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The electrocardiograph (ECG) in a first seizure clinic

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Summary An electrocardiograph (ECG) is recommended as an investigation in all patients with seizures or suspected seizures. However the incidence of abnormal ECGs in patients presenting to the first seizure clinic is unknown. This study examines 161 patients in a first seizure clinic and describes the ECG abnormalities found. Although 17 patients were found to have abnormal ECGs only one was found to have significant cardiac disease. We conclude that serious ECG abnormalities are rare but other abnormalities are common and that close cooperation between cardiology and neurology is important.

Introduction

The diagnosis of epilepsy is not always easy and misdiagnosis is common.[1] Diagnosis of a single episode of loss of consciousness may be even more difficult. Cardiac arrhythmias and vasovagal syncope may present with seizure-like episodes. In the UK, NICE (National Institute for Clinical Excellence) and SIGN (Scottish Intercollegiate Guidelines Network) guidance therefore recommend that a standard 12-lead electrocardiograph (ECG) should be done in all patients presenting with a suspected seizure,[2,3] even though a recent review failed to mention this.[4] The incidence of abnormal ECGs in patients presenting to a first seizure clinic is unknown.

Aims, methods and participants

To establish the incidence and relevance of abnormal ECGs in a first seizure clinic, we did a retrospective review of our first seizure clinic patients. This is a one-stop clinic serving adults (i.e. only patients over 16 years of age) in a population of 400,000 in North East England. This clinic receives referrals from a variety of sources including emergency departments, general practitioners

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Table 1 Diagnoses of new patients seen in the first seizure clinic

Diagnosis	Number
Seizure	60
Simple faint	20
Convulsive syncope as part of a simple faint	17
Convulsive syncope as part of LOC/likely to be syncope	9
Unwitnessed LOC likely to be syncope[a]	13
Unwitnessed LOC with seizure markers[b]	14
Uncertain (LOC with no clinical pointers)	16
Other	12
TOTAL	161

The above subclassifications are made according to the United Kingdom's Driver and Vehicle Licensing Agency (DVLA) guidelines.[5] LOC = loss of consciousness.

[a] Unwitnessed patients are thought to have had syncope, if history includes typical prodrome of syncope.[6]

[b] Seizure markers include tongue biting, urinary incontinence, post-ictal confusion.

and hospital physicians, of patients thought to have had a seizure, including those in whom there may be uncertainty about the diagnosis of a seizure.

Guidelines for the clinic include recording of an ECG (electrocardiograph) in all new patients suspected of having had their first epileptic seizure. ECGs are done as a one-off 12-lead recording at first presentation, i.e. when presenting with loss of consciousness to the local hospital or when first seen in our clinic. The ECGs are recorded and reported using a computer-based system.

Patients thought to have significantly abnormal ECGs have their presentation and investigations reviewed by a cardiologist and additional cardiac investigations arranged as required e.g. a prolonged ECG recording (24 h tape or implantable loop recorder), echocardiogram, tilt test or exercise test. The case notes of all consecutive new referrals from June 2002 to March 2003 were reviewed and any subsequent cardiac history noted.

For the purposes of this study we have used the diagnostic categories according to criteria set out by the United Kingdom's Driver and Vehicle Licensing Agency (DVLA). This was chosen for pragmatic reasons because in the United Kingdom the treating clinicians are required to respond to enquiries from the DVLA following an episode of loss of consciousness, choosing one of these diagnostic categories as their final diagnosis.

Results

One hundred and sixty one new referrals were seen in the first seizure clinic with the diagnosis classified as below (Table 1).

The mean age of patients seen was 33 years (range 16—79). The vast majority of patients were healthy young people with no other significant comorbidities. One hundred and thirty one (81%) of these patients had a 12-lead ECG done, at first presentation either in the local hospital and/or in our clinic.

Seventeen of these ECGs were judged to be significantly abnormal. The ECG abnormalities seen

Table 2 Significant ECG abnormality correlated with initial diagnosis and subsequent cardiac investigation

ECG abnormality	*n*	Consultant neurologist diagnosis	*N*	
Long QTc interval (>430 ms)	3	Seizure	2	(a), (a)
		Uncertain	1	(d)
Unexplained bradycardia (rate <60)	4	Seizure	2	
		Convulsive syncope	1	(a), (b), (c), (e)
		Unwitnessed LOC with seizure markers	1	
Short PR interval (PR ≤100 ms)	2	Seizure	1	
		Convulsive syncope	1	
Left axis deviation	2	Uncertain	1	(a)
		Simple faint	1	
Q waves	2	Seizure	1	
		Convulsive syncope	1	
Left ventricular hypertrophy	1	Unwitnessed LOC with seizure markers	1	(a)
Inverted P waves	1	Unwitnessed LOC likely to be syncope	1	(a)
Non-specific ST/T wave abnormalities	2	Seizure	2	(c)
Total	17	Total	17	

(a) Echocardiogram, (b) 24 h tape, (c) tilt test, (d) implantable loop recorder, (e) exercise test. LOC = loss of consciousness.

were long QTc interval (>430 ms), short PR interval (≤100 ms), left axis deviation, Q waves, left ventricular hypertrophy, inverted P waves, non-specific ST/T wave abnormalities, and unexplained bradycardia. A patient is classified as having an unexplained bradycardia from the 12-lead ECG taken at presentation and/or in our clinic, if there is no reason to account for a heart rate of <60, e.g. medications. Table 2 shows the ECG abnormalities seen correlated with the initial diagnosis and subsequent investigation.

The mean age of the 17 patients with abnormal ECGs was 44 years (range 18—79). Only two of these had abnormalities that could be predicted from their medical history (the two patients with Q waves were known to have ischaemic heart disease).

Only one patient required further cardiological treatment, a 79-year-old patient in whom the diagnosis was felt to be "uncertain" and whose initial ECG showed left axis deviation (LAD), presented again a year later with a further collapse and was then found to be in complete heart block.

Discussion

Referrals to first seizures clinics contain a heterogeneous mix of patients. Differentiation of seizures from convulsive syncope and other causes of loss of consciousness can be difficult and many patients referred with "first seizures" have not had a seizure. A number of features may help distinguish syncope from seizures, including previous lightheaded spells, sweating before loss of consciousness, and association with prolonged sitting or standing.[6] Helpful features to indicate syncope secondary to other causes as opposed to vasovagal syncope include the presence of bifascicular block, asystole, supraventricular tachycardia, diabetes, blue colour noted by bystander, age of first syncope ≥35 years, and that the patient remembers something about the event.[7] Physicians who run first seizure clinics need to be skilled in the investigation and management of conditions included in the differential diagnosis of a first seizure, of which syncope in its various forms is the most common.

An ECG in patients presenting with "a seizure" can demonstrate important abnormalities such as heart block, long QT interval and Brugada Syndrome. Failure to recognise these may result in the [avoidable] sudden death of the patient. However, the incidence of ECG abnormalities and their significance in a first seizure clinic population is unknown.

We found abnormal ECGs in a significant number (17/131 = 13%) of patients presenting to our first seizure clinic but further cardiological investigations of these patients found no evidence of significant cardiac disease. Three patients were found to have long QTc. In one this could be explained by a metabolic abnormality (idiopathic hypocalcaemia), in a second the QTc had reverted to normal in subsequent ECGs and in the third it was probably related to medication. Unexplained bradycardia (<60 beats per minute, bpm) was found in four patients. Two were thought to have had a seizure, one related to substance abuse, the other following a head injury; in the third further cardiological investigations were normal and there was no recurrence of symptoms during two years of follow up. The fourth patient failed to attend for follow up.

The significance of abnormalities such as left axis deviation or short PR interval is less clear. In this series, these were not felt to be relevant to the episode of loss of consciousness. Further cardiological investigations in these patients did not uncover significant cardiac disease or change their management *at the time of investigation* but one patient with left axis deviation in his first ECG had a further episode of loss of consciousness one year later and was then found to be in complete heart block. This was the oldest patient in our group. Our clinic sees predominately young adults; other clinics with an older population would probably have an even higher incidence of abnormal ECGs.

A normal 12-lead ECG does not exclude a cardiac cause for collapse. Many (39 out of 46) of our patients with syncope had a normal ECG. One of our patients with a normal 12-lead ECG but repeated episodes of convulsive syncope subsequently had a tilt test showing cardioinhibitory syncope with asystole of 12 s.

A 12-lead ECG is a low-cost test and can detect clinically significant abnormalities such as long QTc interval or heart block. Doing an ECG in all patients presenting to a first seizure clinic will, inevitably, pick up non-specific abnormalities which require further investigation as demonstrated by this series. Moreover, a normal 12-lead ECG does not exclude a cardiovascular cause for collapse and for those in whom a cardiac cause is still suspected despite a normal ECG, referral to a cardiologist is advisable.

First seizure clinics are usually run by neurologists, and, as can be seen from the list of diagnoses given above, the population of patients includes a heterogeneous group of patients with loss of consciousness. From our experience and that of others, it is evident that a close link with a cardiologist is an important component of any first seizure service. Indeed it could be argued that cardiologists and neurologists should work together to provide a "first

seizure/blackout'' service given the overlap between the two disciplines in this area.

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