Aborted sudden death in a young male

Q1: What is the ECG (fig 1; p 660) diagnosis? Why is it important to recognise this condition?

The ECG done on his arrival at the emergency room (see questions) shows (i) sinus tachycardia, (ii) a QRS complex that ends with a positive deflection (or prominent J wave) that is, a rsR' pattern in V1 and V2, and (iii) an elevated downsloping ST segment ending in a small negative T-wave deflection. This ECG pattern in someone with a history of syncopy and documented ventricular fibrillation/aborted sudden death, is most consistent with the eponymous Brugada syndrome. Described first in 1992 by Brugada and Brugada, Brugada syndrome is an inherited arrhythmogenic disease, which may presease ventricular fibrillation and sudden cardiac death.\(^1\)

The Gussak diagnostic criteria\(^1\) for Brugada syndrome are shown in Box 1. One must be aware that ST elevation in the right praeorcal ECG leads occurs in a variety of clinical conditions, as shown in Box 2, and hence clinical correlation with diligent characterisation of the ECG is mandatory before a diagnosis of Brugada syndrome is made.\(^2\)

Brugada syndrome is a recognised cause of sudden cardiac death, and hence the need for prompt recognition and treatment. Every year in the United States alone, there are about 300 000 new cases of sudden death due to cardiac arrest. Altogether 3%–9% out-of-hospital cases of ventricular fibrillation, unrelated to myocardial infarction, occur in those with minimal or no structural heart disease.\(^3\) Such cases may include those with Brugada syndrome, congenital and acquired long QT syndromes, pre-excitation states such as Wolff-Parkinson-White syndrome, and cases where no ready cause is apparent (so called "idiopathic" ventricular fibrillation). Though seen worldwide, Brugada syndrome is endemic in Southeast Asia and Japan, where it is known as sudden unexplained death syndrome and sudden unexplained nocturnal death syndrome, and the incidence has been estimated to range between five and 66 events per 100 000 people.\(^4\) In some countries, the prevalence of Brugada-type ECG changes among those who were diagnosed with "idiopathic ventricular fibrillation", has been estimated to be as high as 40%–60%.\(^5\) Studies quote an incidence of sudden cardiac death varying between 44%–62% in those with Brugada-type ECG and history of aborted sudden death/syncopy.\(^6\) Considerable variation exists in the clinical presentation, and several "forms" of Brugada syndrome have been described: manifest, concealed, asymptomatic, suspected, and simulated.\(^4\) Brugada syndrome affects males preferentially, and the mean age of those affected tends to be in the mid to late thirties. Clinical manifestations of Brugada syndrome are attributed exclusively to the malignant ventricular arrhythmias that occur in this condition. Tragically, sudden death may be the first and only clinical event. These arrhythmias often occur at rest, and in some at night-time, high sympathetic tone, anxiety, and alcohol consumption have all been proposed as possible provocative factors.\(^7\)

Q2: What is the pathophysiological basis of this condition? What further diagnostic tests would you consider doing in this patient?

Genetic studies have shown that Brugada syndrome and chromosome 3-linked long QT syndrome (LQT3) are allelic disorders of the cardiac channel gene (SCN5A, 3p21). The inheritance is autosomal dominant with variable penetrance. The SCN5A gene codes for the alpha subunit of the sodium channel. Mutations of this gene results in abnormalities of the sodium channel, with abnormal ion conductance patterns and can be demonstrated in up to 25% Brugada syndrome cases.\(^1\) Brugada-type downsloping ST segment is a normal feature of the ECG in some rodents, whereas in higher mammals, the ST segment is usually isoelectric in the normal state. Figure 1 (below) describes the various phases of the cardiac ventricular action potential. Failure of the plateau phase or "dome" to develop occurs when the transient outward currents, termed I\(_{\text{to}}\) (phases 1 and 3; fig 1) overwhelms the inward current, mainly calcium current termed I\(_{\text{Ca}}\) (phase 2; fig 1). This results in a 40%–70% abbreviation of the action potential in some, but not all epicardial sites (schematically represented by the dotted line in fig 1), resulting in a marked dispersion of repolarisation within the ventricular muscle. This is manifest on the ECG as marked QT-dispersion. Propagation of the dome form sites where it is maintained to sites where it is abolished (fig 2).

Figure 1 Phases of the cardiac ventricular action potential, solid line shows normal ventricular action potential and dotted line shows Brugada-type action potential (schematic).

re-entry can result in local re-excitation, producing closely coupled extrastyles, which in turn may initiate circus movement re-entry.\(^8\) In those cases where the typical ECG changes are evanescent, programmed electrical stimulation (PES) with or without chemical challenge with certain drugs may unmask the ST segment elevation in V1–V3 and right bundle branch block-like pattern in many patients.\(^9\) Sodium channel blockers

Box 1: Gussak’s criteria

- **Major criteria:**
  1. Presence of the ECG marker of Brugada syndrome in patients with structurally normal heart.
  2. Appearance of the ECG marker of Brugada syndrome after administration of sodium channel blocker.

- **Minor criteria:**
  1. Family history of sudden cardiac death.
  2. Syncopy of unknown origin.
  3. Documented episodes of ventricular tachycardia/ventricular fibrillation.
  4. Positive programmed electrocardiosimulation test on ventricular tachycardia/ventricular fibrillation.
  5. Genetic mutations of ion channels (yet to be fully defined).

Box 2: Causes of ST segment elevation in right precordial ECG leads

- Anterior myocardial infarction.
- Right or left bundle branch block.
- Right ventricular infarction.
- Left ventricular aneurysm.
- Exercise test induced.
- Acute myocarditis.
- Dissecting aortic aneurysm.
- Acute pulmonary thromboembolism.
- Right ventricular outflow tract obstruction (tumour, etc).
- Various central and autonomic nervous system disorders.
- Duchenne’s muscular dystrophy.
- Friedrich’s ataxia.
- Hypercalcaemia and hyperkalaemia.
- Heterocyclic antidepressant overdose.
- Cocaine intoxication.
- Thiamine deficiency (beriberi).

Adapted from Gussak et al.\(^1\)
(SCB) such as procainamide, ajmaline and flecainide, β-blockers such as propranolol, α-adrenergic and muscarinic stimulation—may bring out the typical ECG features, and indeed induce ventricular tachyarrhythmia and/or ventricular fibrillation in those with Brugada syndrome. While PES and SCB challenge may be useful in risk stratifying patients with Brugada syndrome, their ability to identify the symptomatic (cardiac arrest, syncope) cases is at best modest (for PES, positive and negative predictive values and overall accuracy 50%, 46% and 49% respectively, for SCB challenge, positive predictive value 35%). A complete workup of a symptomatic patient with Brugada syndrome may also include echocardiography, coronary angiography, stress testing, magnetic resonance imaging, and rarely, myocardial biopsy. This patient underwent PES with procainamide challenge, which resulted in inducing the ventricular tachyarrhythmia. He underwent cardiac catheterisation, which revealed normal coronary artery anatomy and left ventricular function.

Q3: How is this condition treated? What is the prognosis?
For the symptomatic Brugada patients (syncope, aborted sudden death) the treatment of choice is placement of an implantable cardioverter-defibrillator (ICD) device. The incidence of arrhythmic events is similar in patients receiving either an ICD device, β-blocker or amiodarone, but only the ICD device protects patients with Brugada syndrome from sudden death to this date. There is no pharmacological agent that has been shown to confer a survival benefit to patients with Brugada syndrome.

In some countries such as Japan, the incidence of asymptomatic Brugada syndrome cases is very high and far exceeds those with symptoms. In as much as the ICD device prevents death in symptomatic cases, many lives could be potentially saved if we could successfully identify the high risk, asymptomatic patients as well. There is some evidence that asymptomatic patients with Brugada syndrome who have a positive provocative test may benefit by placement of an ICD device. When followed up for over 33 months, 17% of indolent Brugada syndrome patients had an arrhythmic episode compared with 41% in those of the population who were not inducible. As to what constitutes optimal therapy for non-inducible cases of Brugada syndrome, is still unclear and more studies are required to address this question.1

Regardless of the presence or absence of symptoms, the prognosis of Brugada syndrome is poor, with a 10% per year mortality. While no correlation between right bundle branch block and SCD has yet been established in a large population other than those with Brugada syndrome, the magnitude of ST segment elevation has been linked to the incidence of life threatening arrhythmias, especially in Brugada syndrome. Careful attention to the ECG is mandated in every case of aborted sudden cardiac death in order to recognise and treat the patient with the Brugada syndrome.

Final diagnosis
Brugada syndrome.

Acknowledgements
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References

An unusual cause of abdominal pain
Q1: What is the diagnosis and what are the clinical features of this condition?
The underlying diagnosis is tuberous sclerosis. Tuberous sclerosis complex (TSC), described by Bourneville in 1880, is one of the neurocutaneous syndromes. Inheritance is autosomal dominant with spontaneous mutation in 60%. Two loci on chromosomes 9 and 16 produce the phenotype, both encoding proteins with tumour suppressor function. Incidence is estimated as one per 10 000. Diagnostic criteria were reviewed in 1999. Clinical features result from hamartomas affecting various organ systems. Cerebral manifestations occur in up to 95% of patients, which include cortical tubers, subependymal nodules, giant cell astrocytomas, epilepsy (60%), learning difficulties (40%), and autism (40%-45%). Skin involvement (90%-95%) includes facial angiofibroma, hypomelanotic macules, forehead fibrous plaques, Shagreen’s patches, ash leaf spots, and perungual fibromas (fig 1; p 661). Renal involvement includes cysts and angiomylipoma (45%-66%),3 composed of blood vessels, smooth muscle, adipose tissue. Typically they are benign and may be symptomless, though may differentiate to renal cell carcinoma in well under 5% and may occur bilaterally. Renal disease is a leading cause of death in patients with TSC.4 Pulmonary lymphangioleiomyomatosis occurs exclusively in women.5 Retinal phakomas, dental pitting, cardiac rhabdomyomas, gingival fibromas, and rectal polyps are recognised features.6

Q2: What does the computed tomogram of the abdomen (fig 2; p 661) show?
The non-contrast computed tomogram shows grossly abnormal kidneys with enlarged focal areas of fatty change surrounded by streaky material largely replacing the renal tissue. A large uniform soft tissue mass is seen to arise from the anteromedial aspect of the right kidney.

Q3: What do the renal ultrasound scans (figs 3, 4, 5; p 661) show and what is the likely diagnosis?
The initial ultrasound (fig 3; p 661) shows a homogenous 10 cm mass in the mid-lower abdomen. Subsequent scans (fig 4 and 5; p 661) over a six week period show the mass to be reduced in size, with a more loculated irregular echo pattern consistent with resolving haematoma within a large section of angiomylipoma. The diagnosis is spontaneous haemorrhage into a renal angiomylipoma in a patient with tuberous sclerosis. Intrarenal, perirenal, retroperitoneal, and intraperitoneal haemorrhage are well recognised complications of angiomylipoma.7 Bleeding risk increases when they exceed 4 cm in size, and if symptomatic may require intervention with embolisation or nephric sparing surgery.2

Q4: What is the cause of the clotting abnormality?
A normal prothrombin time and prolonged activated partial thromboplastin time which is not reversed when the patients plasma is diluted 1:1 with normal platelet free plasma suggests lupus anticoagulant activity. Anticardiolipin antibodies were subsequently negative in this case, and clotting studies require follow up.

Final diagnosis
Spontaneous haemorrhage into a renal angiomylipoma in a patient with tuberous sclerosis.

References
orthopnoea, a careful search for paradoxical abdominal movement is important.

Fluoroscopic screening of the diaphragms can be set to confirm bilateral paresis and paradoxical movement.

Q2: What is the likely clinical diagnosis. How would you try to establish this?

Bilateral diaphragmatic weakness is most often observed in the context of generalised neurological illnesses affecting muscle (for example, polymyositis or muscular dystrophies), neuromuscular transmission (for example, myasthenia gravis), inflammatory polyneuropathies (for example, Guillain-Barré syndrome), or anterior horn cell disease. However, involvement of the diaphragm in association with the rapid onset of dyspnoea, orthopnoea, and use of accessory muscles of respiration is unusual unless the patient has an underlying disease that directly affects the diaphragm.

The annual incidence is approximately 1.64 per 100 000. The annual incidence is low and in one series only one patient out of 525 patients treated with radioiodine showed an extremely high radioiodine turnover.1110 MBq in view of an isotope uptake study –1110 MBq in view of an isotope uptake study –1110 MBq in view of an isotope uptake study showing an extremely high radioiodine turnover. On this occasion she was hospitalised before the administration of RAI therapy and did not have any associated comorbidity. After recovery from thyroid storm, carbimazole was recommenced five days after RAI therapy and did not have any associated comorbidity. After recovery from thyroid storm, carbimazole was recommenced five days after RAI therapy. Carbimazole was recommenced five days after RAI therapy and did not have any associated comorbidity. After recovery from thyroid storm, carbimazole was recommenced five days after RAI therapy.

The patient had developed thyroid storm secondary to radioiodine therapy. Thyroid storm is a rare, life threatening complication of hyperthyroidism with an incidence of 1%–2% in hospitalised patients with hyperthyroidism, although it has a high mortality of around 15%. The incidence of thyroid storm after RAI treatment is variable because of variations in the regimens of RAI, in patient selection, and in the use of thyrystatic medications before and after RAI. The overall incidence is low and in one series only one patient out of 525 patients treated with 550 MBq RAI developed thyroid storm.7 The risk of thyroid storm after RAI treatment is difficult to predict in an individual patient but appears to be higher in patients with severe hyperthyroidism, in older patients, and in the presence of cardiovascular and cerebrovascular disease.4

Q3: What is the mechanism and what are the criteria for diagnosis of this condition?

The mechanism of thyroid storm is either a reduction in levels of binding proteins or the release of preformed thyroid hormones. Examples of the former include postoperative state or a major systemic illness; the latter is encountered as a result of injury to the follicular cells after RAI treatment or even after vigorous manipulation of the thyroid gland. Other precipitating factors include radiation, diabetic ketoacidosis, toxaemia of pregnancy, and paruiton. Diagnosis is entirely based on typical clinical features in an appropriate setting. Hypertensive manifestations include vomiting, diarrhoea, pyrexia, tachycardia, atrial fibrillation, cardiac failure, and neurological manifestations including agitation, delirium, seizures and coma, although not all classical features are essential for the diagnosis. Suppressed thyroid stimulating hormone and raised thyroid hormone levels support the diagnosis but the degree of elevation of the latter is not always exceptional.

Q3: How is this condition managed and how can one prevent it?

Management of thyroid storm precipitated by RAI therapy is along similar lines as that of thyroid storm caused by any other precipitant. Thyroid storm should preferably be managed in conjunction with an endocrinologist and management includes the administration of Lugol’s iodine, high dose propylthiouracil, corticosteroids, and supportive measures. There are no specific recommendations for prevention of thyroid storm.5 Thyroid storm secondary to radioiodine is along similar lines as that of thyroid storm caused by any other precipitant. Thyroid storm should preferably be managed in conjunction with an endocrinologist and management includes the administration of Lugol’s iodine, high dose propylthiouracil, corticosteroids, and supportive measures. There are no specific recommendations for prevention of thyroid storm. Management of thyroid storm precipitated by RAI therapy is along similar lines as that of thyroid storm caused by any other precipitant. Thyroid storm should preferably be managed in conjunction with an endocrinologist and management includes the administration of Lugol’s iodine, high dose propylthiouracil, corticosteroids, and supportive measures. There are no specific recommendations for prevention of thyroid storm.5 Thyroid storm secondary to radioiodine is along similar lines as that of thyroid storm caused by any other precipitant. Thyroid storm should preferably be managed in conjunction with an endocrinologist and management includes the administration of Lugol’s iodine, high dose propylthiouracil, corticosteroids, and supportive measures. There are no specific recommendations for prevention of thyroid storm.

Our patient developed thyroid storm even though she had been rendered euthyroid before RAI therapy and did not have any associated comorbidity. After recovery from thyroid storm, carbimazole was recommenced five days after RAI. There was no recurrence of thyroid storm and three months later the patient became hypothyroid, requiring thyroxine replacement. It is likely that thyroid storm was successfully prevented by early reintroduction of carbimazole after the RAI treatment.

References


An unusual case of relapsing Graves’ disease

Q1: What is the diagnosis and how frequently is this condition encountered?

The patient had developed thyroid storm secondary to radioiodine therapy. Thyroid storm is a rare, life threatening complication of hyperthyroidism with an incidence of 1%–2% in hospitalised patients with hyperthyroidism, although it has a high mortality of around 15%. The incidence of thyroid storm after RAI treatment is variable because of variations in the regimens of RAI, in patient selection, and in the use of thyrystatic medications before and after RAI. The overall incidence is low and in one series only one patient out of 525 patients treated with 550 MBq RAI developed thyroid storm. The risk of thyroid storm after RAI treatment is difficult to predict in an individual patient but appears to be higher in patients with severe hyperthyroidism, in older patients, and in the presence of cardiovascular and cerebrovascular disease.

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