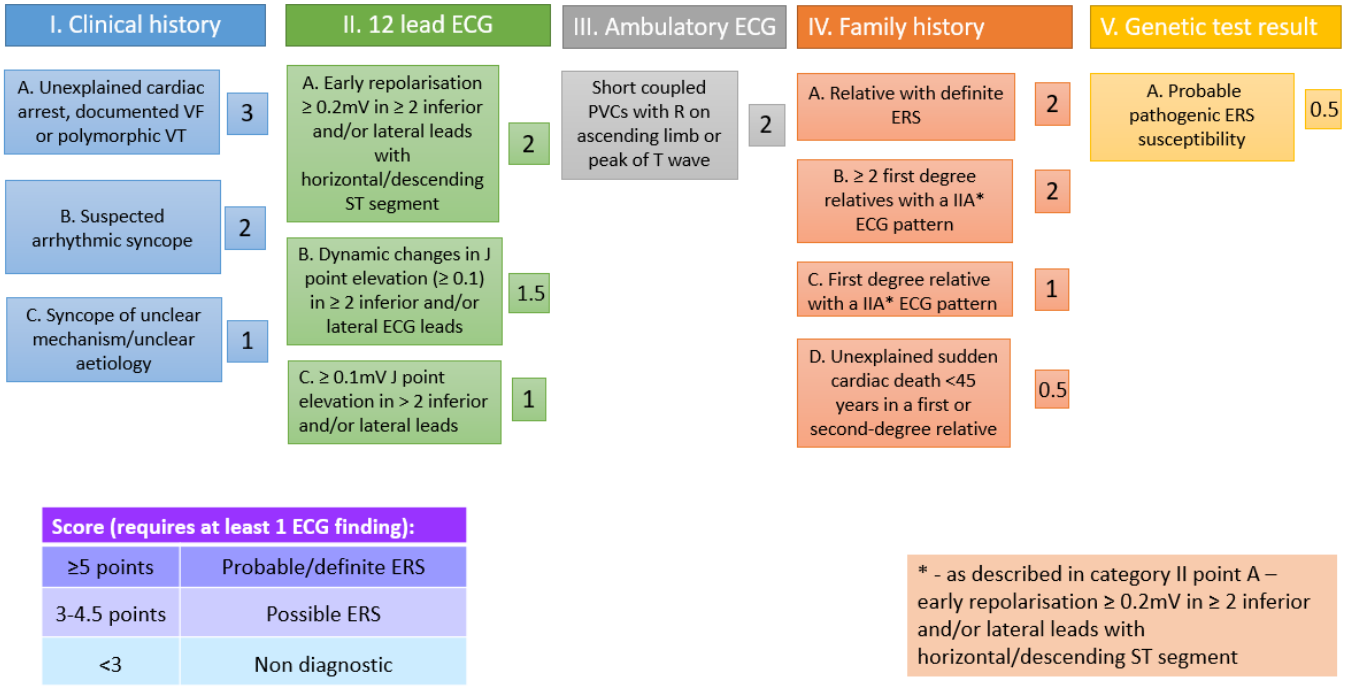

Figure 3. Shanghai score system for diagnosis of early repolarisation syndrome (13). Image produced by M Klis.
ECG = electrocardiogram; ERS = early repolarisation syndrome; VF = ventricular fibrillation; VT = ventricular tachycardia.

Pathophysiology of early repolarisation

Some of the difficulty with stratifying the risk is related to the fact that the pathophysiology of ERP is not well understood. The most supported hypothesis states that J point elevation is caused by dispersion of repolarisation. I_{to} and I_{KATP} potassium channels are more abundant in the epicardium than in the endocardium. Genetic channel mutations, vagotonia and hormonal changes may lead to the outward potassium current mediated by those channels outweighing the inward I_{Na} and I_{CaL} currents in the endocardium. This results in a net repolarising outward current, resulting in the J point elevation on surface ECG (**Figure 4**). Dispersion of repolarisation leads to phase 2 reentry arrhythmias. The hypothesis of testosterone influence over the I_{to} channels explains why this pattern is commonly seen in men in their early 30s. Due to the long recovery time of I_{to} channels, J point changes tend to be more pronounced during bradycardia and therefore most arrhythmias occur at rest or during sleep (14).

Even though pathogenic mutations can currently be found only in a minority of cases there is a significantly increased risk of ERP in offspring of patients with early repolarisation syndrome (15, 16).

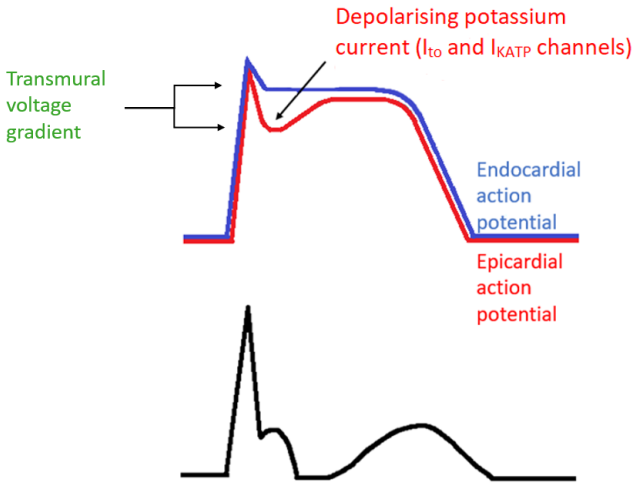

Figure 4. Dispersion of repolarisation between epi- and endocardium causing J wave on the surface ECG. Image adapted from (13).

ERP in athletes

Both ST elevation and ERP are more commonly seen in athletes, particularly male, of black ethnicity and with slower resting heart rates. It most commonly causes ascending ST changes in lateral leads but can also include descending ST segment changes in inferior leads. The ECG changes become more pronounced with exercise regardless of the leads affected but develop independent of the development of athlete's heart on echocardiography.

There is no evidence to suggest that those changes are associated with increased risk in athletes (17). Most of those changes resolve on exercise and/or with ajmaline administration. Patients in whom ERP persists have downsloping ST segment in inferior leads and are more likely to have had history of unexplained syncope which may suggest higher arrhythmic risk (18).

Management of patients with ERP

Due to lack of convincing data about prognosis in asymptomatic patients with ERP at present ICD implantation is only indicated in patients who have suffered a cardiac arrest. Current ESC guidelines on management of patients with ERP is summarised in **Figure 5** (19). It is worth noting that the incidental finding of ERP on an ECG does not require further investigations.

Conclusions

ERP should only be used in relation to J point elevation associated with slurring or notching of the terminal part of the QRS. ST elevation without those changes should not be described as ERP. ERP has been connected to mildly increased risk of ventricular arrhythmias and sudden cardiac death however, according to the most recent expert consensus asymptomatic patients do not require further investigations.

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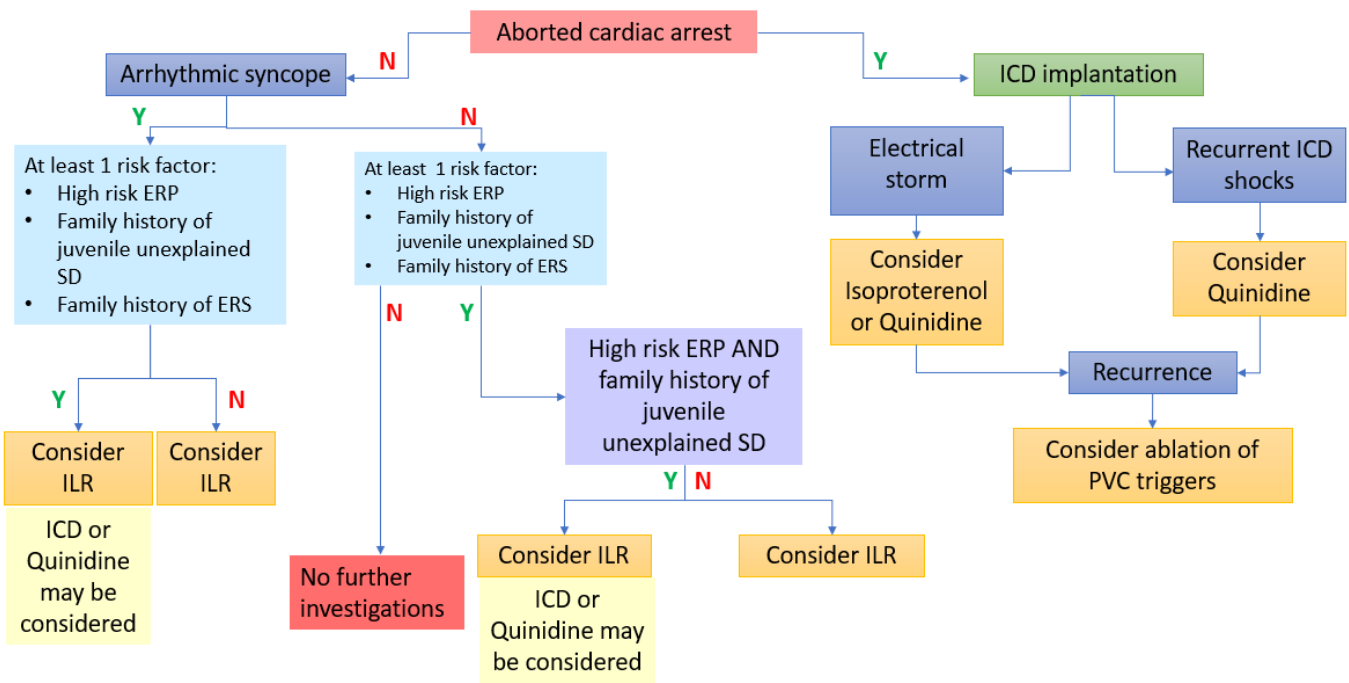

Figure 4. Summary of ESC guidelines on management of patients with ERP. Image adapted from (19).
ERP = early repolarisation pattern; ICD = implantable cardioverter defibrillator; ILR = implantable loop recorder; PVC = premature ventricular complexes; SD = sudden death.

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