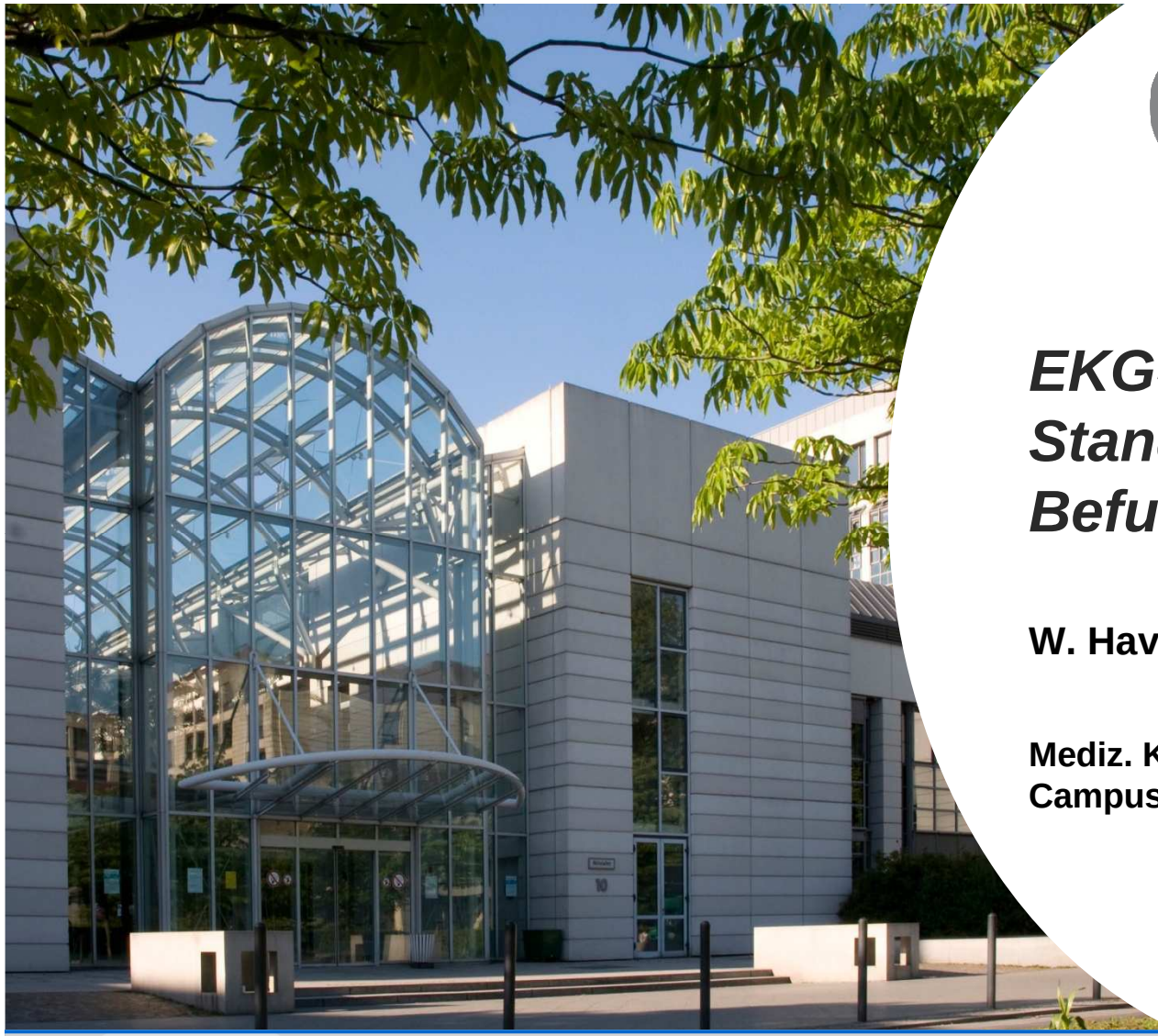


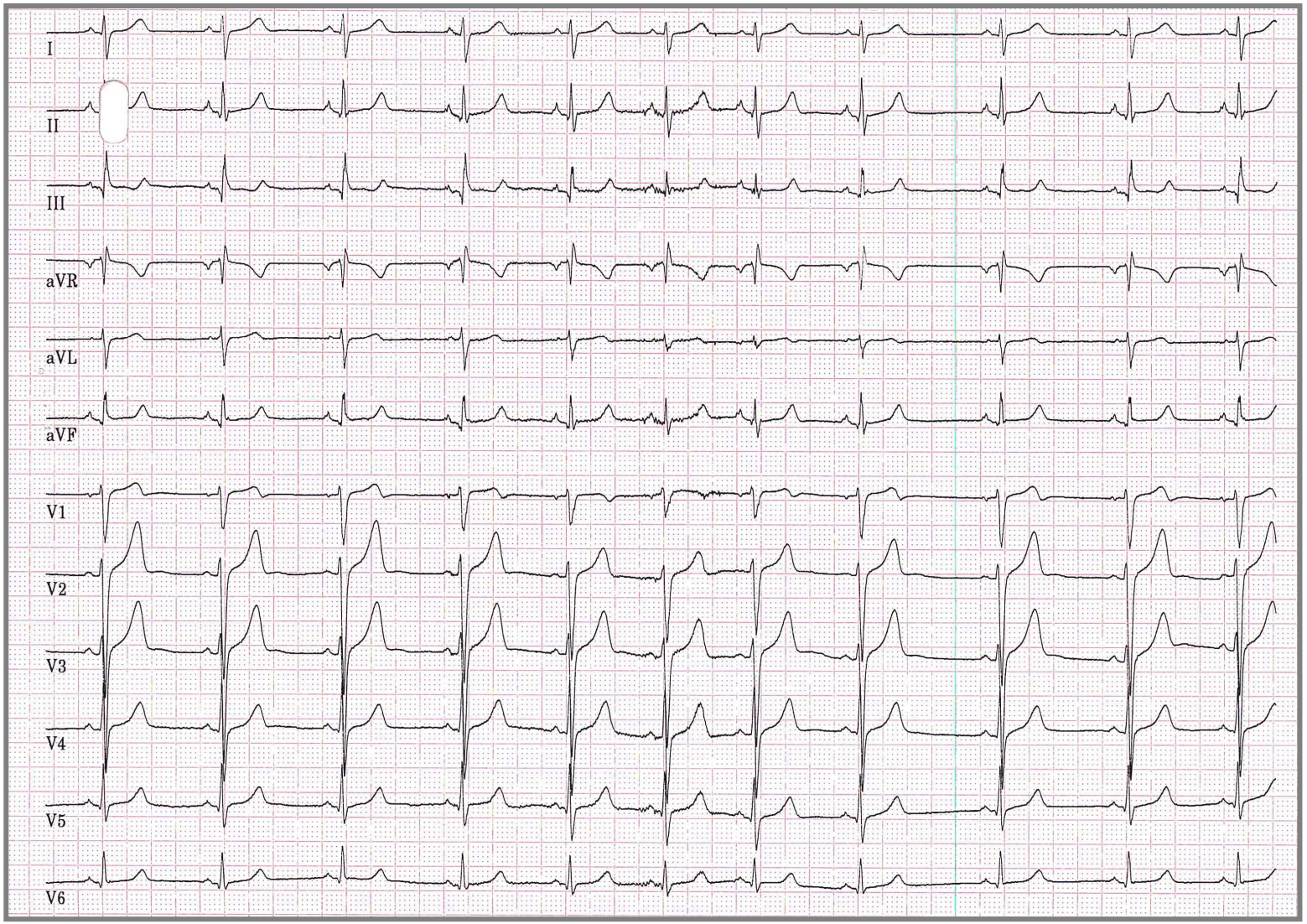
CHARITÉ
UNIVERSITÄTSMEDIZIN BERLIN

EKG-Grundlagen – Standards in der Befundung

W. Haverkamp

Mediz. Klinik m. S. Kardiologie
Campus Virchow-Klinikum

Standard 12-Kanal-EKG



EKG-Standards

REPORT OF COMMITTEE ON ELECTROCARDIOGRAPHY, AMERICAN HEART ASSOCIATION

Recommendations for Standardization of Electrocardiographic and Vectorcardiographic Leads

COMMITTEE MEMBERS: FRANK N. WILSON, M.D., HONORARY CHAIRMAN†
CHARLES E. KOSSMANN, M.D., CHAIRMAN, GEORGE E. BURCH, M.D., EMANUEL GOLDBERGER, M.D., ASHTON GRAYBIEL, Captain, MC, USN, HANS H. HECHT, M.D., FRANKLIN D. JOHNSTON, M.D., EUGENE LEPESCHKIN, M.D., GORDON B. MYERS, M.D.

1954

EKG-Standards

European Heart Journal (1985) **6**, 815–825

Recommendations for measurement standards in quantitative electrocardiography

THE CSE WORKING PARTY*

KEY WORDS: Computer ECG analysis programs, standardisation of measurements, wave recognition.

* Common Standards for Quantitative Electrocardiography

EKG-Standards

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AHA/ACC/HRS SCIENTIFIC STATEMENTS

Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part I: The Electrocardiogram and Its Technology

A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society

Endorsed by the International Society for Computerized Electrocardiology

Paul Kligfield, MD, FAHA, FACC; Leonard S. Gettes, MD, FAHA, FACC; James J. Bailey, MD; Rory Childers, MD; Barbara J. Deal, MD, FACC; E. William Hancock, MD, FACC; Gerard van Herpen, MD, PhD; Jan A. Kors, PhD; Peter Macfarlane, DSc; David M. Mirvis, MD, FAHA; Olle Pahlm, MD, PhD; Pentti Rautaharju, MD, PhD; Galen S. Wagner, MD

ECG - AHA/ACC/HRS Scientific Statements

TABLE 1. Primary Statements

A. Overall interpretation	
1	Normal ECG
2	Otherwise normal ECG
3	Abnormal ECG
4	Uninterpretable ECG
B. Technical conditions	
10	Extremity electrode reversal
11	Misplaced precordial electrode(s)
12	Missing lead(s)
13	Right-sided precordial electrode(s)
14	Artifact
15	Poor-quality data
16	Posterior electrode(s)

Mason et al. 2007

TABLE 1. Primary Statements

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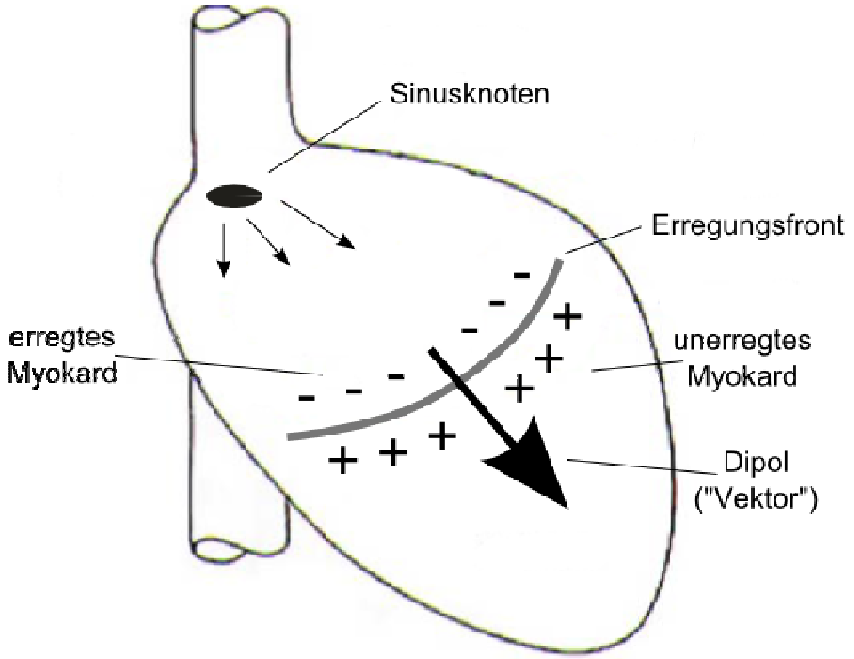
13	Right-sided precordial electrode(s)
14	Artifact
15	Poor-quality data
16	Posterior electrode(s)
C. Sinus node rhythms and arrhythmias	
20	Sinus rhythm
21	Sinus tachycardia
22	Sinus bradycardia
23	Sinus arrhythmia
24	Sinoatrial block, type I
25	Sinoatrial block, type II
26	Sinus pause or arrest
27	Uncertain supraventricular rhythm
D. Supraventricular arrhythmias	
30	Atrial premature complex(es)
31	Atrial premature complexes, nonconducted
32	Retrograde atrial activation
33	Wandering atrial pacemaker
34	Ectopic atrial rhythm
35	Ectopic atrial rhythm, multifocal
36	Junctional premature complex(es)
37	Junctional escape complex(es)
38	Junctional rhythm
39	Accelerated junctional rhythm
40	Supraventricular rhythm
41	Supraventricular complex(es)
42	Bradycardia, nonsinus
E. Supraventricular tachyarrhythmias	
50	Atrial fibrillation
51	Atrial flutter
52	Ectopic atrial tachycardia, unifocal
53	Ectopic atrial tachycardia, multifocal
54	Junctional tachycardia
55	Supraventricular tachycardia
56	Narrow-QRS tachycardia
F. Ventricular arrhythmias	
60	Ventricular premature complex(es)
61	Fusion complex(es)
62	Ventricular escape complex(es)
63	Idioventricular rhythm
64	Accelerated idioventricular rhythm
65	Fascicular rhythm
66	Parasystole
G. Ventricular tachyarrhythmias	
70	Ventricular tachycardia
71	Ventricular tachycardia, unsustained
72	Ventricular tachycardia, polymorphous
73	Ventricular tachycardia, torsades de pointes
74	Ventricular fibrillation
75	Fascicular tachycardia
76	Wide-QRS tachycardia
H. Atrioventricular conduction	
80	Short PR interval
81	AV conduction ratio N:D
82	Prolonged PR interval
83	Second-degree AV block, Mobitz type I (Wenckebach)
84	Second-degree AV block, Mobitz type II
85	2:1 AV block
86	AV block, varying conduction
87	AV block, advanced (high-grade)
88	AV block, complete (third-degree)
89	AV dissociation
I. Intraventricular and intra-atrial conduction	
100	Aberrant conduction of supraventricular beat(s)
101	Left anterior fascicular block
102	Left posterior fascicular block
104	Left bundle-branch block
105	Incomplete right bundle-branch block
106	Right bundle-branch block
107	Intraventricular conduction delay
108	Ventricular preexcitation
109	Right atrial conduction abnormality
110	Left atrial conduction abnormality
111	Epsilon wave
J. Axis and voltage	
120	Right-axis deviation
121	Left-axis deviation
122	Right superior axis
123	Indeterminate axis
124	Electrical alternans
125	Low voltage
128	Abnormal precordial R-wave progression
131	Abnormal P-wave axis
K. Chamber hypertrophy or enlargement	
140	Left atrial enlargement
141	Right atrial enlargement
142	Left ventricular hypertrophy
143	Right ventricular hypertrophy
144	Biventricular hypertrophy

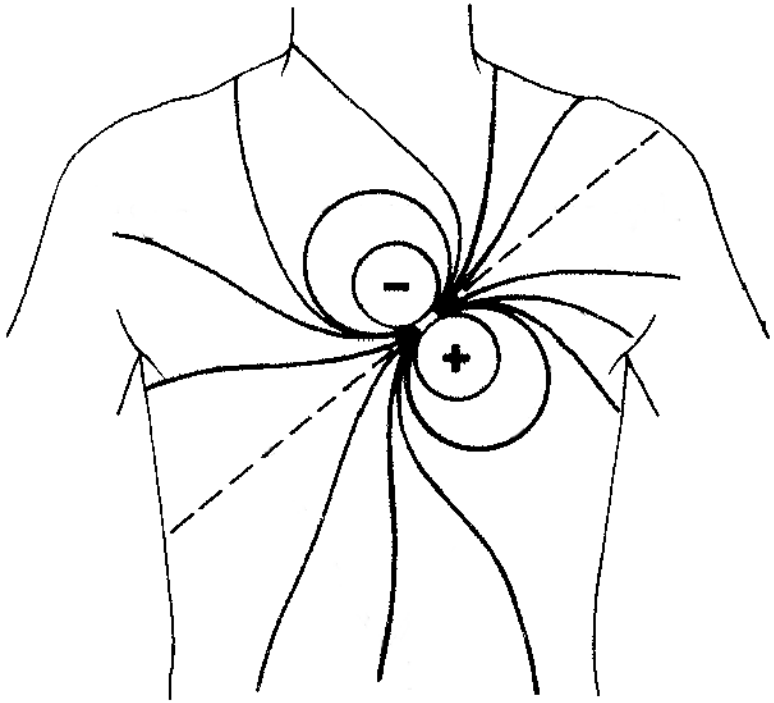
Mason et al. 2007

EGK-Grundlagen

- **Wichtige Konzepte**
  1. Wenn die Erregung in **Richtung der positiven Elektrode** erfolgt, ergibt sich im EKG ein **positiver Ausschlag**
  2. Mittels der verschiedenen Ableitungen lässt sich die elektrische Aktivität des Herzens aus **unterschiedlichen Blickwinkeln** betrachten
  3. Es ergeben sich 4 **Hauptsummationsvektoren**, die wegweisend für die Analyse der elektrischen Aktivität des Herzens sind

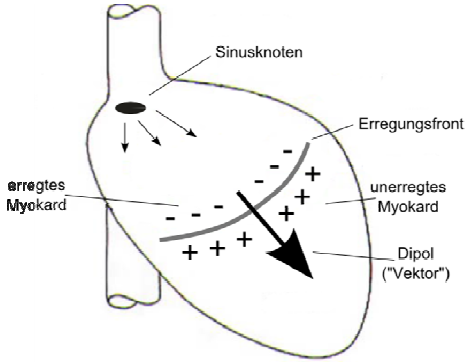
Vektoren und elektrisches Feld



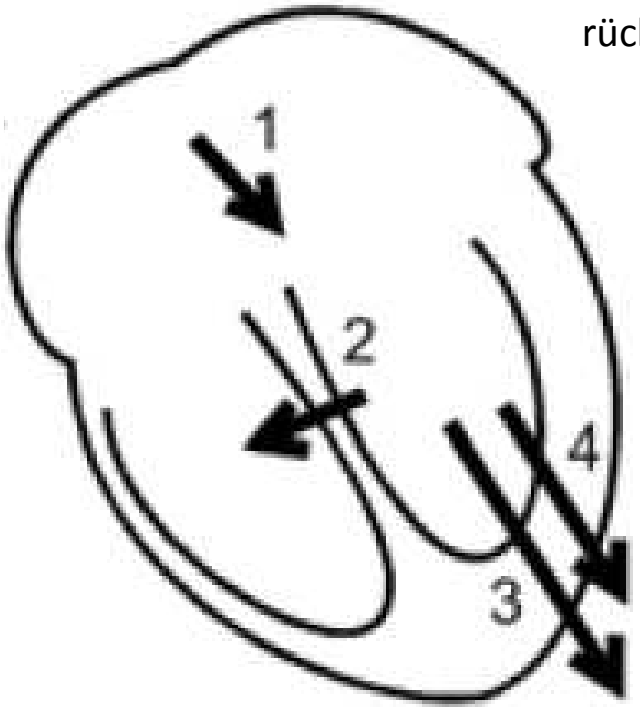


Dipol: zwei benachbarte, nicht zusammenfallende Ladungen; Größe mit Vektorcharakter

Summationsvektoren während der Depolarisation

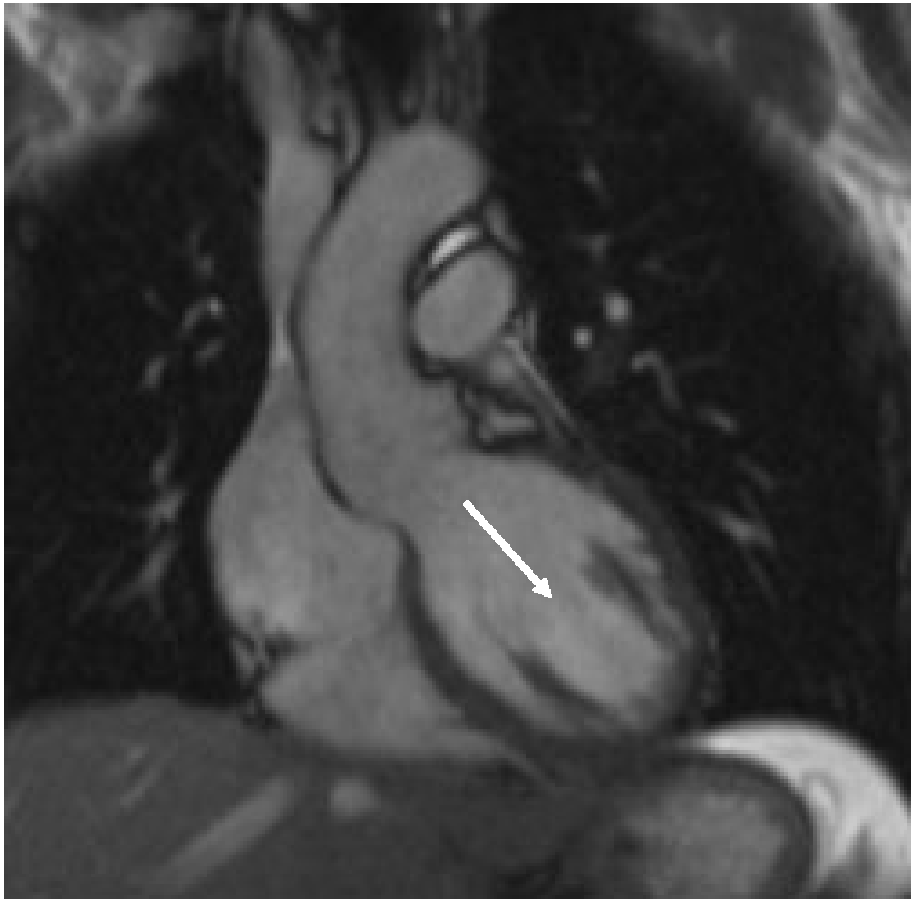


1: Vorhoferregung
2: septale Erregung
3: ventrikuläre Erregung
4: ventrikuläre Erregungs-rückbildung

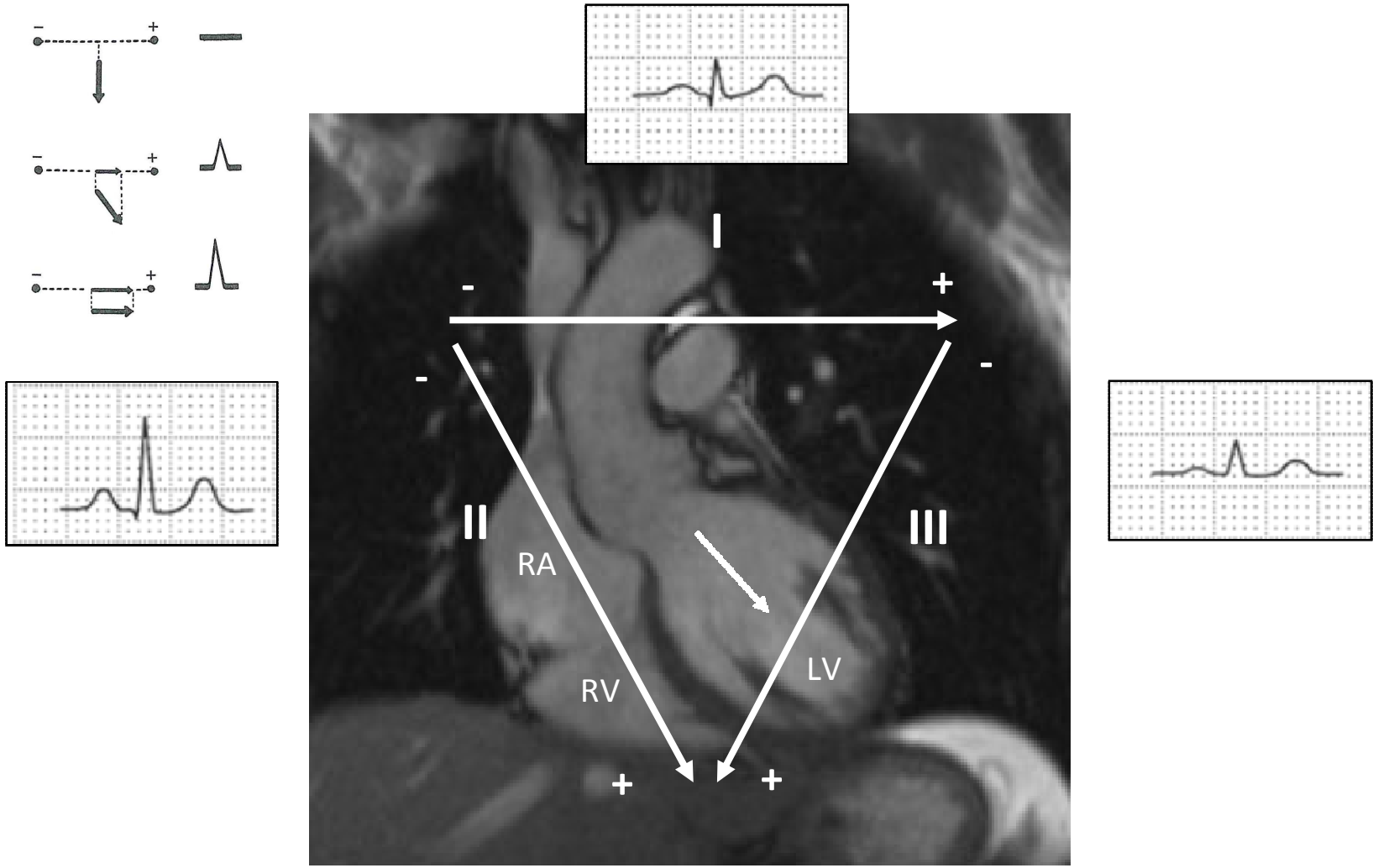


Foster, 2007

Hauptrichtung der ventrikulären Erregungsausbreitung



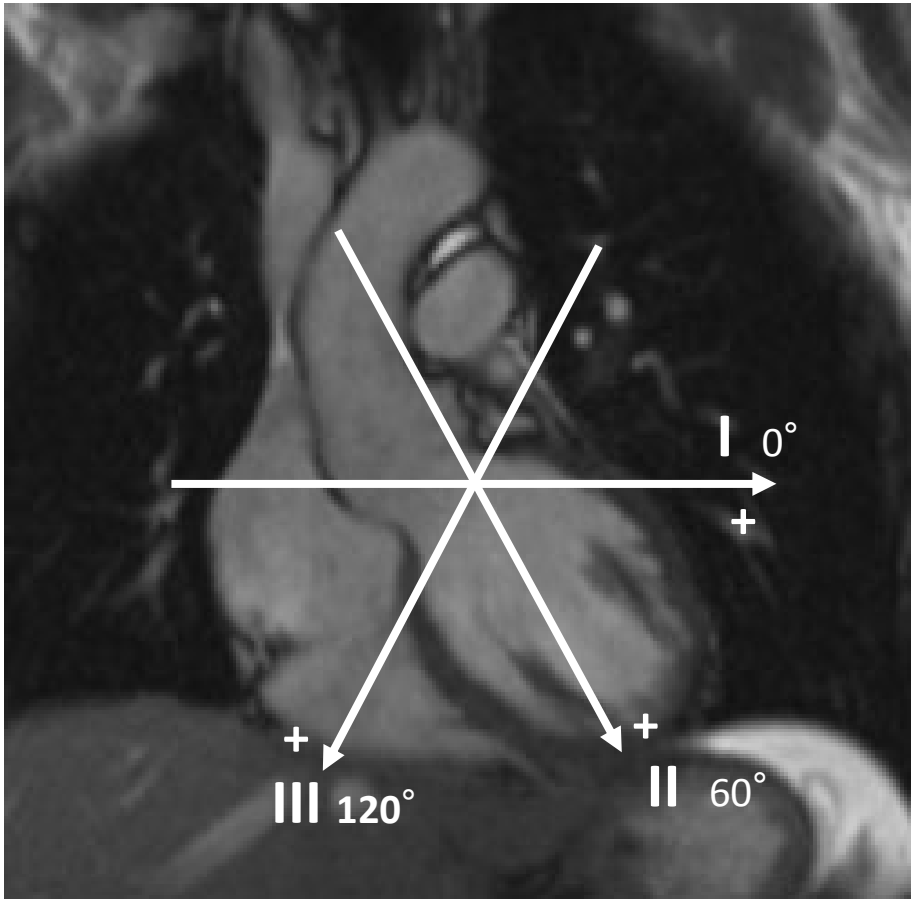
Extremitätenableitungen nach Einthoven



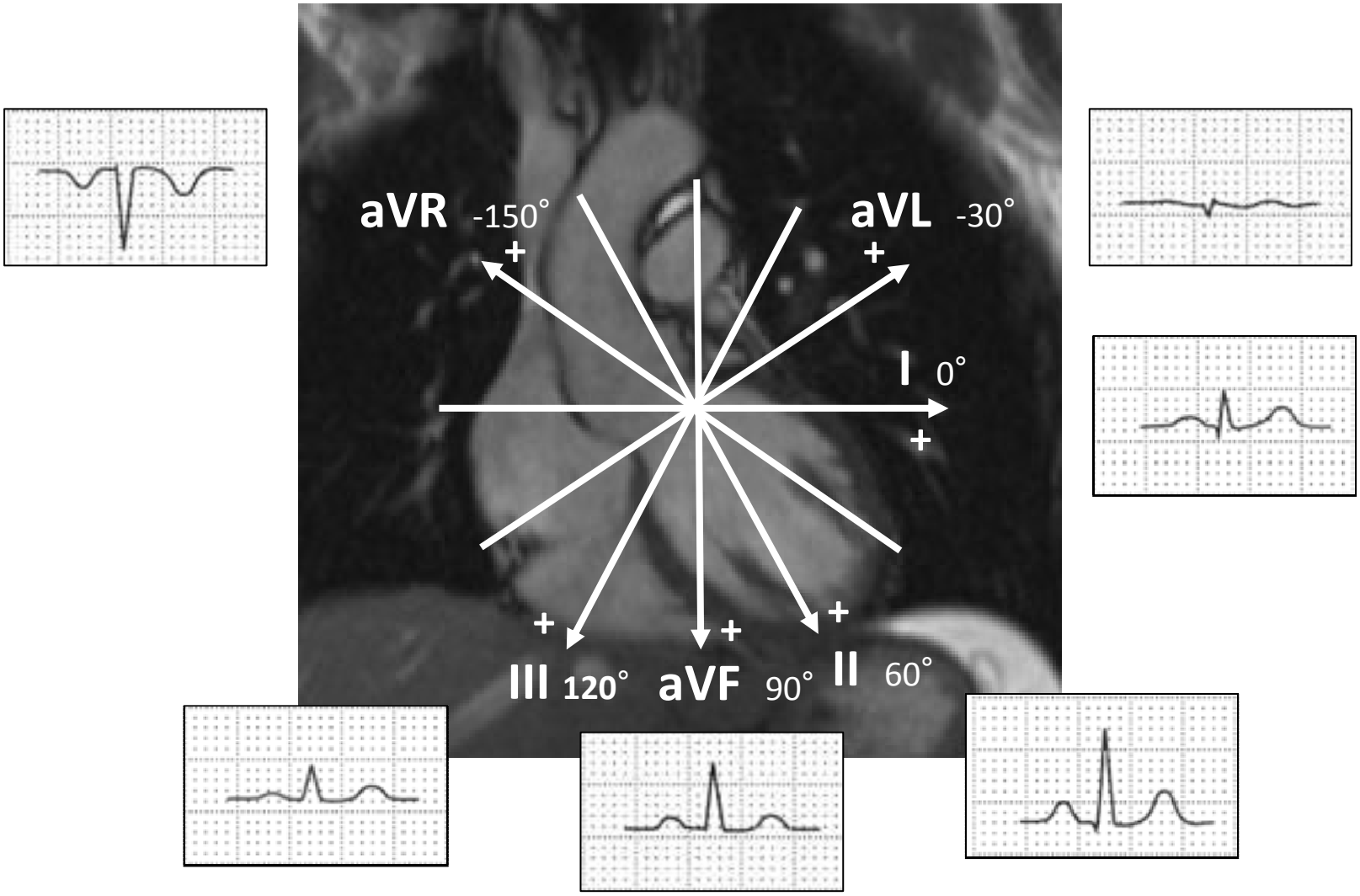
Frontalebene

Extremitätenableitungen nach Einthoven

Parallel-verschiebung

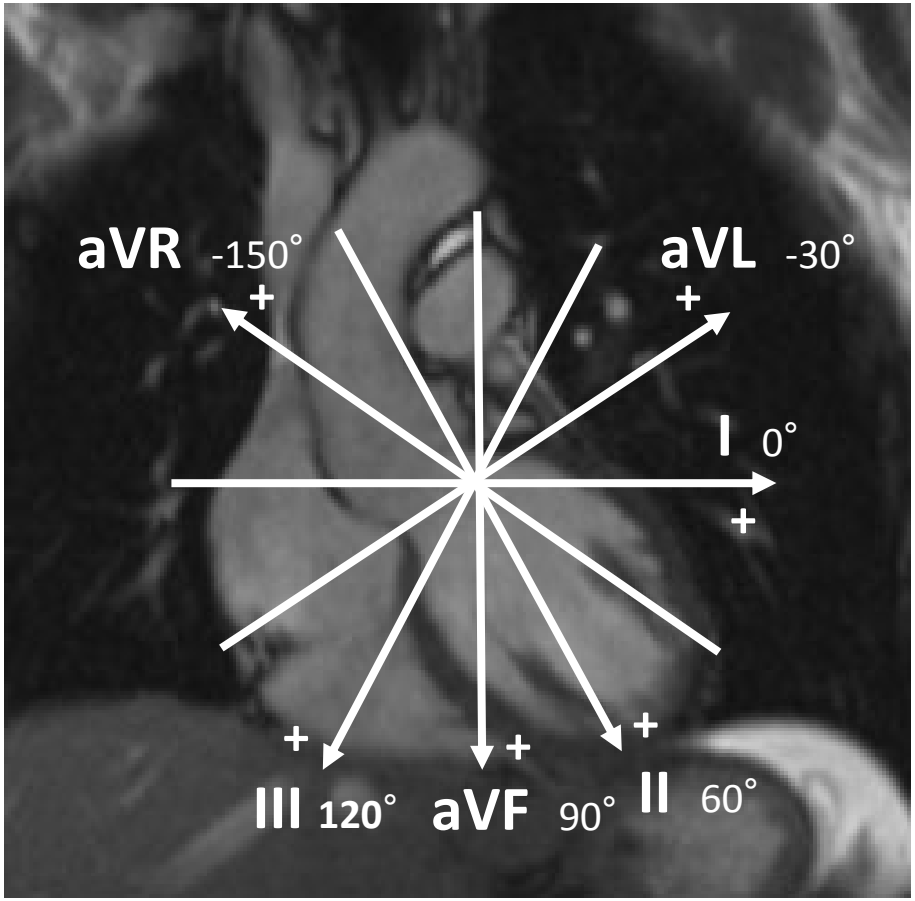


Extremitätenableitungen nach Einthoven u. Goldberger



Extremitätenableitungen nach Einthoven u. Goldberger

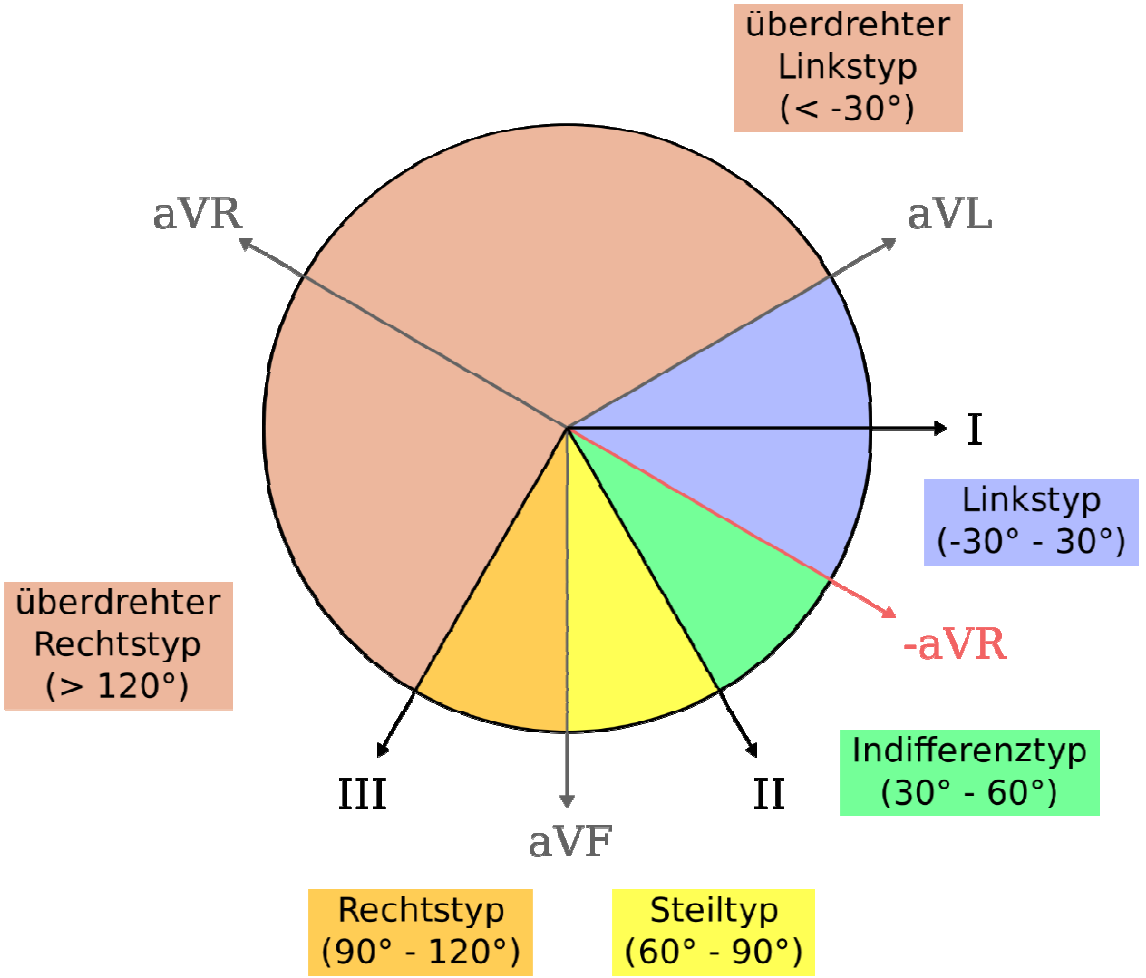
OBEN



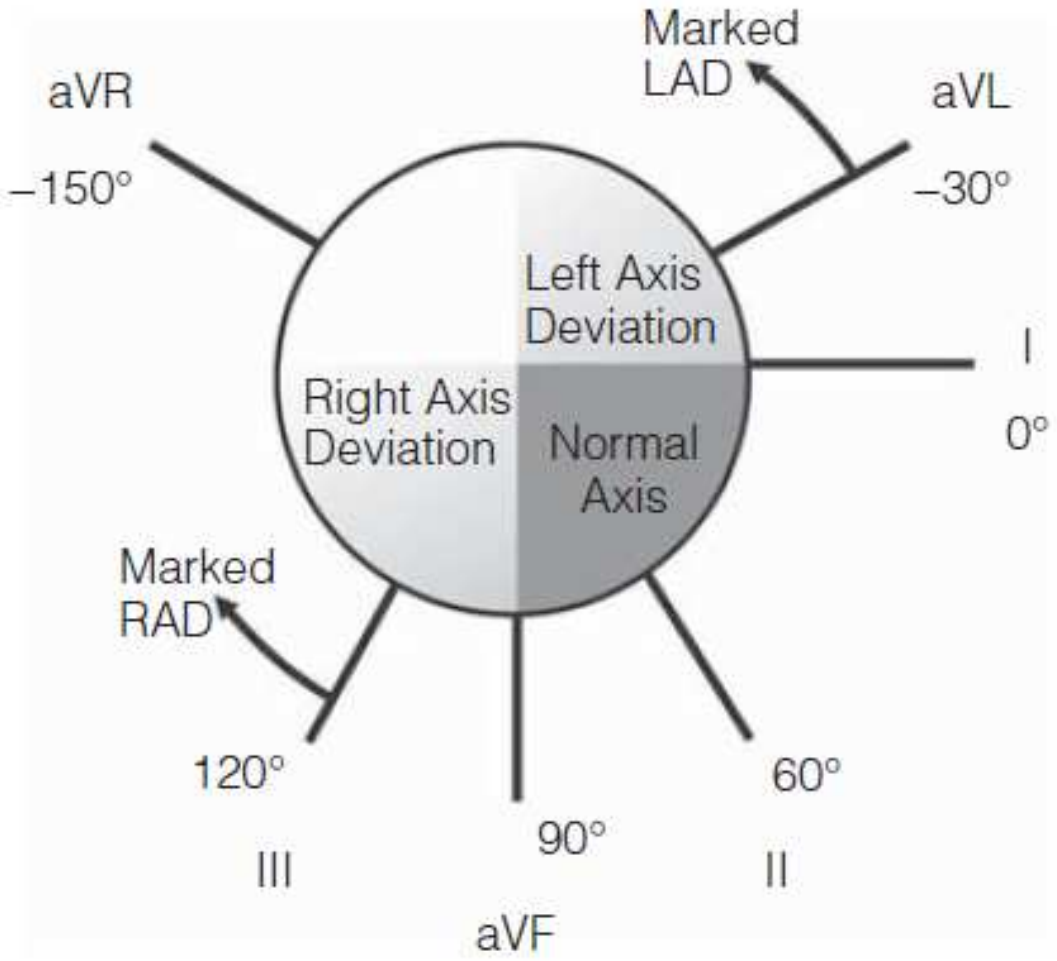
RECHTS **LINKS**

UNTEN

Cabrera-Kreis und Lagetypen

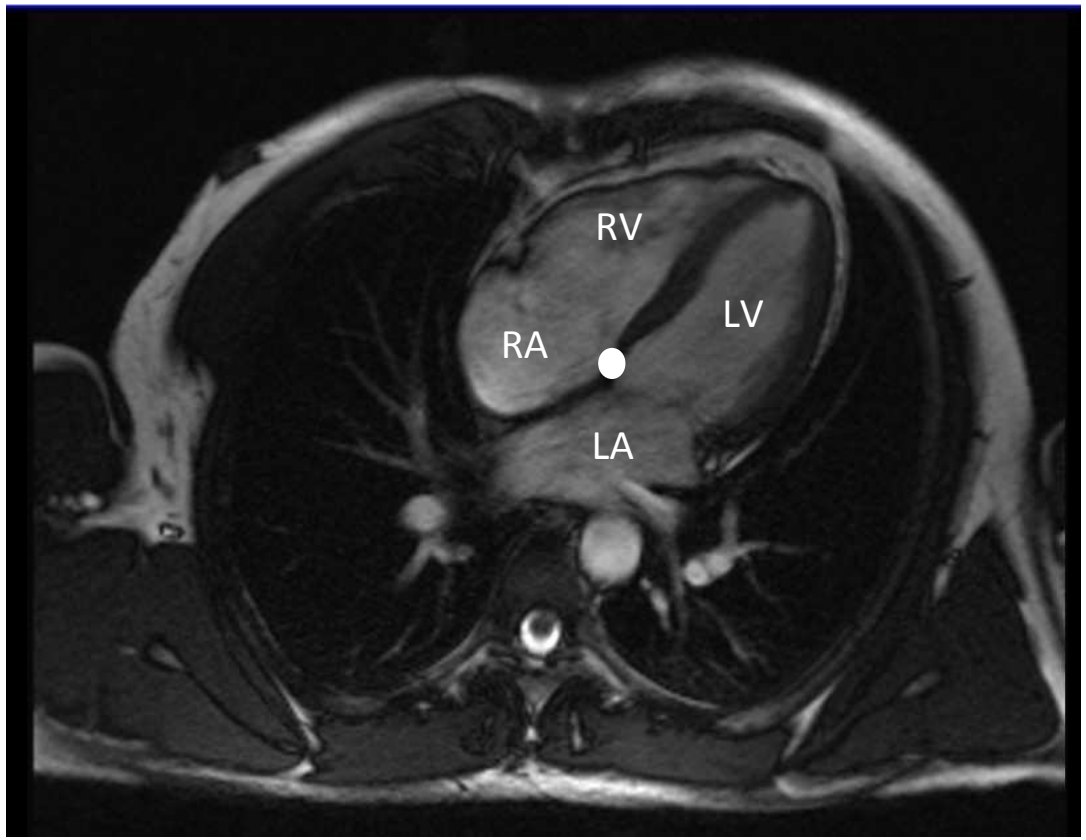


(Elektrische) QRS-Achsen



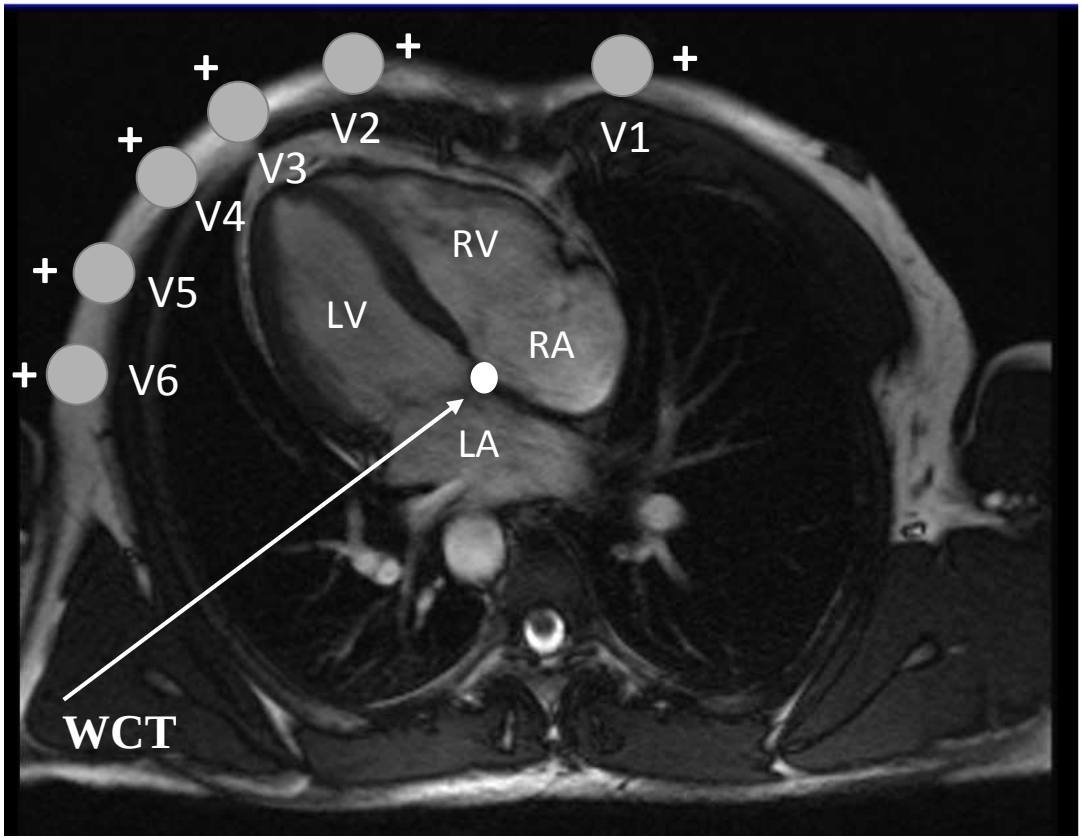
Foster, 2007

MRT Herz - Horizontalebene

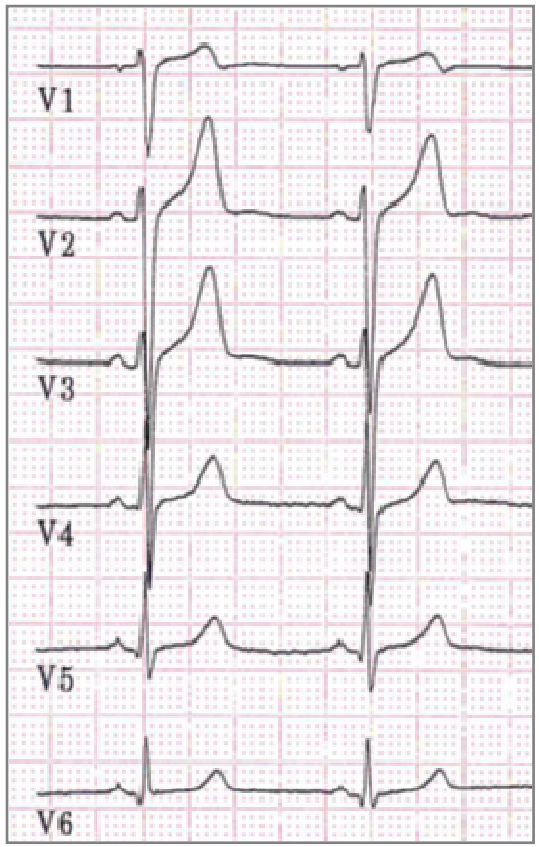


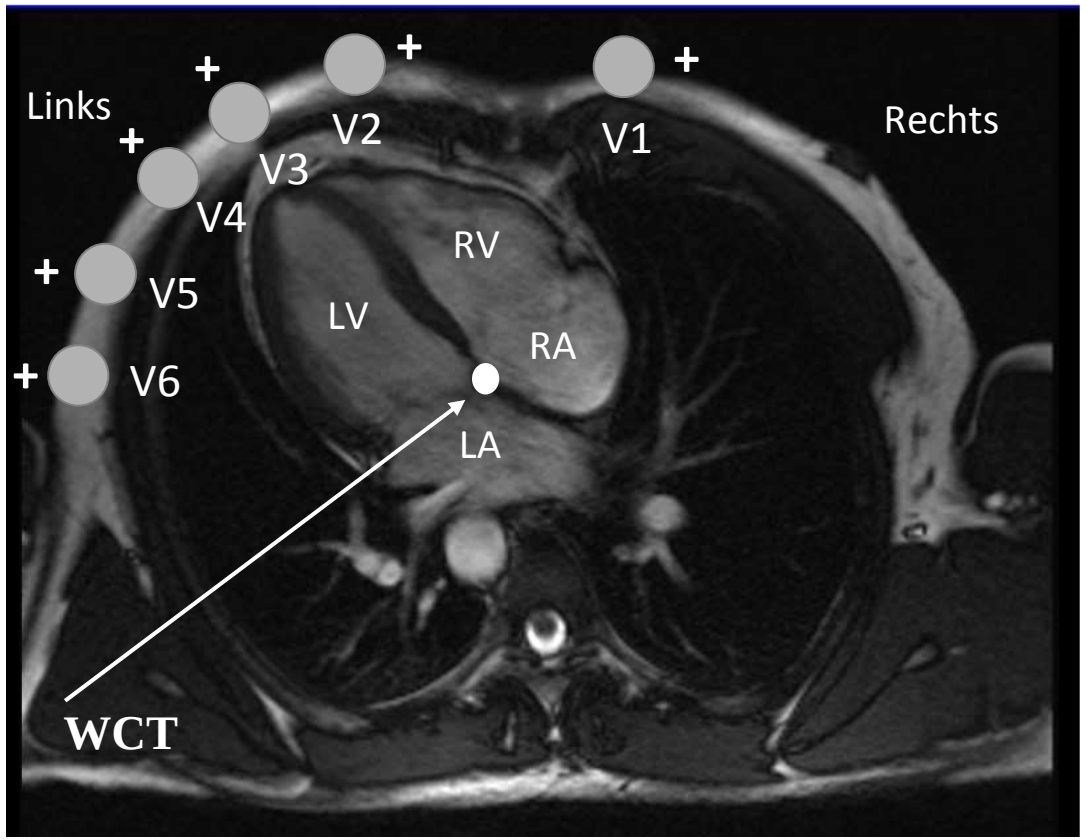
Brustwandableitungen nach Wilson

- Septal = 1-2
- Anterior = V3-4
- Lateral = V5-6



Brustwandableitungen nach Wilson





Warum Brustwandableitungen?

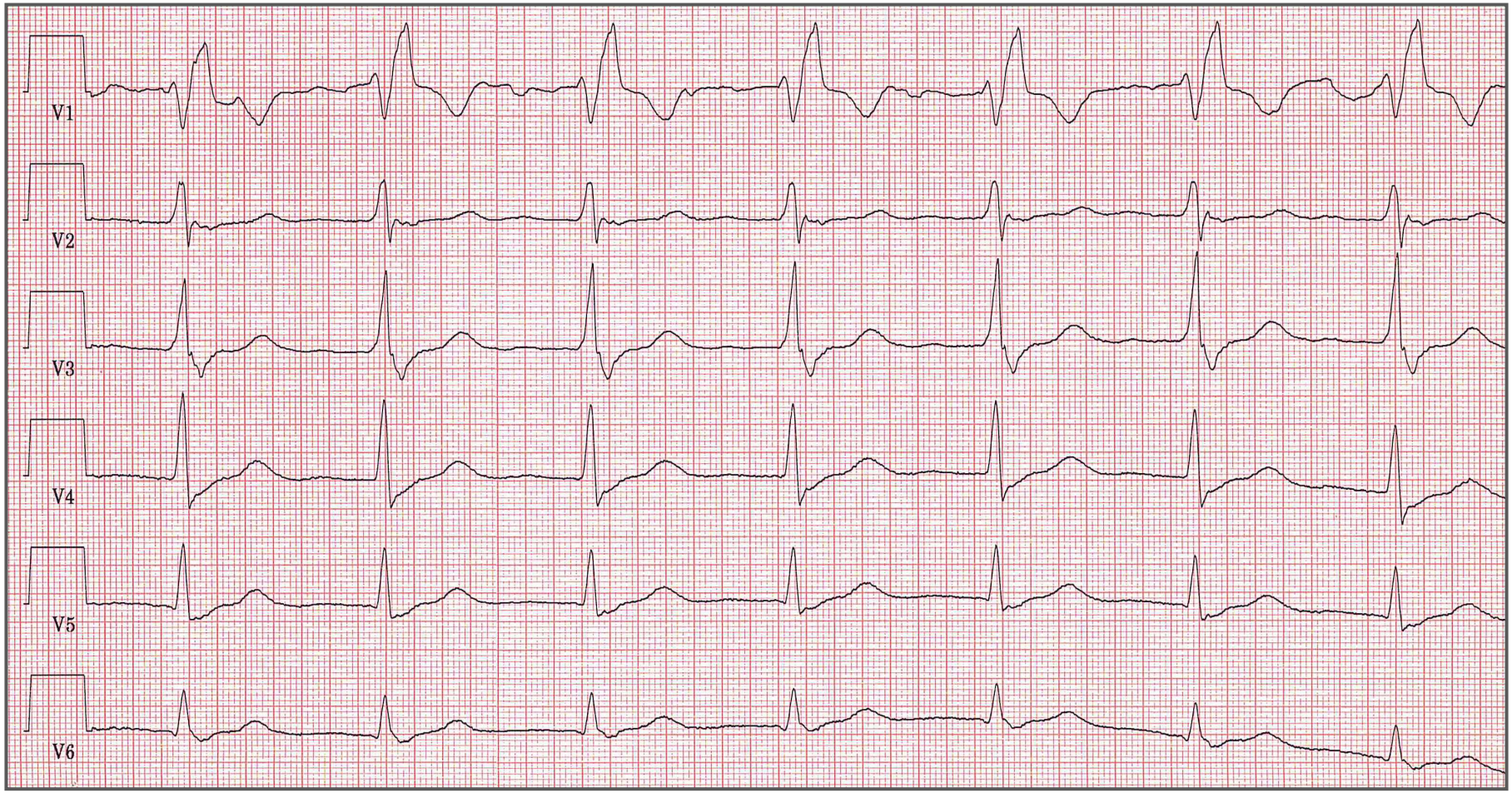
- **Wilson made a reasonable assumption that the potential oscillations of his central terminal would be small compared with those of the exploring electrode and that his “unipolar” leads therefore would largely reflect the potential variation under the exploring electrode.** Later investigators have often mistakenly taken this to mean that these leads reflect electrical activity only of cardiac regions in the vicinity of the exploring electrode.

Kligfield et al. 2007

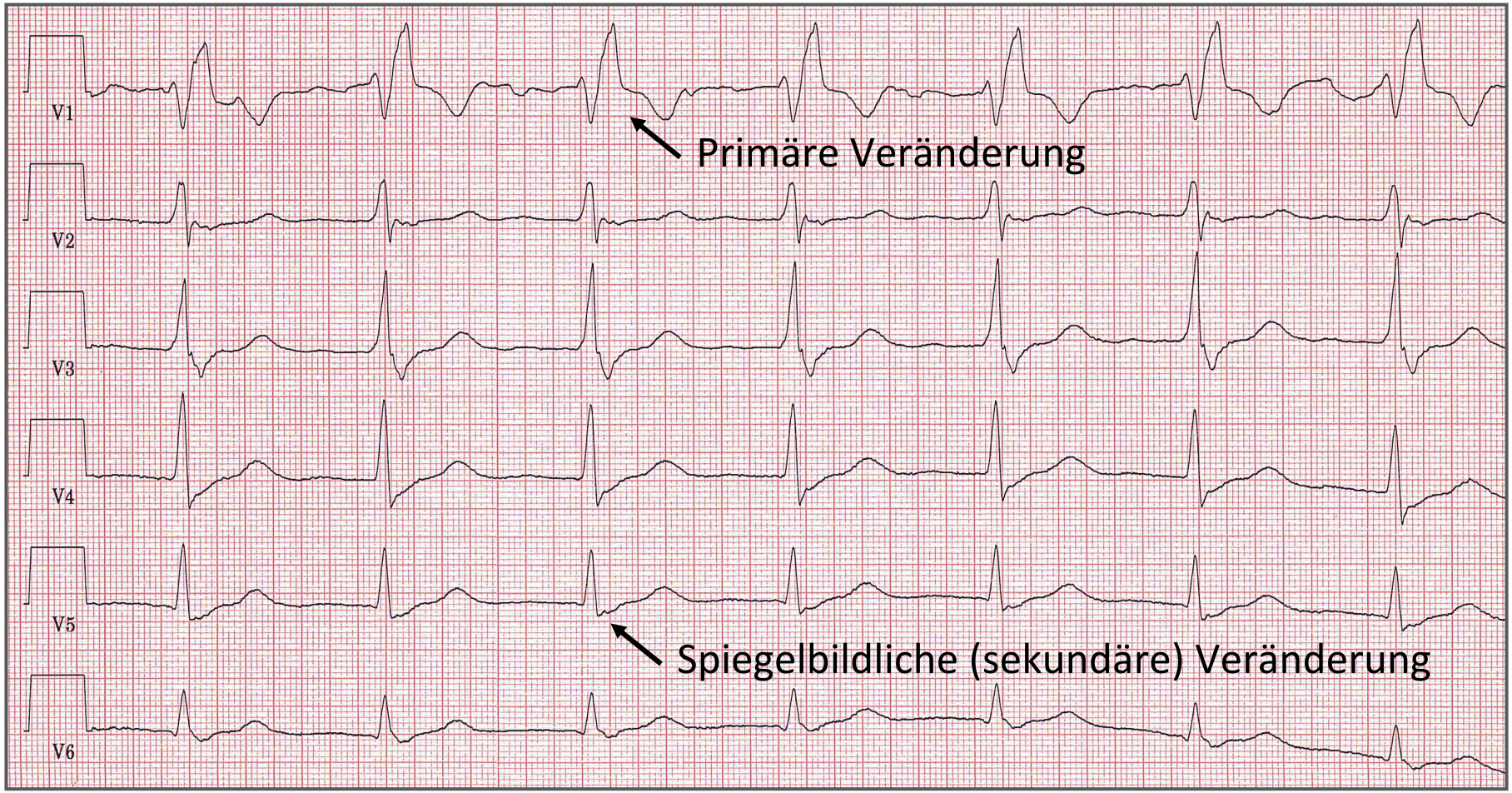
„Blickwinkel“ von Ableitungen

- **Globale Effekte** (“Blickwinkel” basierend auf bipolarer Ableitung)
- **Direkte regionale Effekte** (“verstärkter Blick” auf Aspekte in der Nähe der ableitenden Elektrode)
- **Indirekte regionale Effekte** (“Blick in die Entfernung” durch elektrodennahe Pathologien)

Diagnose?



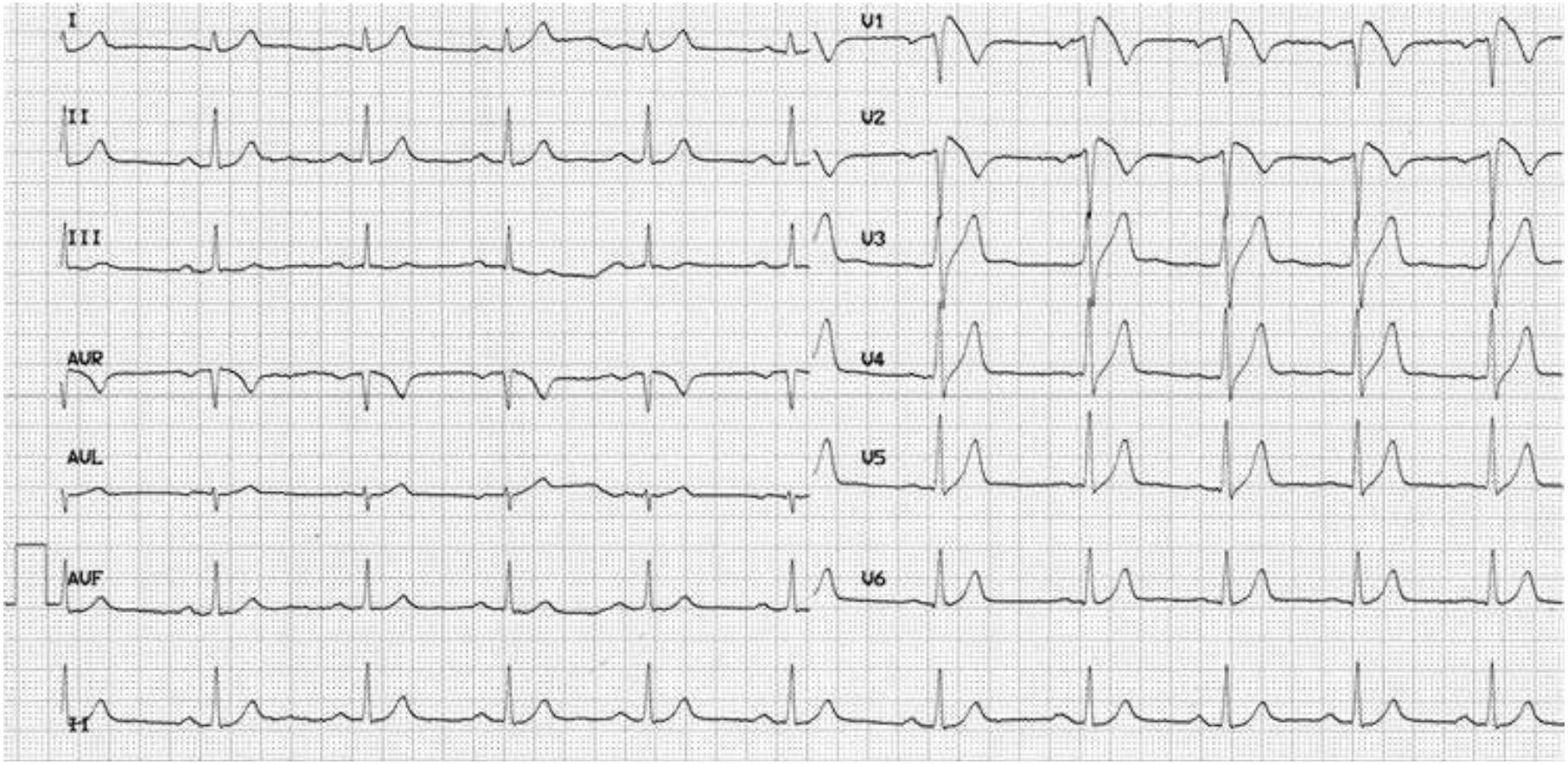
Rechtsschenkelblock



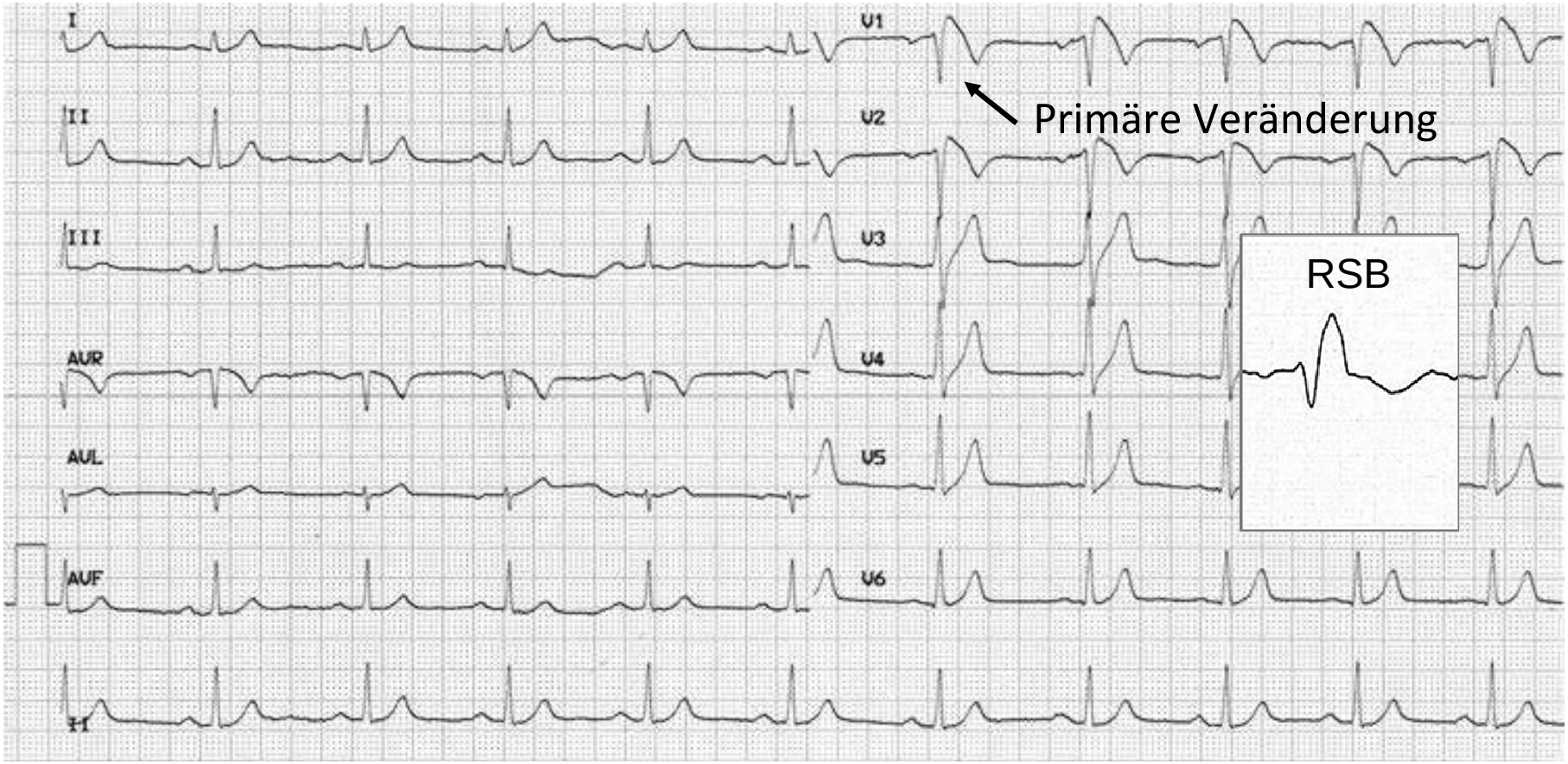
RSB: EKG-Kriterien

- QRS-Dauer ≥ 120 ms (definiert die Schenkelblockierung)
- **rSR´-Komplex in V1, so genannte M-Form** (verspätete rechtsventrikuläre Aktivierung)
- Verspätung der größten Negativitätsbewegung in V1 (> 50 ms)
- Breite S-Zacken in I, aVL und V5/6 (Spiegelbild der verspäteten rechtsventrikulären Aktivierung)

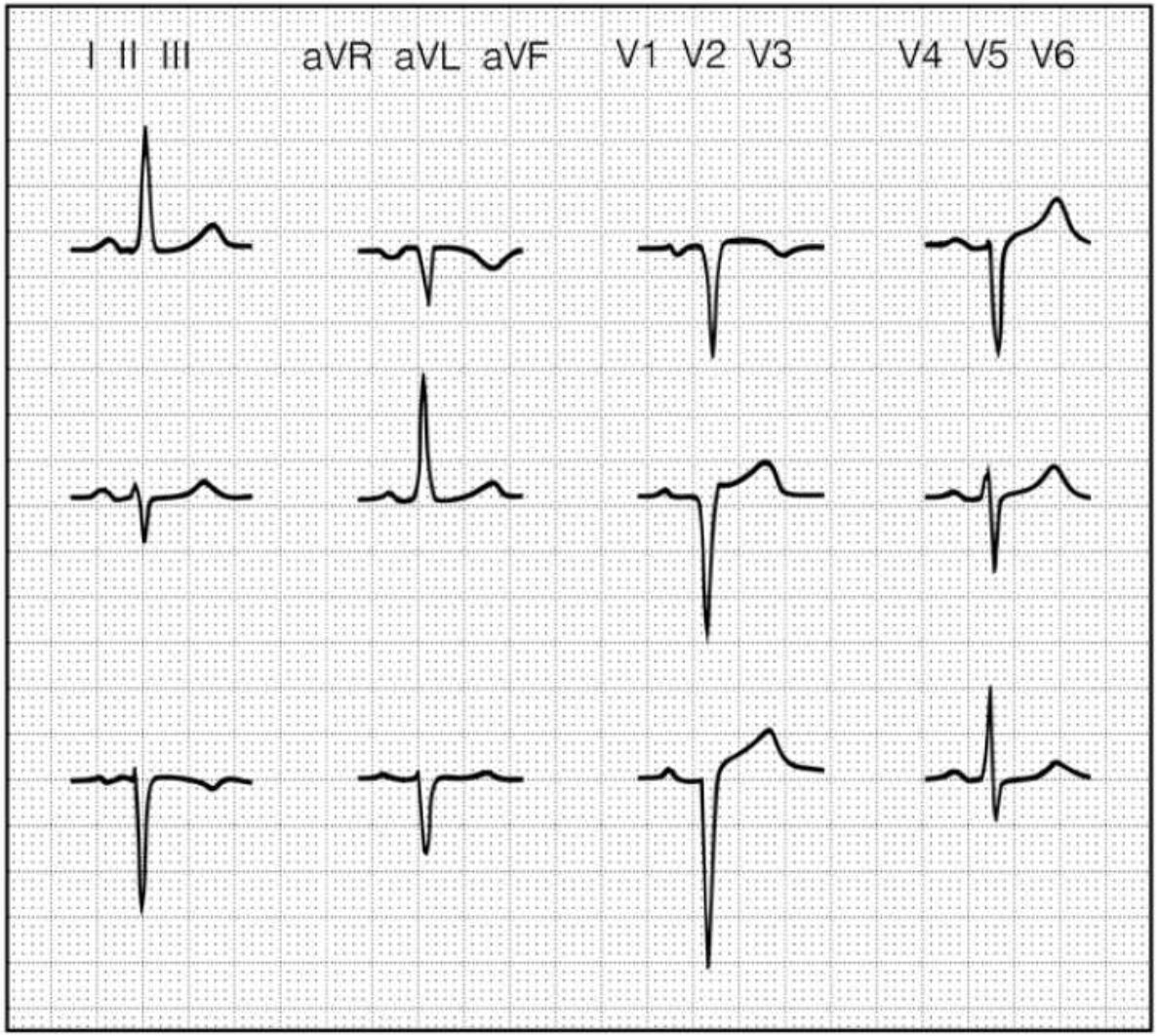
Diagnose?



Brugada-Syndrom

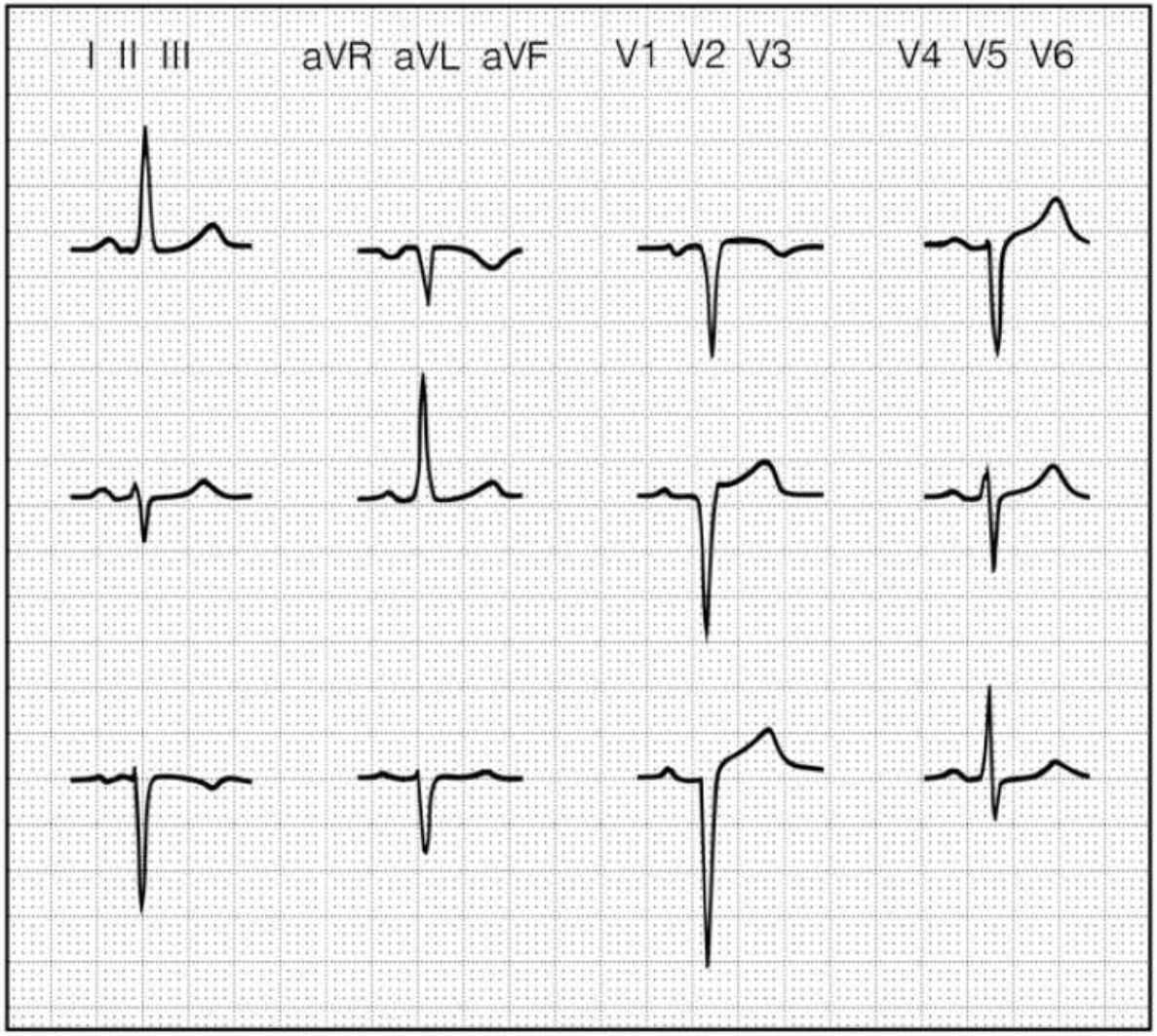


Diagnose



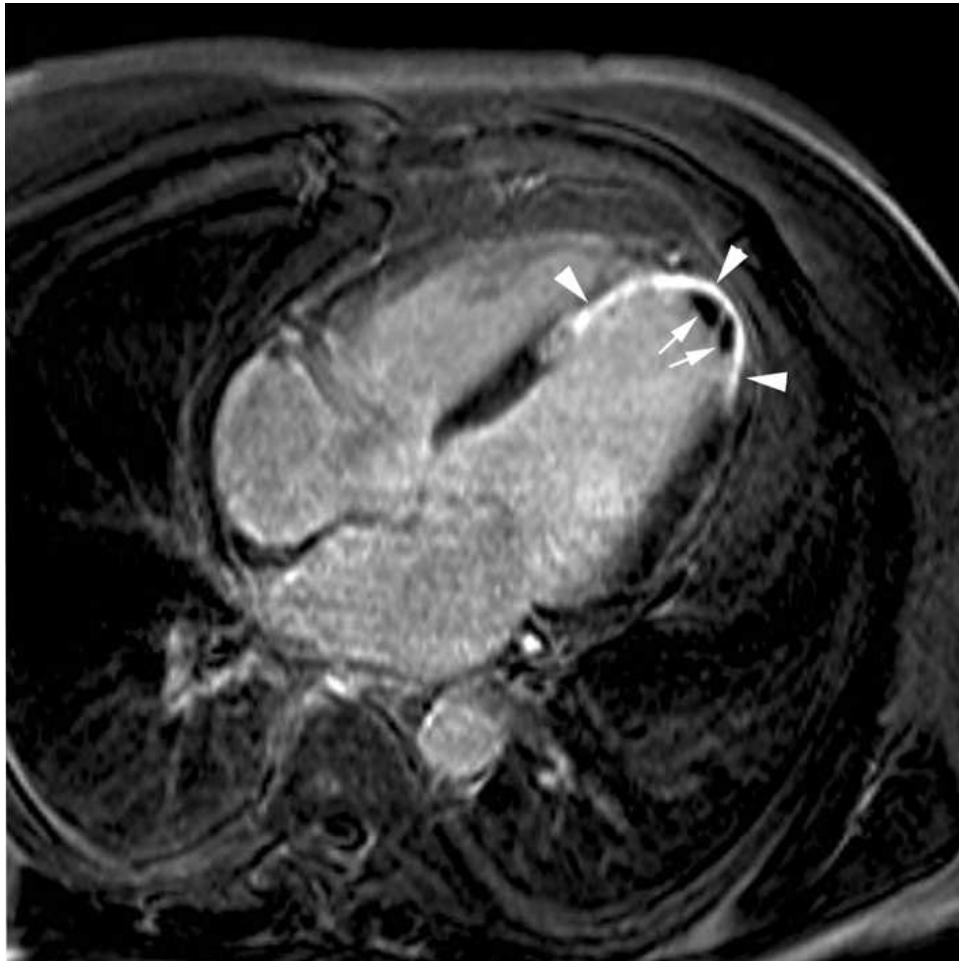
Foster, 2007

Alter Vorderwandinfarkt



Foster, 2007

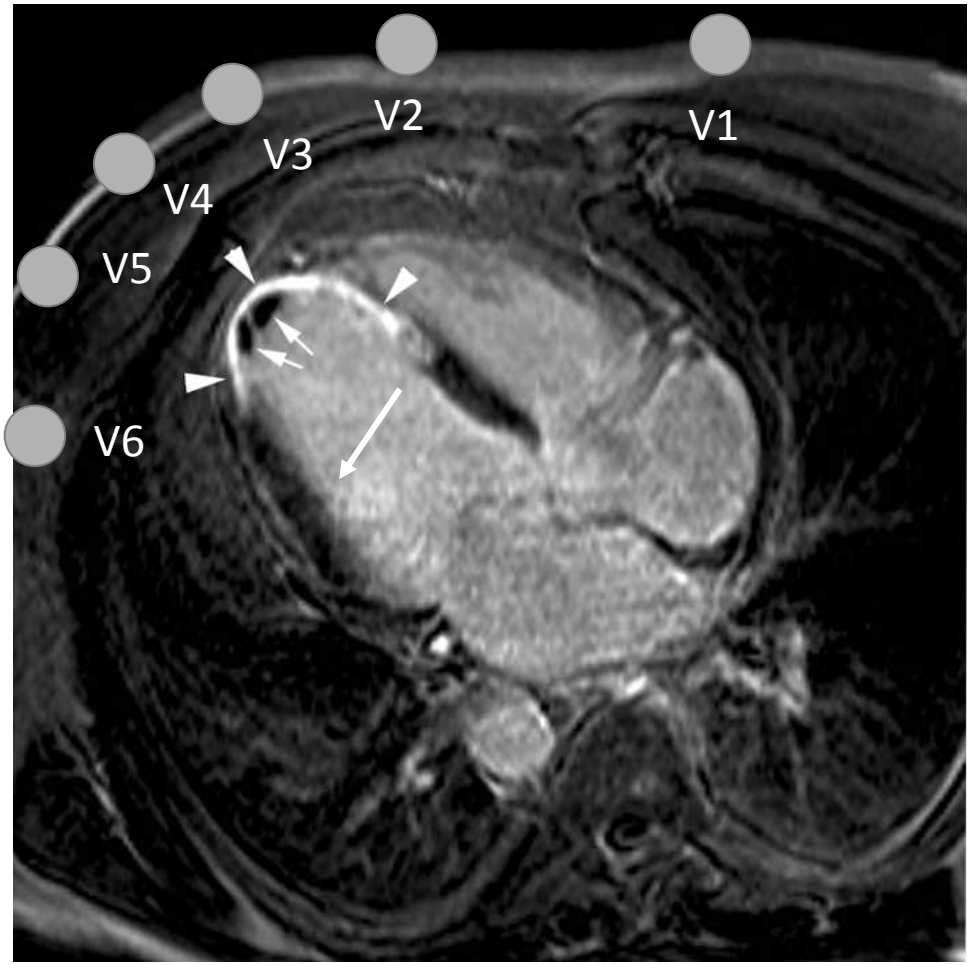
Alter ausgedehnter Vorderwandinfarkt



Giorgio und Bogaert, 2012

Alter ausgedehnter Vorderwandinfarkt

- Ein **Vektor** ist durch Betrag und Richtung definiert

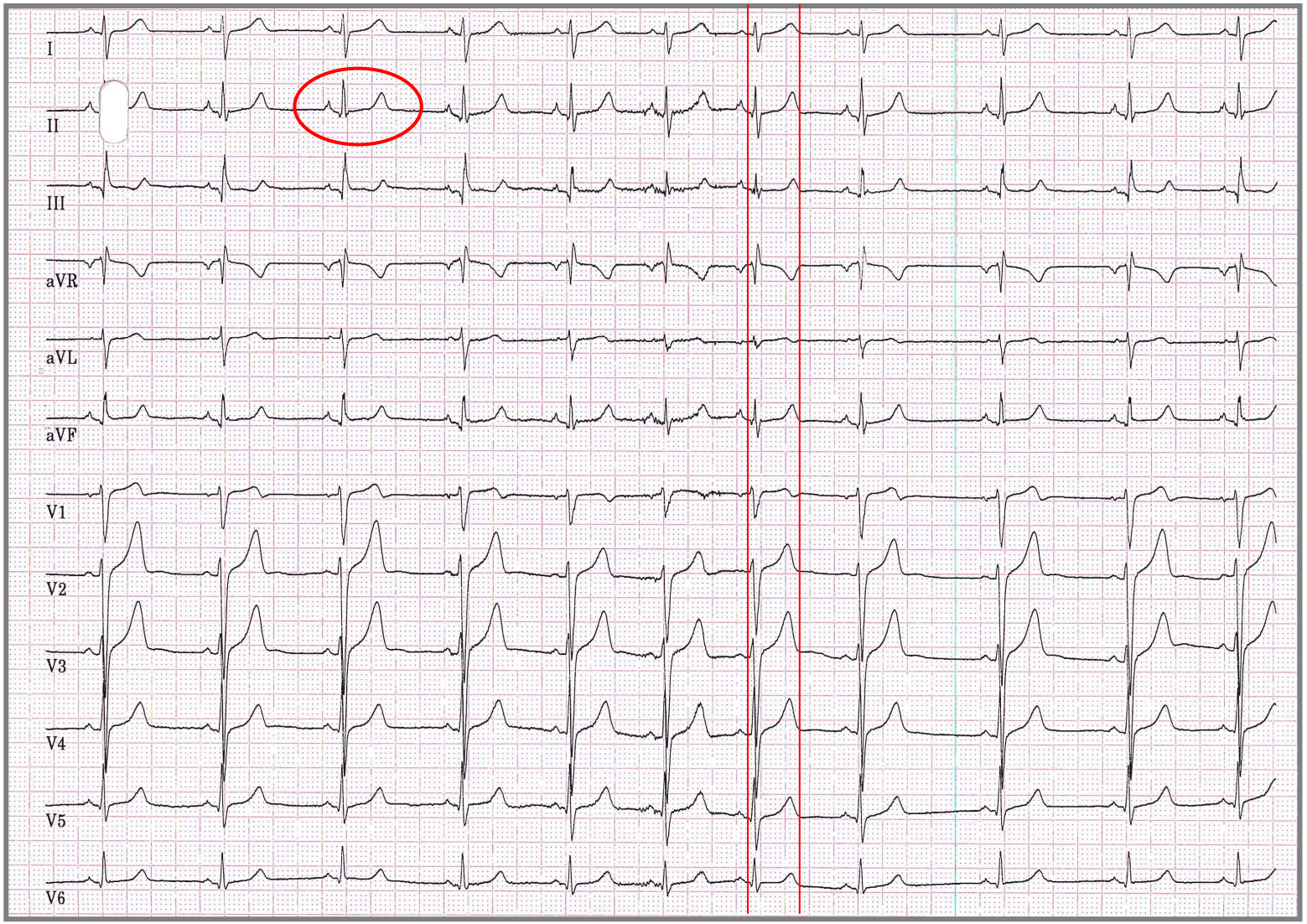


Blick in den Kopf hinein …

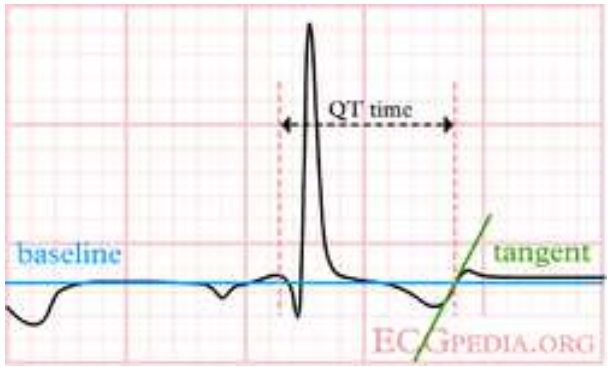
Vermessung des QT-Intervalls

- Wo soll gemessen werden?
- Womit messen?
- Wie angeben (Sekunden oder Millisekunden)?

12-Kanal-EKG: Wo das QT-Intervall messen?



Vermessung mittels Tangentenkonstrution?



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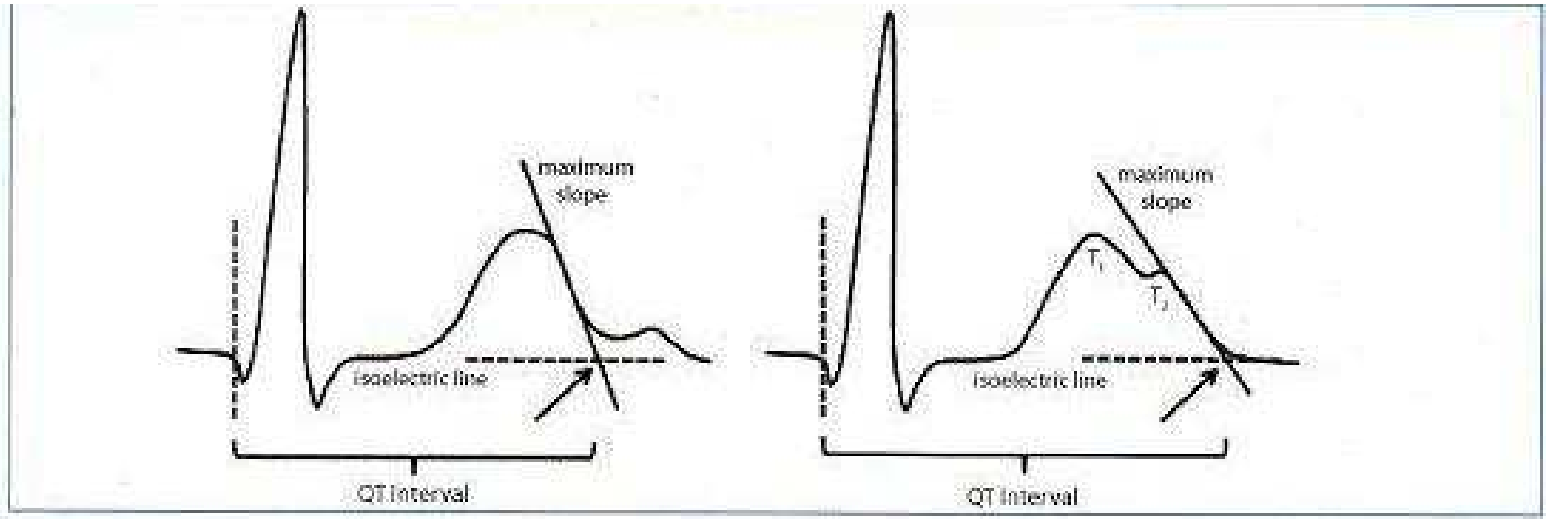
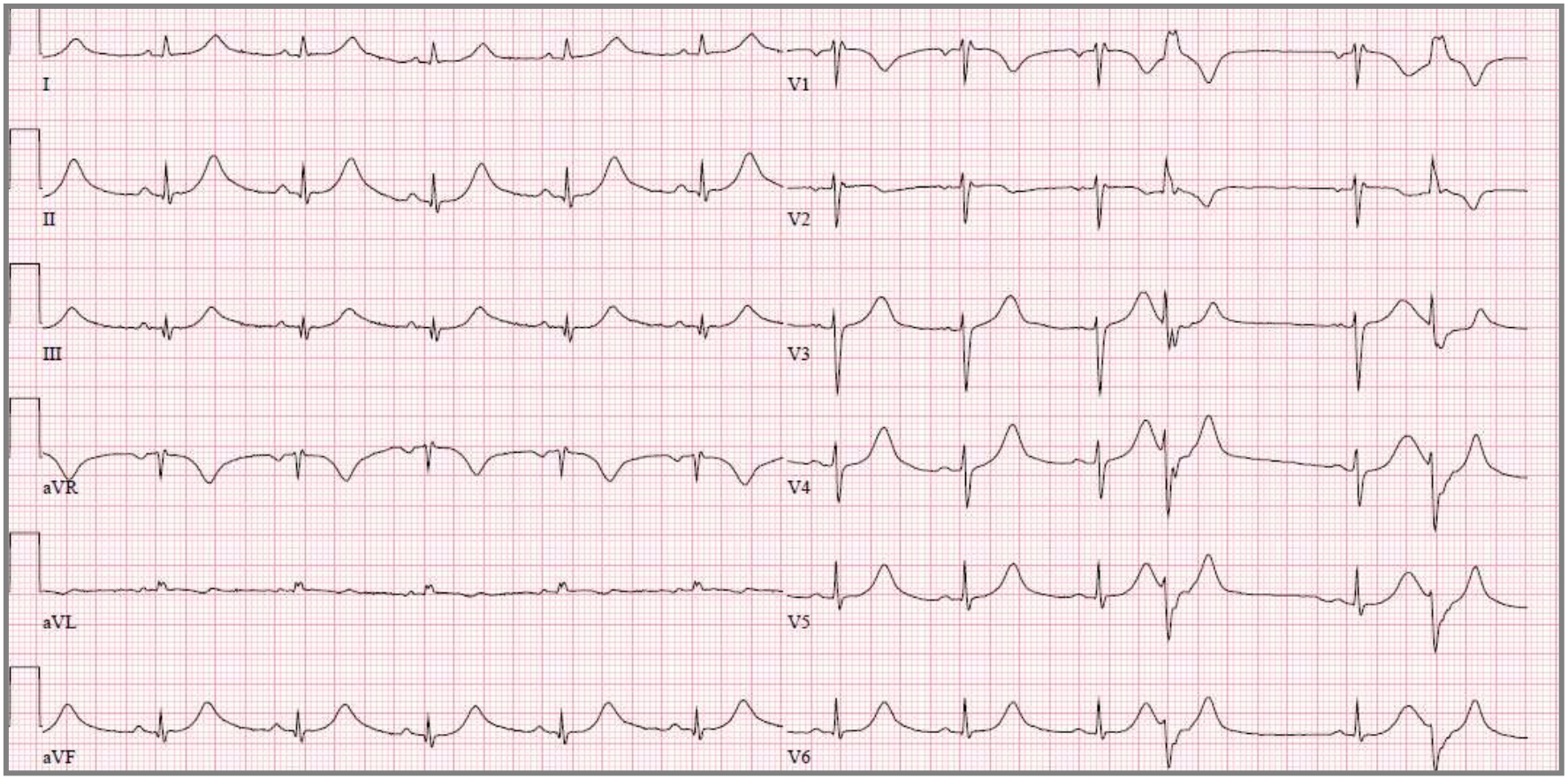
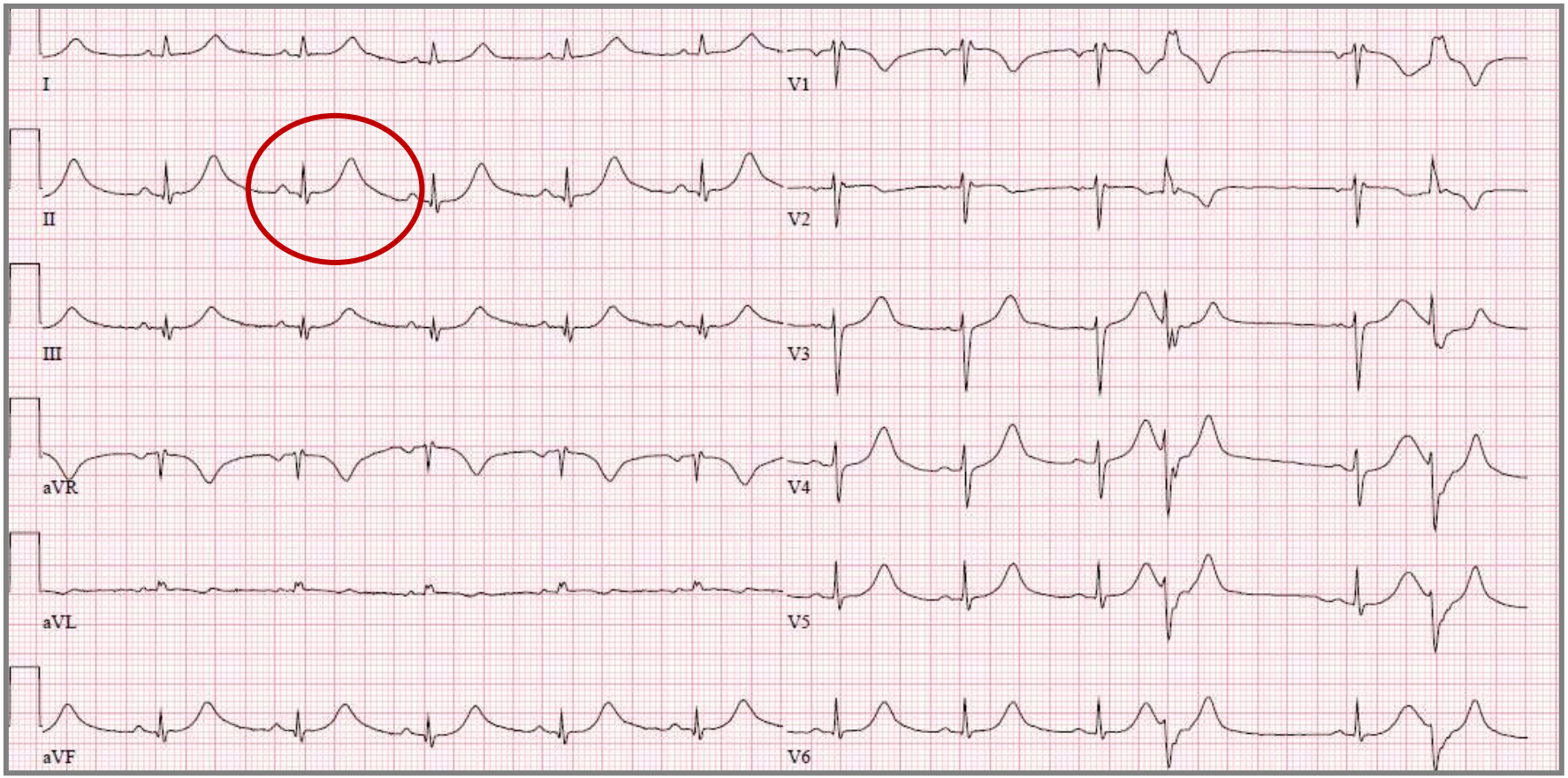


12-Kanal-EKG: Wo das QT-Intervall messen?



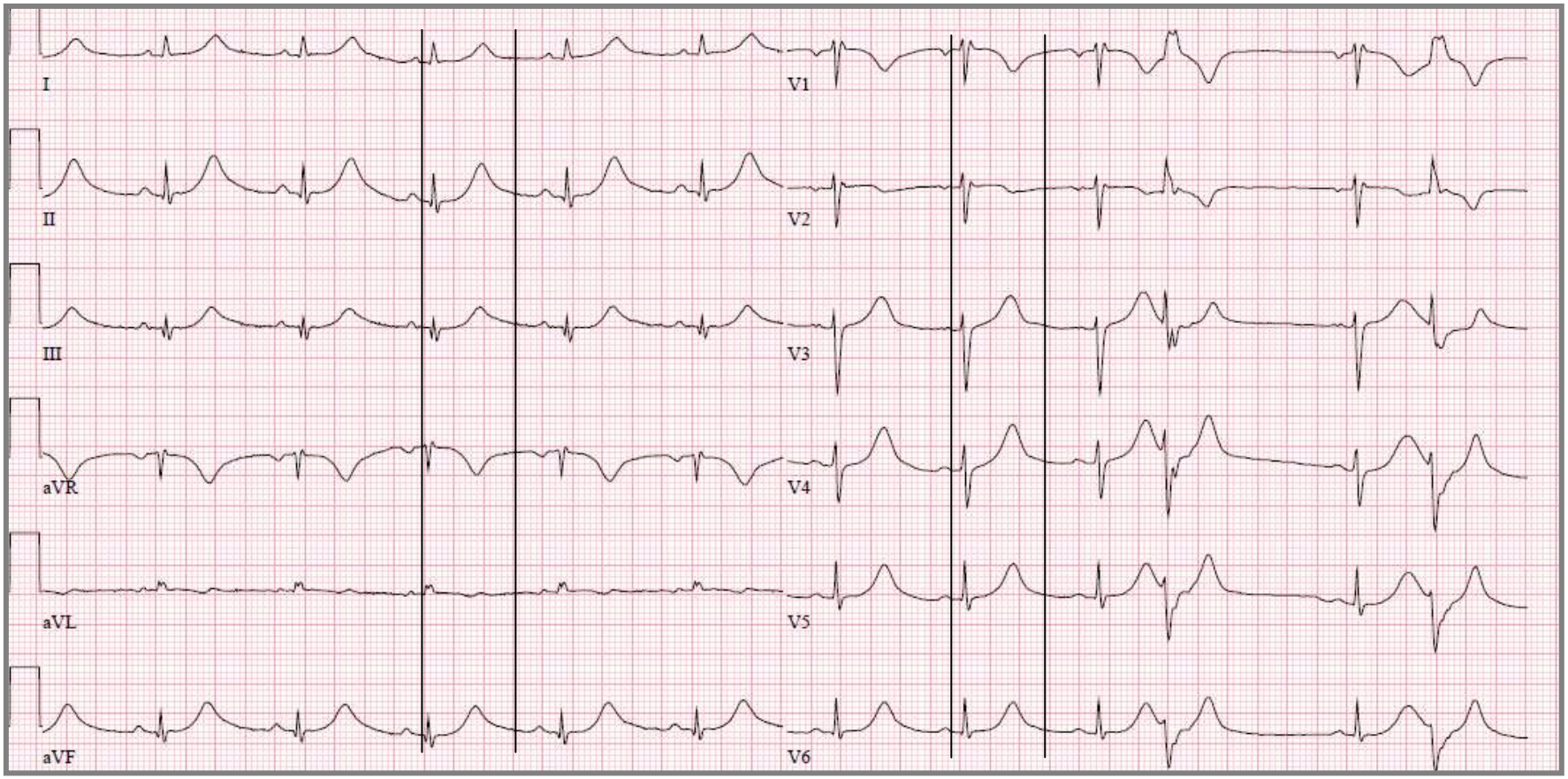
QTc: 524 ms; 6.3.2016

12-Kanal-EKG: Intervallmessung in Ableitung II



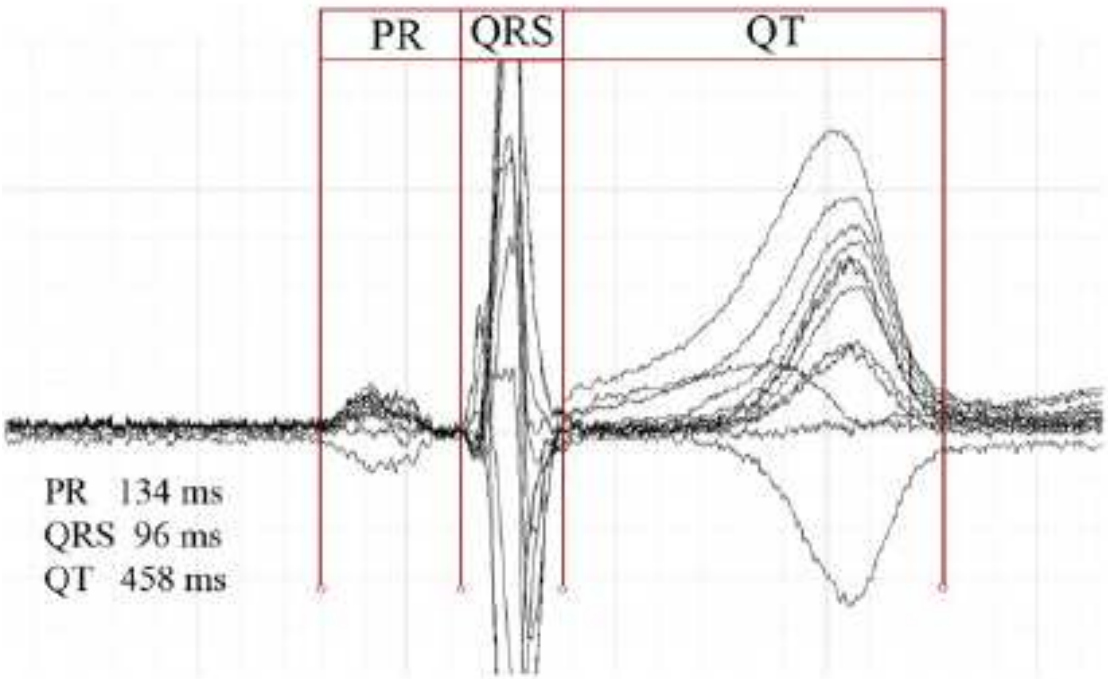
QTc: 524 ms; 6.3.2016

12-Kanal-EKG: Wo das QT-Intervall messen?



QTc: 524 ms; 6.3.2016

EKG-Intervallmessung

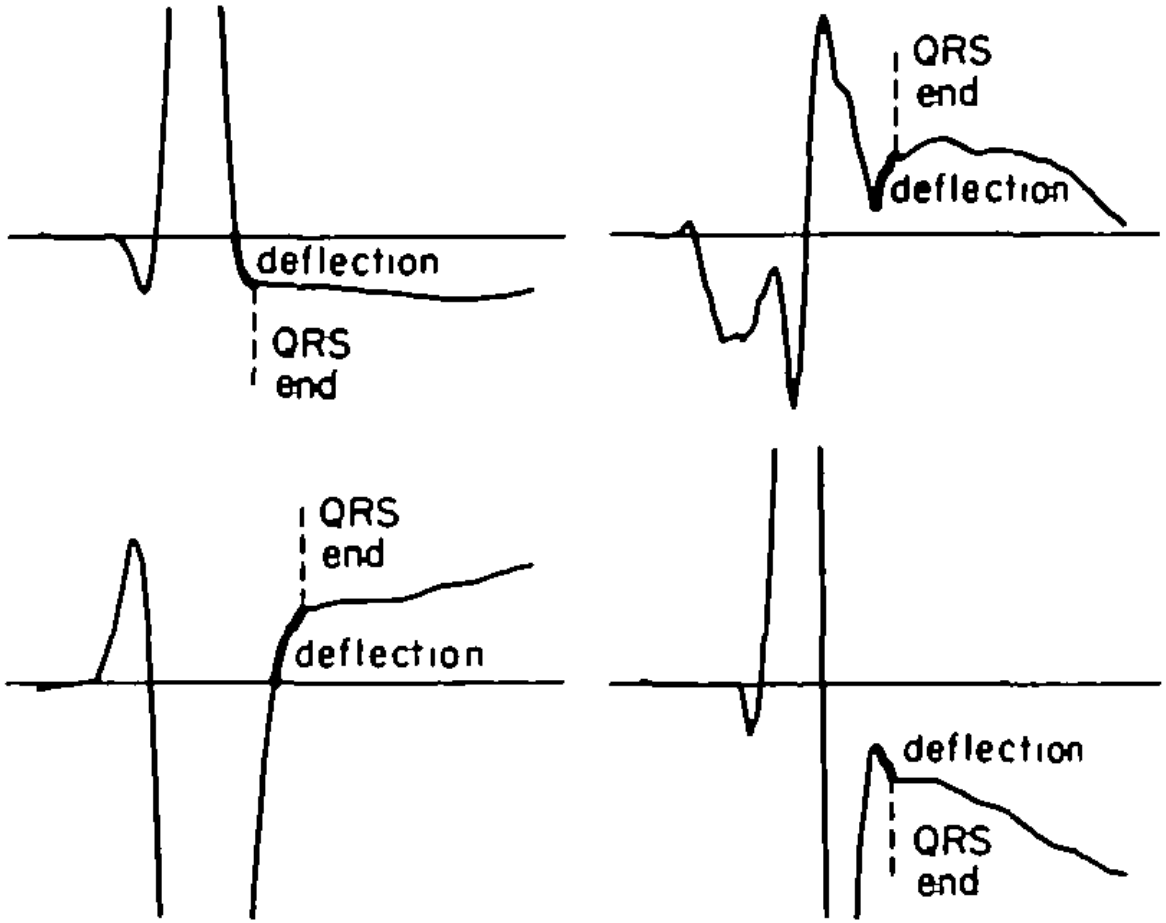


Frequenzkorrektur von QT

- **Bazett's formula:** $QT_C = QT / \sqrt{RR}$
- **Fredericia's formula:** $QT_C = QT / RR^{1/3}$
- **Framingham formula:** $QT_C = QT + 0.154\ (1 - RR)$
- **Hodges formula:** $QT_C = QT + 1.75\ (\text{heart rate} - 60)$

- The RR interval is given in seconds (RR interval = 60/heart rate).

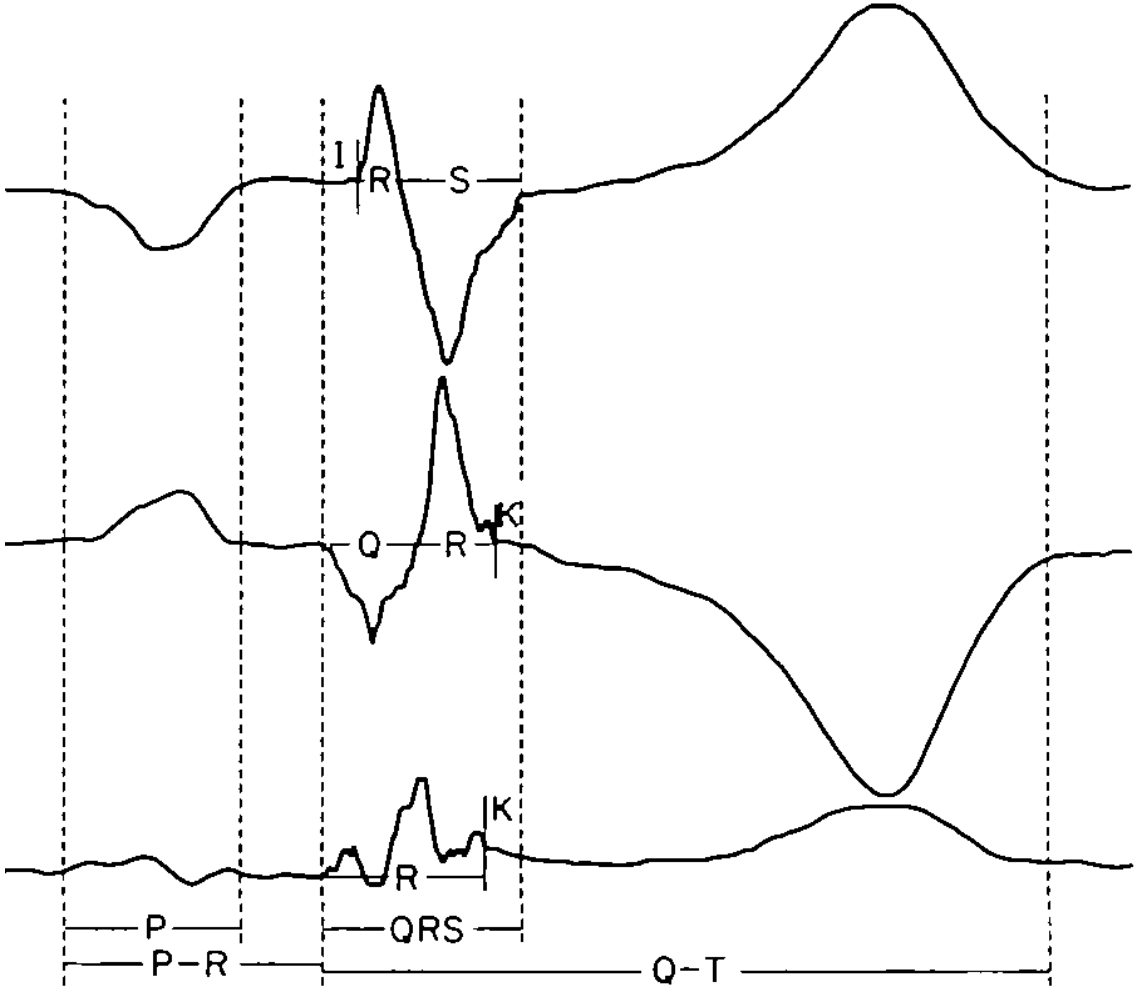
Vermessung der QRS-Dauer



CSE 1985

Kompletter Linksschenkelblock

Intervallvermessung



ENDE

Vielen Dank für Ihre Aufmerksamkeit!