

ECG FEATURES OF VENTRICULAR TACHYCARDIA



“Metamorphosis of Narcissus”, oil on canvas, Salvador Dali, 1937, Tate Gallery, London.

“I have to thank you indeed for the introduction of our visitor of yesterday. Until now I was inclined to regard the Surrealists – who seem to have adopted me as their patron saint – as 100% fools (or let’s rather say, as with alcohol, 95%). This young Spaniard, with his ingenious fanatical eyes, and his undoubtedly technically perfect mastership, has suggested to me a different estimate. In fact it would be very interesting to explore analytically the growth of a picture like this. From a critical point of view, one might still say, that Art by its definition would refuse enlarging its scope so widely, unless the quantitative relation on unconscious material and pre-conscious elaboration should be kept within certain limits. In any case there are serious problems from the psychological point of view”

Sigmund Freud, letter to Stefan Zweig, July 1938.

“He remarked, I showed him one of my pictures, that in the paintings of the Old Masters one immediately tends to look for the unconscious whereas, when one looks at a surrealist painting one immediately has the urge to look for the conscious”

Salvador Dali, letter to Anton Breton, January 1939.

“Dr Sigmund Freud, aged 82, is adorable. He is full of sparkle though a little baffled at moments by having newly become a bit deaf. He talked to me for a long while, during which Dali sketched him hastily but accurately into a drawing book. Salvador was looking so inspired, his eyes were so blazing with excitement while he sketched the inventor of psychoanalysis that the old man whispered in German, “That boy looks like a fanatic. Small wonder that they have civil war in Spain if they all look like that.”

Edward James, letter to Christopher Sykes 20 July 1938.

On the 19th July, 1938 a remarkable meeting took place between two truly remarkable people. A very famous yet elderly and frail Sigmund Freud was introduced to a young, largely unknown, Spanish artist by the name of Salvador Dali. Sigmund Freud, born in 1856 had revolutionized the field of psychology. After graduation from medical school in 1882, he became interested in trying to understand the subconscious workings of the human mind. Finding hypnosis inadequate, he developed the technique of conversational “free association”, which he called psychoanalysis. He refined his techniques over the years and developed a set of theories and rules for interpreting the disturbed minds of his patients. In particular he placed profound importance on the data he gathered from his patients regarding their dreams and memories of childhood.

Although many psychiatrists and psychologists today disagree with many aspects of his work, he did have a profound influence in inspiring modern psychiatry to examine the inner workings of the subconscious mind in an attempt to understand many types of mental illness and “idiosyncrasies”. One of his great successes, despite the social taboos of the time, was to examine human sexuality for the first time in a scientific manner. It was this aspect of his work that made him such a controversial figure. By utilizing his vast knowledge of mythologies, literature and art he also helped establish the profound importance of culture in the development of the adult personality. His theories began to influence and inspire a new generation of young artists in the early 20th century, in particular those known as the “surrealists”. Salvador Dali, in particular began to try to depict the inner subconscious for the first time as a concrete work of art. Salvador practically adopted Sigmund Freud as his patron saint and even though Sigmund had little interest in emerging “modern” art forms, he was persuaded by a mutual friend to meet with Salvador. It must have been a fascinating meeting, with only tantalizing snippets of letters written by those present now available for posterity. Freud closely examined a work of Salvador’s that the artist had bought with him to show his idol. It was called “Metamorphosis of Narcissus”, a work full of psycho-sexual symbolism, probably best not gone into in this present discussion! Sigmund apparently examined it extremely closely and admitted that was not sure exactly what to make of it. There was no doubt in his mind at all, however that its creator would make a fascinating subject for psychoanalysis. There was also no doubt in the maestro’s mind that there was something seriously “wrong” with young Salvador, apparently much to the unending delight of the artist!

Just as Sigmund used his rules to gain significant insights into the minds of his disturbed patients, so may we use certain rules when analysing our patients ECGs, to gain significant insights into the disturbed inner workings of our patients’ myocardiums. Sigmund realized with young Salvador that he may not always be able to make a precise diagnosis on any given patient, yet he could nonetheless recognize that there was something seriously wrong! So it is for us, that whilst we may not be able to make a precise diagnosis on the inner behaviour of our patient’s myocardium, we may nonetheless be able to recognize that there is similarly something seriously wrong.

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Introduction

VT is frequently difficult to distinguish from SVT with aberrancy, and may on occasions be impossible.

The important point however is to treat the patient, rather than excessively ruminate of the exact diagnosis.

In some situations, when the patient is stable and good information is available including old ECGs, the drug therapy may be appropriate.

Unstable patients should be cardioverted.

Strict Definition of VT

1. Wide complex QRS (> 0.12 seconds)
2. Rate > 100 (but usually 120-200)
3. 3 or more consecutive ventricular beats.

The principal differential diagnoses of a rapid regular ventricular rhythm include:

1. VT
2. SVT with aberrancy:
 - Aberrant conduction due to bundle branch block
 - Aberrant conduction due to WPW syndrome.

Distinguishing features

A number of ECG features help to distinguish VT from SVT with aberrancy, including:

1. General features
2. Brugada's criteria
3. Wellen's criteria

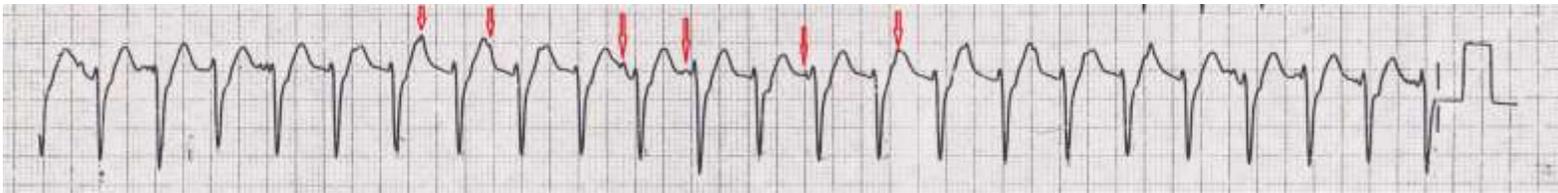
Note that there are a range of other criteria as well, but again the important thing will be to assess patient stability and to treat the patient.

General features:

Features suggestive of VT include:

1. Bizarre extreme left axis (even “north-west” deviation.
 - ie axis in “no man’s land”
 - ♥ QRS is positive in aVR and negative in I and aVF.
2. Concordance across all pre-cordial leads.
 - This may be concordance upwards, or downwards
3. QRS pattern different from baseline:
 - The availability of a previous normal ECG (when immediately available) is extremely helpful in interpreting the abnormal one.
4. A-V dissociation:

This is uncommonly seen, and when present can be difficult to definitively interpret.



Red arrows show the irregular appearance of P waves - irregularly related to the ventricular complexes. Although the QRS complexes are only marginally widened, this was a case of VT.

5. Regularity:
 - Monomorphic VT is regular.
 - If the rhythm is irregularly irregular, then AF with aberrancy is likely.
6. **Supraventricular capture** beats or **ventricular fusion** beats:

A key feature of determining the diagnosis of VT is when a break occurs in the rhythm pattern.

When this occurs, two features in particular can be very helpful:

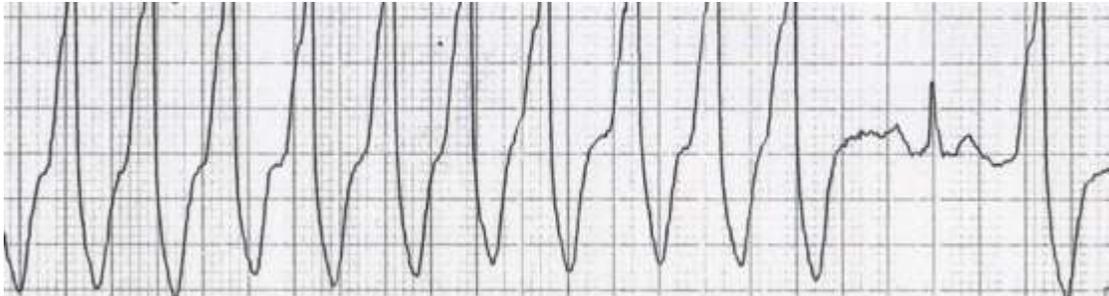
Both capture and fusion beats are more likely to be seen in VTs of (relatively) slower rates.

Capture beats:

- This is the sudden appearance of a normal looking, narrow QRS complex.

It is due to a supraventricular beat that has been successfully conducted into the ventricle, (hence, “capturing the ventricle”).

Although not common, captured beats are very helpful in confirming and rhythm as VT.



*Run of VT, interrupted by a capture beat, (i.e a normal sinus beat conducted into the ventricle).
(LITFL)*

Fusion beats:

- A **fusion beat** occurs when a supraventricular and a ventricular impulse coincide to produce a **hybrid** electrical complex, as shown above.

Fusion beats indicate that there are two foci of pacemaker cells firing simultaneously, a supraventricular pacemaker (e.g. the sinus node) and a competing ventricular pacemaker (source of ventricular ectopics).

The fusion beats are of intermediate width and morphology between that of the supraventricular and ventricular complexes.

Fusion beats can be seen in AIVR as well as VT



Fusion beat - the first (hybrid complex) that follows the wide ventricular complexes - two normal supraventricular beats follow, then a return of the ventricular complex, (courtesy Dr Chris Nickson, LITFL Website).

Brugada's Criteria

1. Absence of an R-S complex in all pre-cordial leads. (Yes = VT)

- Note that this is essentially the same thing as having positive or negative concordance.

If all the precordial leads consist of either monophasic R or S waves then VT is diagnosed.

If there are any RS complexes present in V1-6 then move on to the next step of the algorithm.

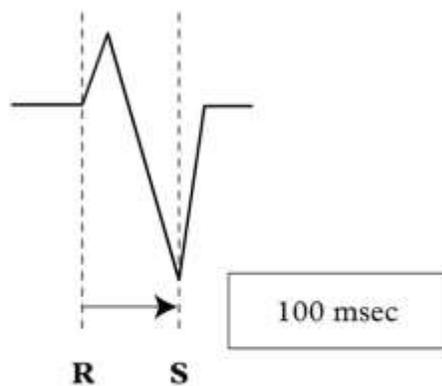
2. R-S interval > 100 milliseconds, (2.5 small squares) in any one of the pre-ordial leads. (Yes =VT)

- If RS complexes are present in V1-6 then the RS interval can be measured.

This is the time from the onset of the R wave to the nadir of the S wave.

If the RS interval is > 100 ms VT is diagnosed.

If the RS interval is < 100 ms move on to next step.



3. Is there A-V dissociation, (see above) ? (Yes = VT).
4. If none of the above is helpful, then look at specific morphological criteria.
 - If these criteria are positive = VT, if not = SVT with aberrancy.

Wellen's / Brugada Morphological Criteria for VT

“RBBB” pattern (i.e. a positive R wave in v1):

V1

1. Monophasic R wave.
2. **Left** side up “**rabbit ear**” (Marriot’s sign).

V6

1. R/S ratio < 1 (if also LAD).
2. QS wave (i.e. a completely negative wave)

3. A qR complex:
i.e a small Q wave and tall R wave.

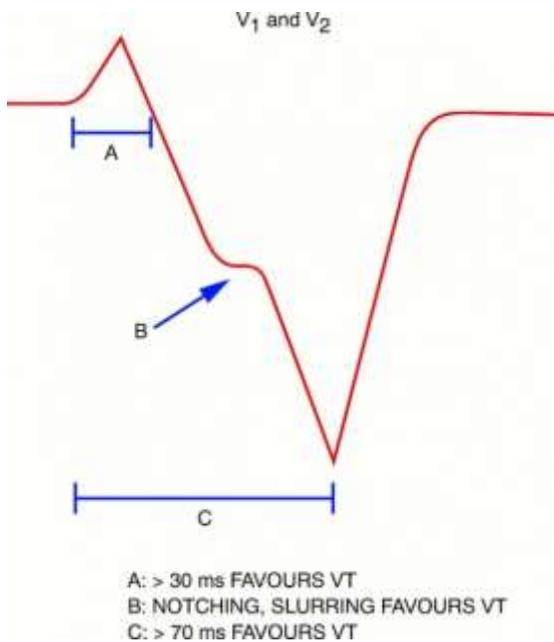
“LBBB” pattern (i.e a negative s wave in v1):

V1

1. R wave > 0.03
(> 1 small square)
2. R-S > 60 milliseconds
(i.e. > 1.5 small squares)
3. Notched down slope on the S wave.

V6

1. QS waves.
2. Any Q wave.
(LBBB does not have q waves in V6)



Clinical assessment

The clinical setting will also help suggest the likelihood of SVT with aberrancy or VT:

Clinical features making VT more likely include:

1. Age > 35 (positive predictive value of 85%)
2. Structural heart disease
3. Ischaemic heart disease
4. Known IHD
5. Congestive heart failure

6. Cardiomyopathy
7. Family history of sudden cardiac death:
 - For example HOCM, congenital long QT syndrome, Brugada syndrome or arrhythmogenic right ventricular dysplasia that all are associated with VT.

Features making SVT with aberrancy more likely include:

1. Previous ECGs showing a bundle branch block pattern with identical morphology to the broad complex tachycardia.
2. Previous ECGs showing evidence of WPW.
3. A history of paroxysmal tachycardias that have been successfully terminated with adenosine or vagal manoeuvres.

References:

1. Ventricular Tachycardia in Marriots Practical Electrocardiology 8th ed 1988.
2. Aberration versus Ectopy in Understanding Electrocardiography 7th ed Conover p.192
3. Brugada's Criteria for VT Circulation vol 83 May 1991.
4. Chan et al. ECG in Emergency Medicine and Acute Care, Elsevier Mosby, 2005.
5. Life in the fast Lane Website, "SVT with Aberrancy verses VT".

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Reviewed May 2015.