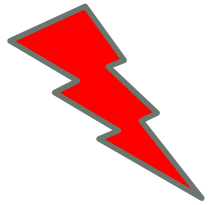
İNTRAOPERATİF MONİTÖRİZASYON

Monitör = Monere = Uyarı



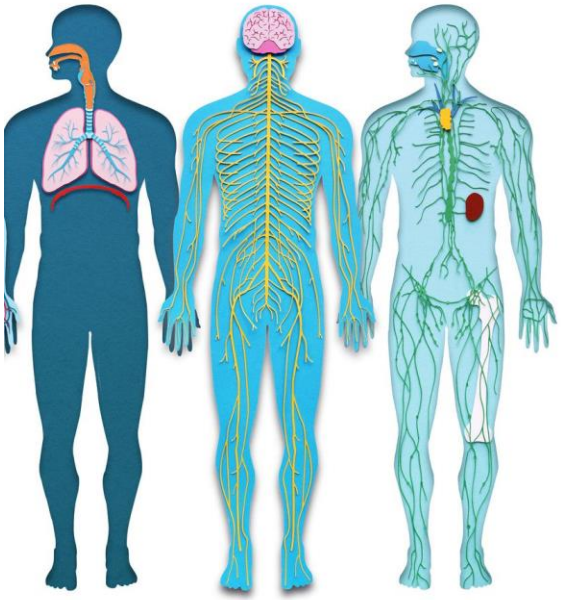
Önemli yaşamsal değişkenleri duyularımızı uyaran elektronik aygıtlar aracılığıyla ölçme işlemi

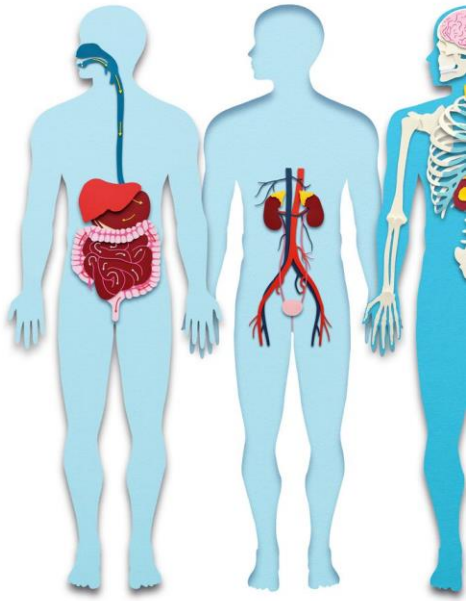
Neden gerekli?

- Değişkenleri incelenmesi
- Sorunları tanınması
- Sorunların ciddiyetini belirlenmesi
- Tedaviye cevabın değerlendirmesi

Parametreler

- KVS
- Solunum
- Renal
- Nöromüsküler
- Sıcaklık
- SSS



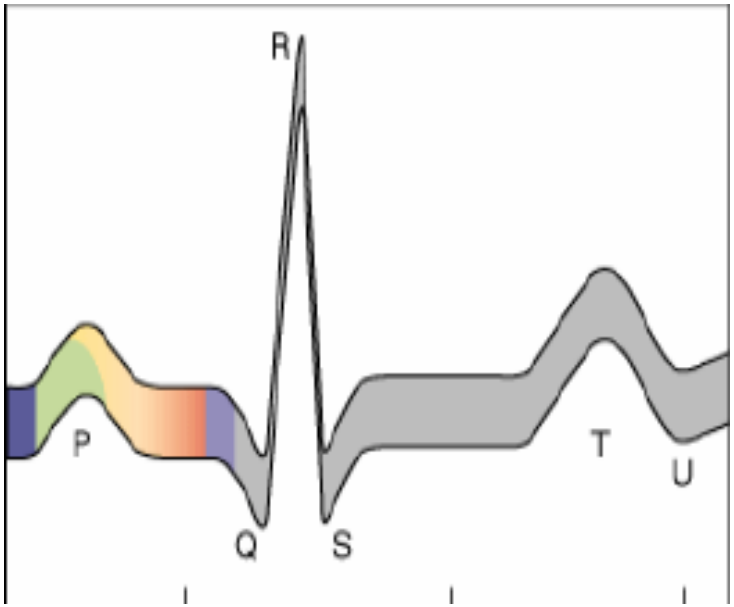


KARDİYOVASKÜLER SİSTEM

- Elektrokardiografi(EKG)
- Arteriyel kan basıncı
- Santral venöz basınç
- Pulmoner arter ve kapiller kama basınçları
- Kardiyak debi
- Oksijen sunum ve tüketimi

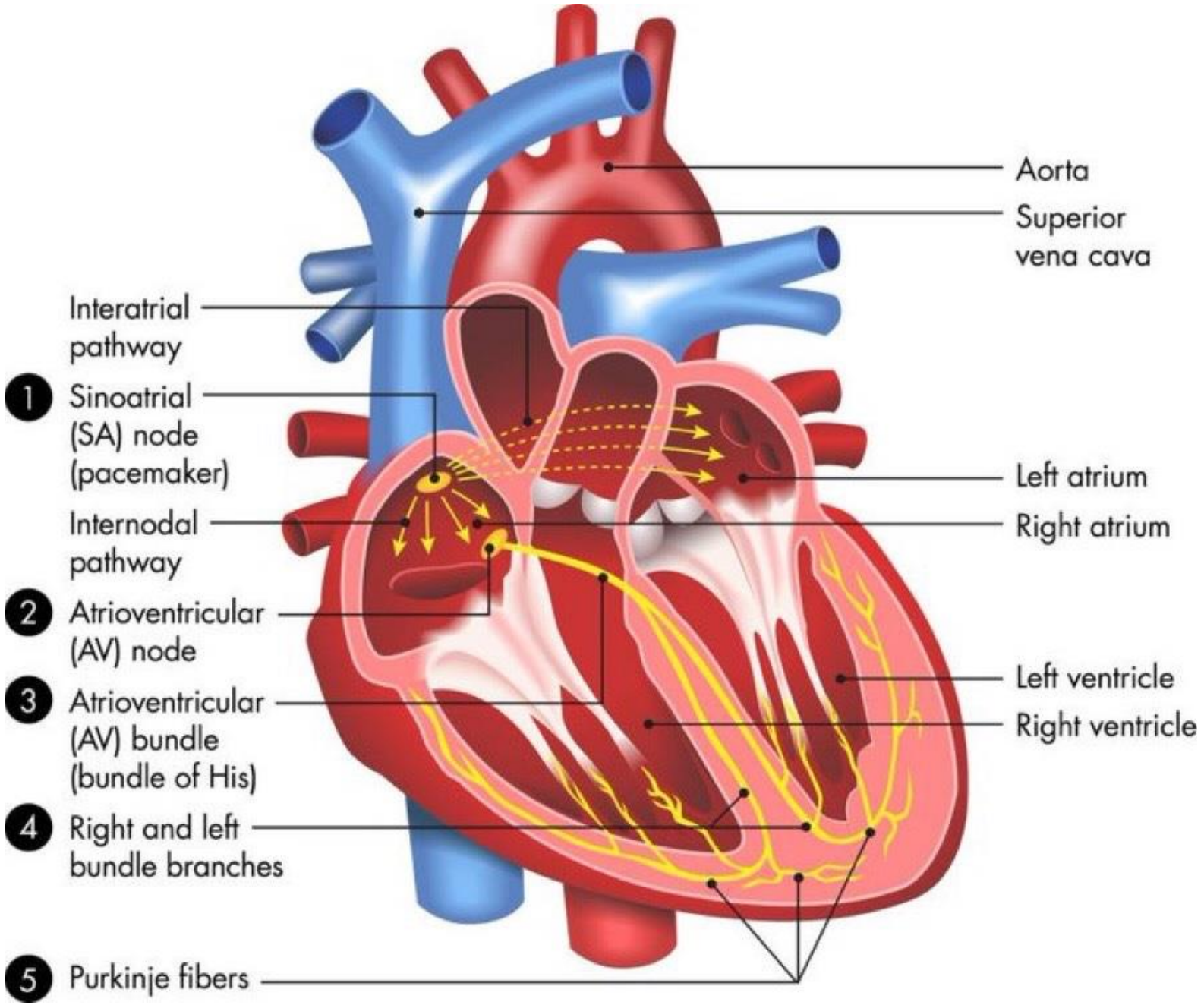
Elektrokardiyografi (EKG)

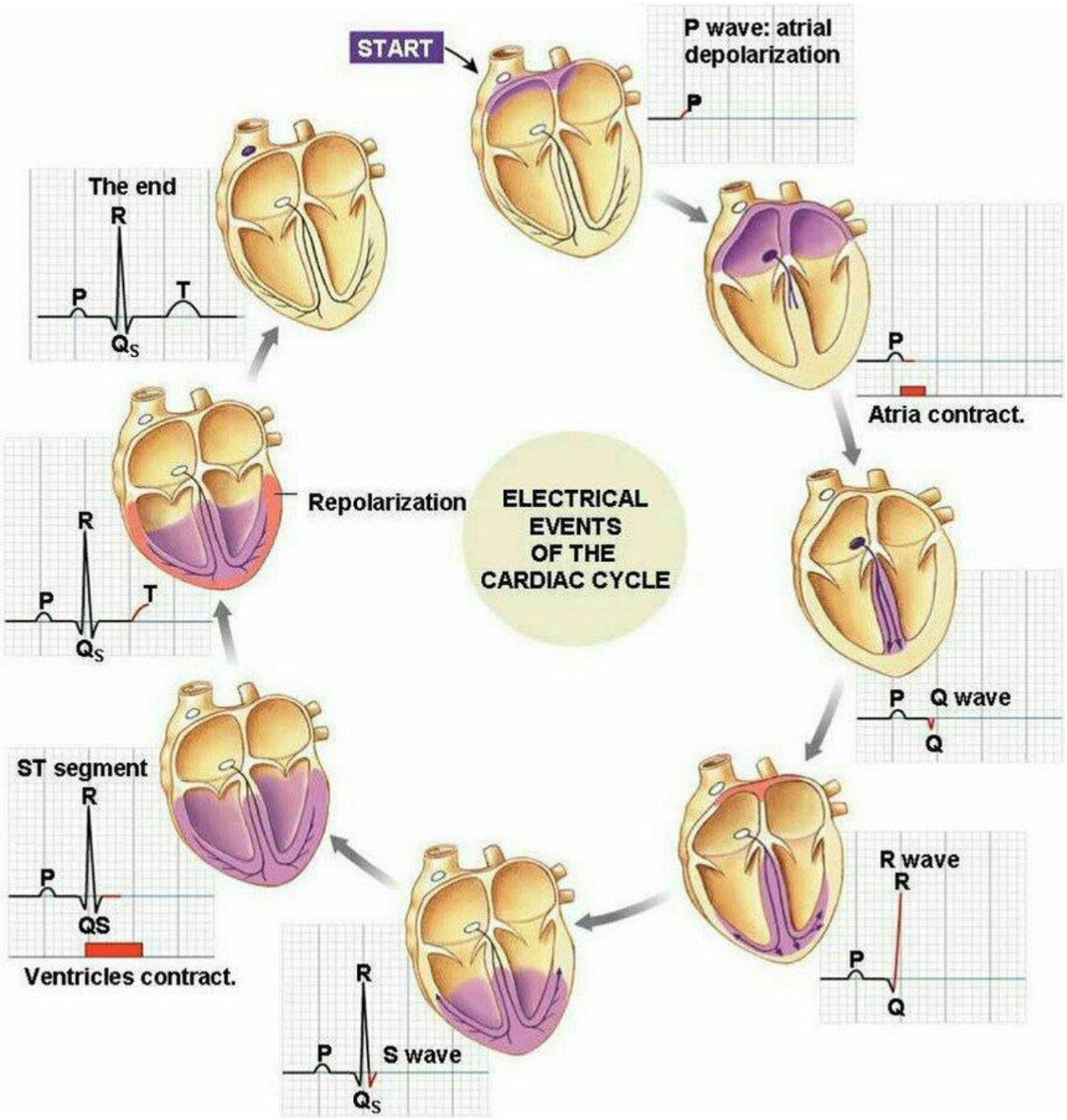
- Vücut yüzeyindeki voltajı ölçer
- Kardiyak kontraksiyona ilişkin elektromekanik olayları yansıtır.



Standart 3 derivasyonlu EKG

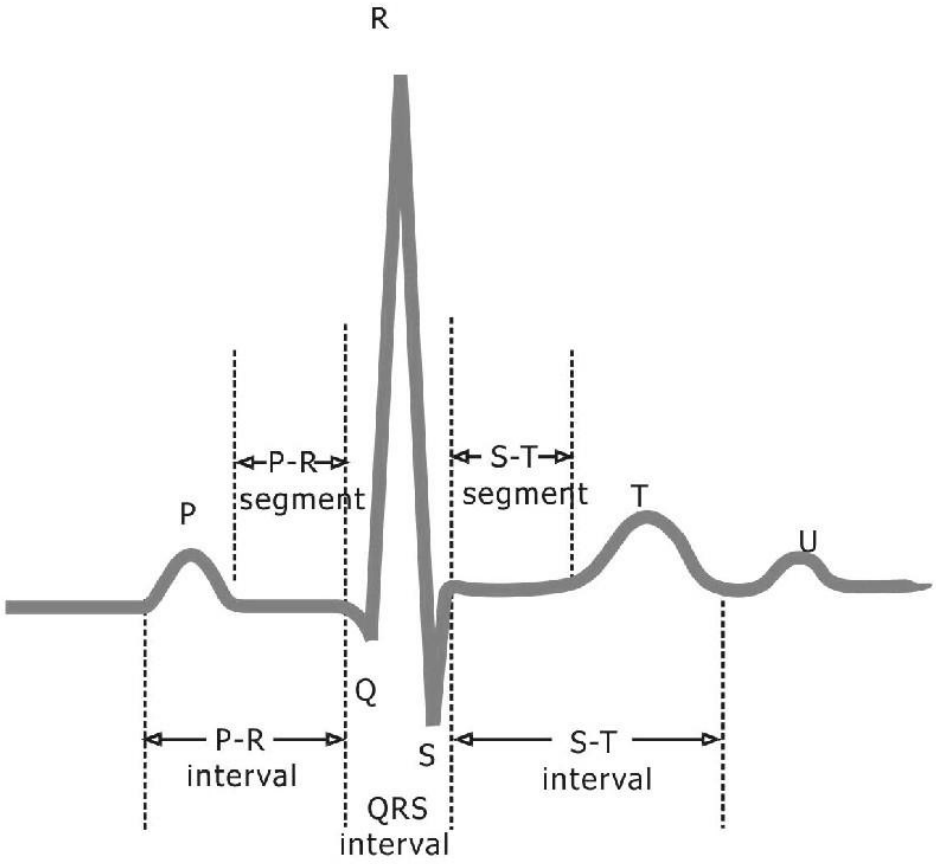
- DI: iki kol arası
- DII: sağ kol ile sol bacak arası → en sık
- DIII: sol kol ile sol bacak arası potansiyel fark


Aorta
Superior vena cava
Interatrial pathway
1 Sinoatrial (SA) node (pacemaker)
Internodal pathway
2 Atrioventricular (AV) node
3 Atrioventricular (AV) bundle (bundle of His)
4 Right and left bundle branches
5 Purkinje fibers
Left atrium
Right atrium
Left ventricle
Right ventricle


START
P wave: atrial depolarization
P
Atria contract.
P
P Q wave
Q
R wave
R
P
Q
R
P
S wave
QS
ST segment
R
P
QS
Ventricles contract.
R
P
T
QS
Repolarization
The end
R
P
T
QS
ELECTRICAL EVENTS OF THE CARDIAC CYCLE

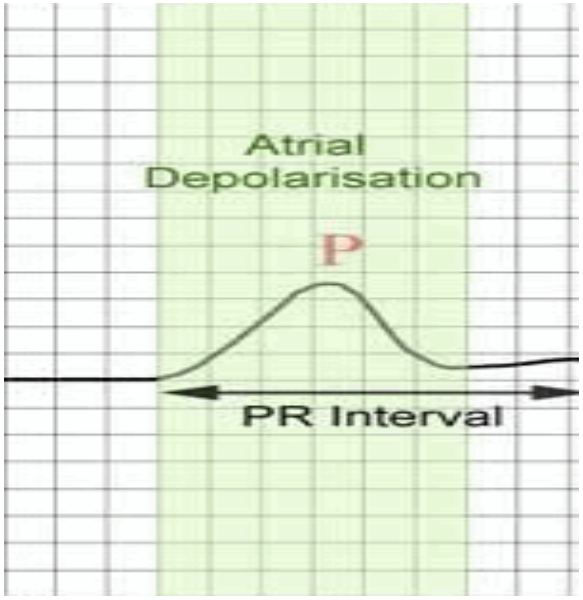
Genel bilgiler

- 1 küçük kare 0,04 sn
- Hız, 300/ büyük kare
  1500 / küçük kare



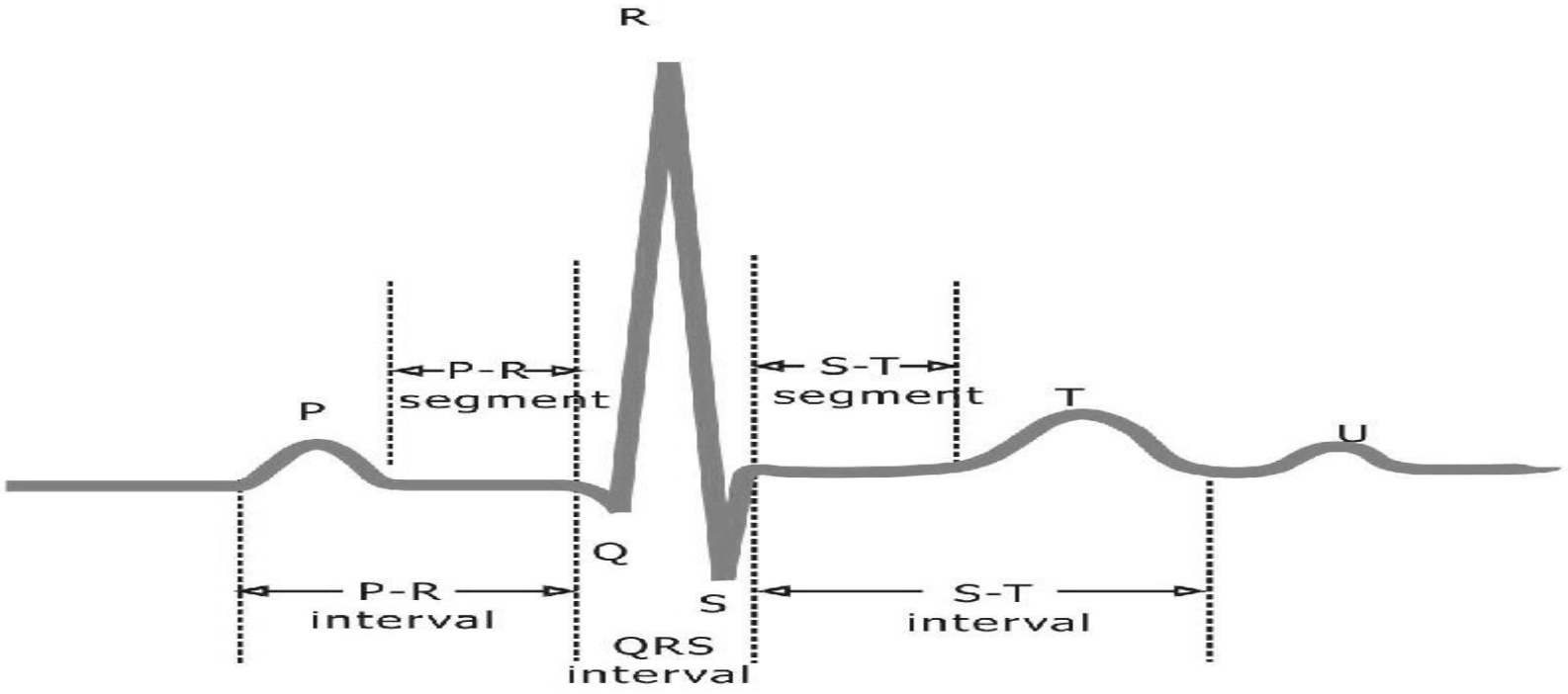
P Dalgası

- Atriyum sistolü ile oluşur (0.12 sn=< 3 kare)
- aVR hariç tüm derivasyonlarda (+)



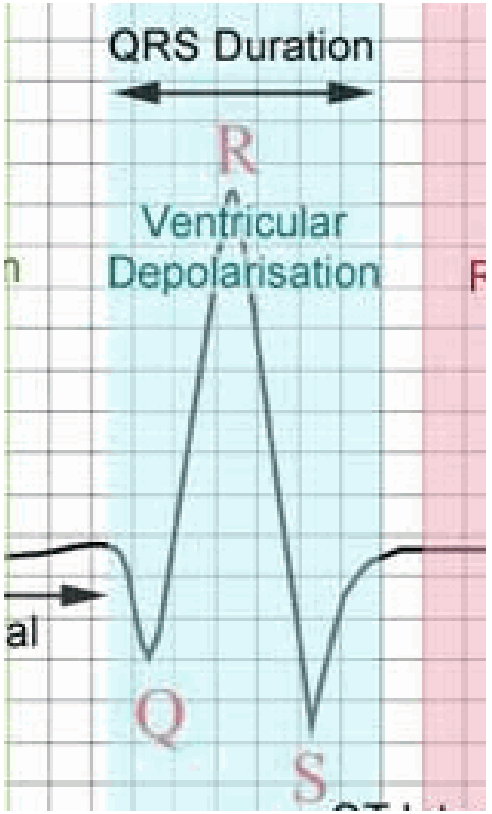
PR intervali

- Uyarının SA noddan ventriküle iletilme/AV iletim süresi
- 0.12-0.20 sn
- Uzun PR intervali = 1.derece AV blok

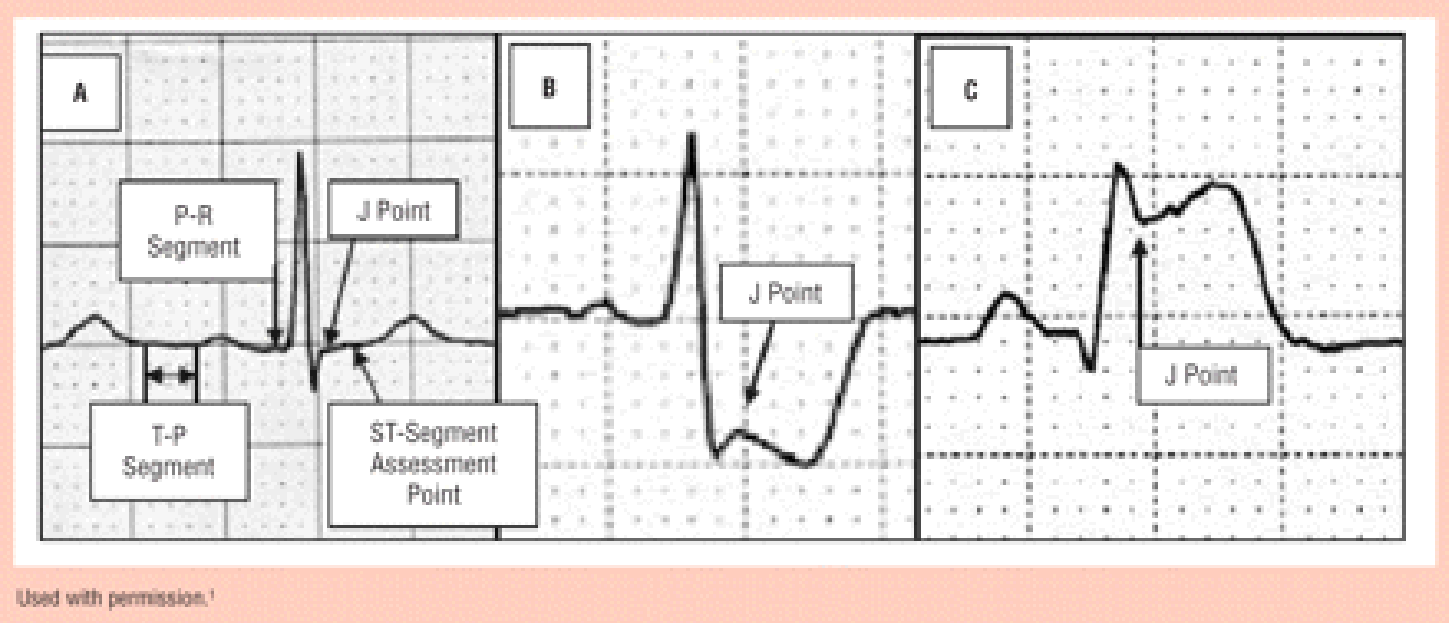


QRS kompleksi

- Ventrikül sistolü ile oluşur (< 0.12 sn)
- Anormal derecede geniş QRS
  - sağ/sol dal bloğu
  - hiperkalemi



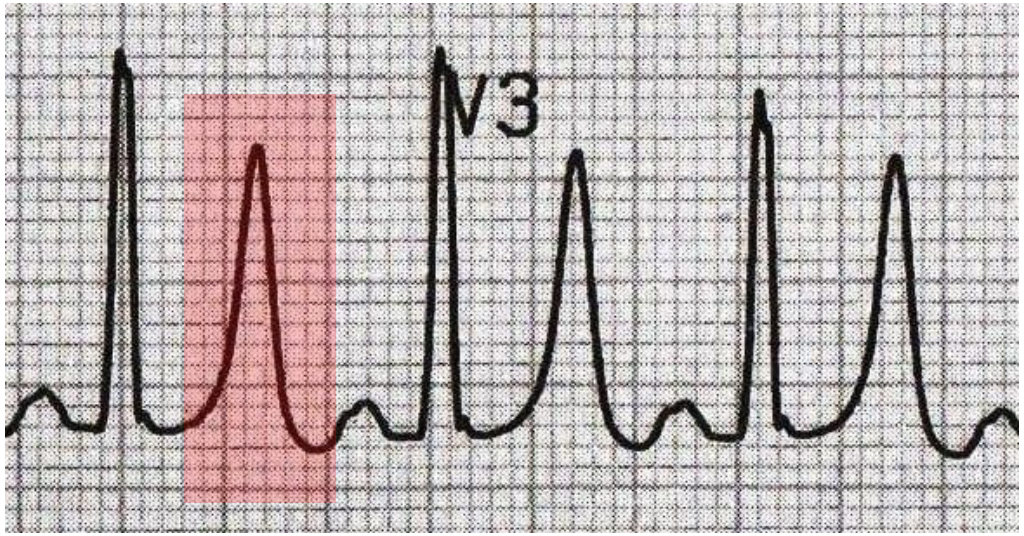
ST segment analizi



- A → ST j noktasından sonra 0.6 sn (ST izoelektrik/normal)
- B → ST 5 mm kadar çökmüş (depresyon)
- C → ST 4 mm kadar yükselmiş (elevasyon)

T Dalgası

- Ventriküler repolarizasyonu gösterir
- Standart derivasyonlarda (+) (AVR-V1'de (-))
- Yüksek T dalgası
  - Hiperkalemi
  - Hiperakut MI
  - Sol dal bloğu
- Negatif T dalgası
  - İskemi
  - Perikardit
  - Hiperventilasyon



Sinüs Ritmi

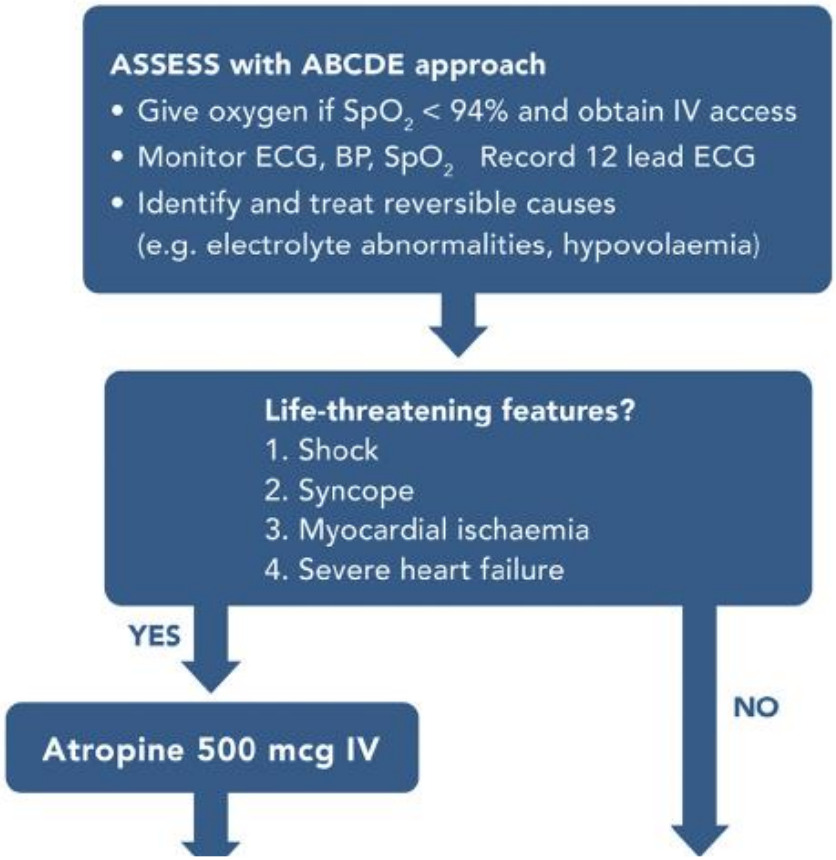
- Hız → 60-100 atım/dak
- En etkin ritim
- En optimal kardiyak debi
- Oksijen tüketimi en az

Sinüs Bradikardisi

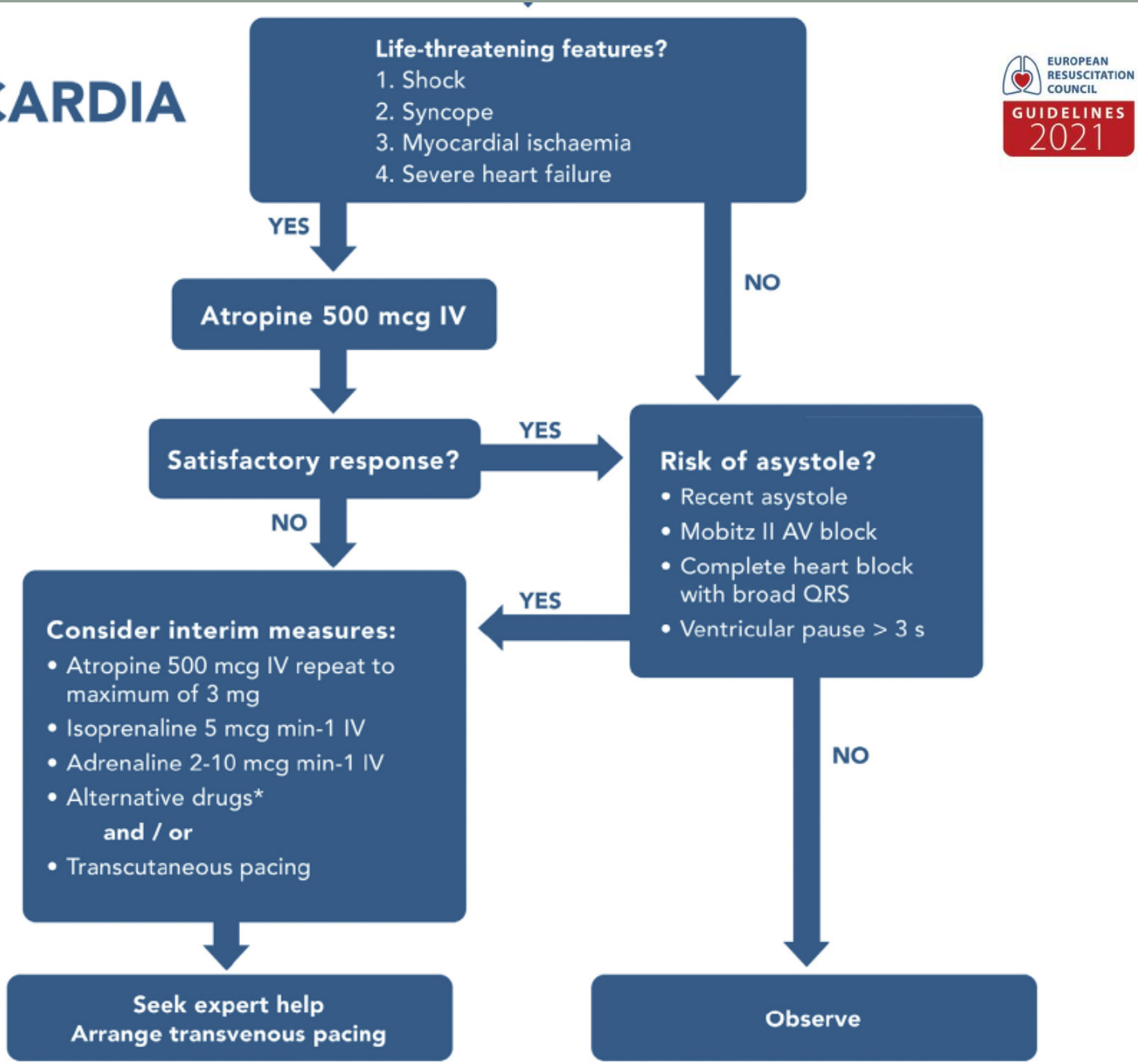
- Kalp hızı 40-60 atım/dakika, ritm düzenli
- Hemodinami stabilse tedavi gereksizdir

BRADYCARDIA

EUROPEAN RESUSCITATION COUNCIL
GUIDELINES 2021



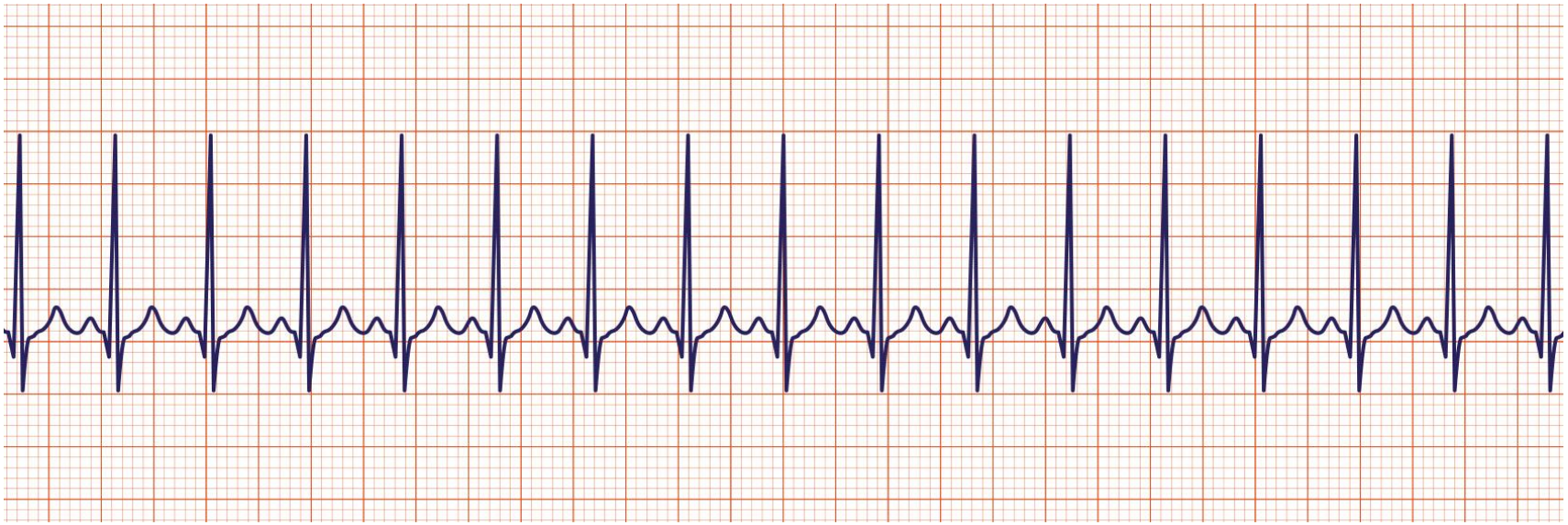
BRADYCARDIA



EUROPEAN RESUSCITATION COUNCIL
GUIDELINES 2021

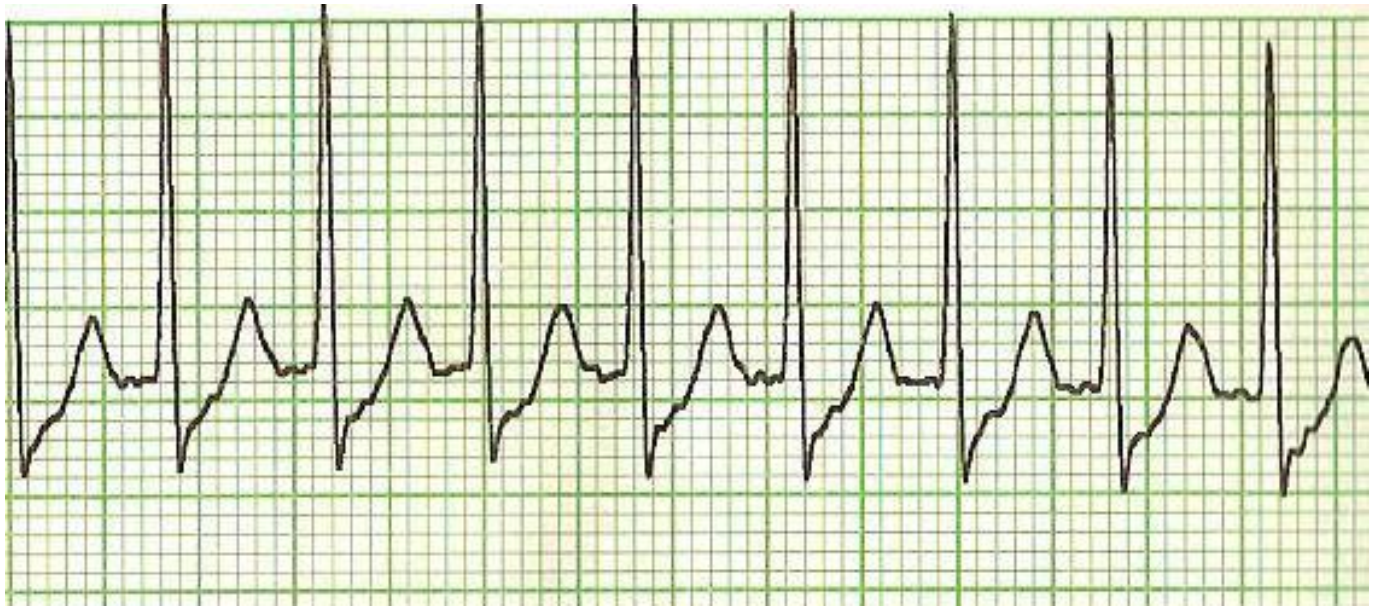
Sinüs Taşikardisi

- Hız 100 atım/dakika üzerinde, ritm düzenli
- En yüksek 150-170 atım /dakika
- Miyokard oksijen tüketiminde aşırı artış



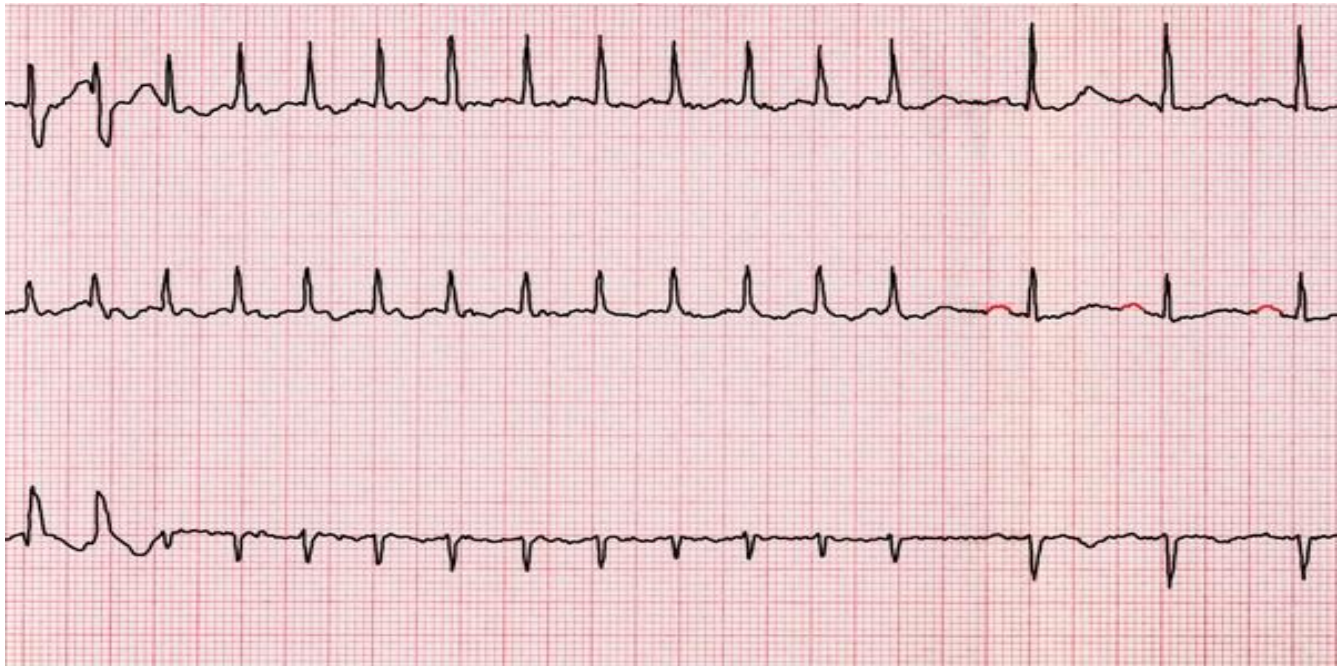
Supraventriküler Taşikardi (SVT)

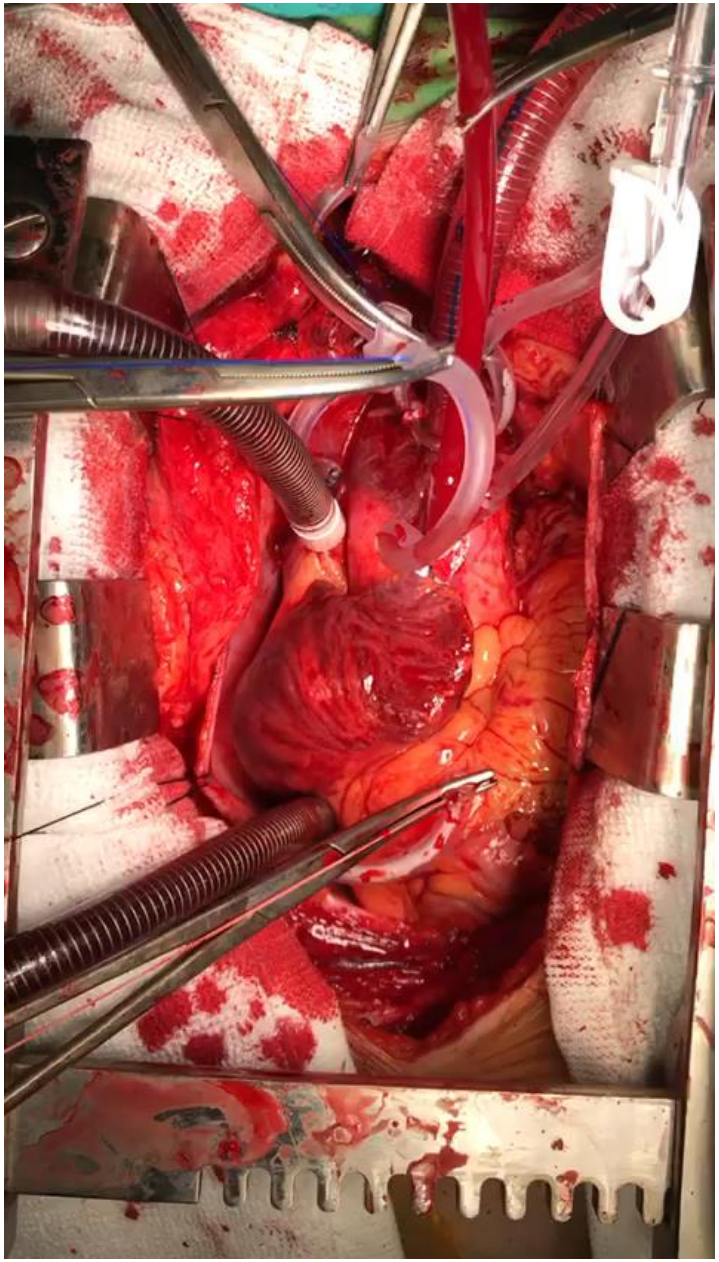
- Kalp hızı 150-250/dk arasında
- P:QRS ilişkisi genellikle 1:1 şeklindedir
- P dalgası QRS kompleksi içine girebilir

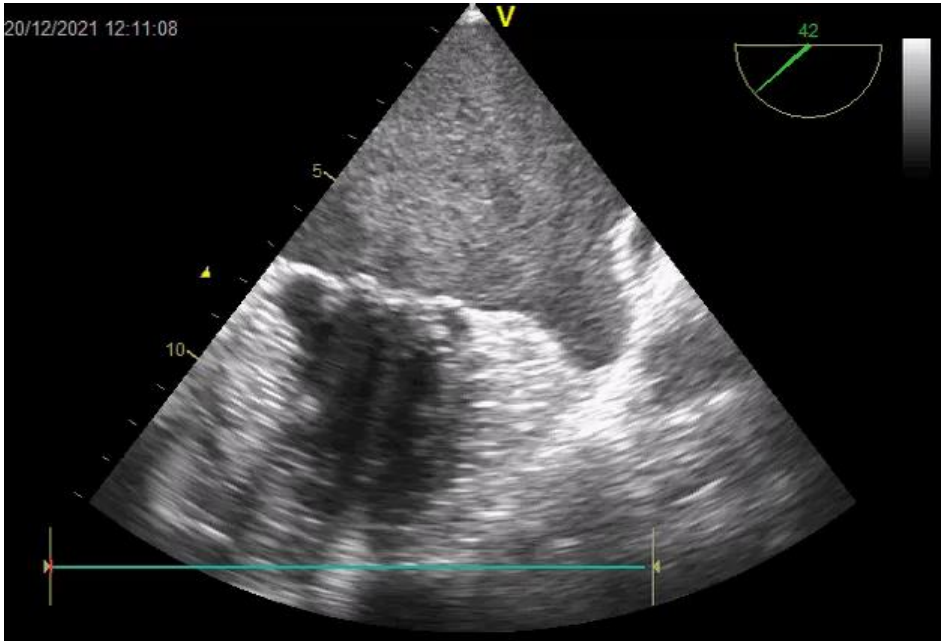


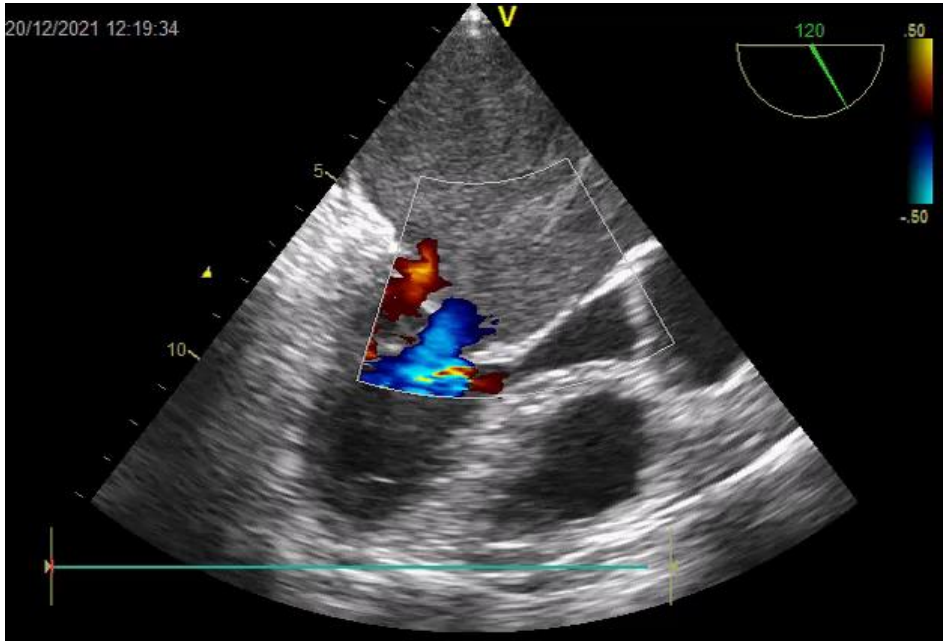
Atriyal fibrilasyon (AF)

- P dalgaları yok
- Atriyum hızı 350-500/dk, ventrikül hızı ise 60-170/dk
- Sol atriyumda trombüs → pulmoner ve sistemik emboli






20/12/2021 12:11:08
V
42
5
10


20/12/2021 12:19:34
V
120
.50
-.50
5
10

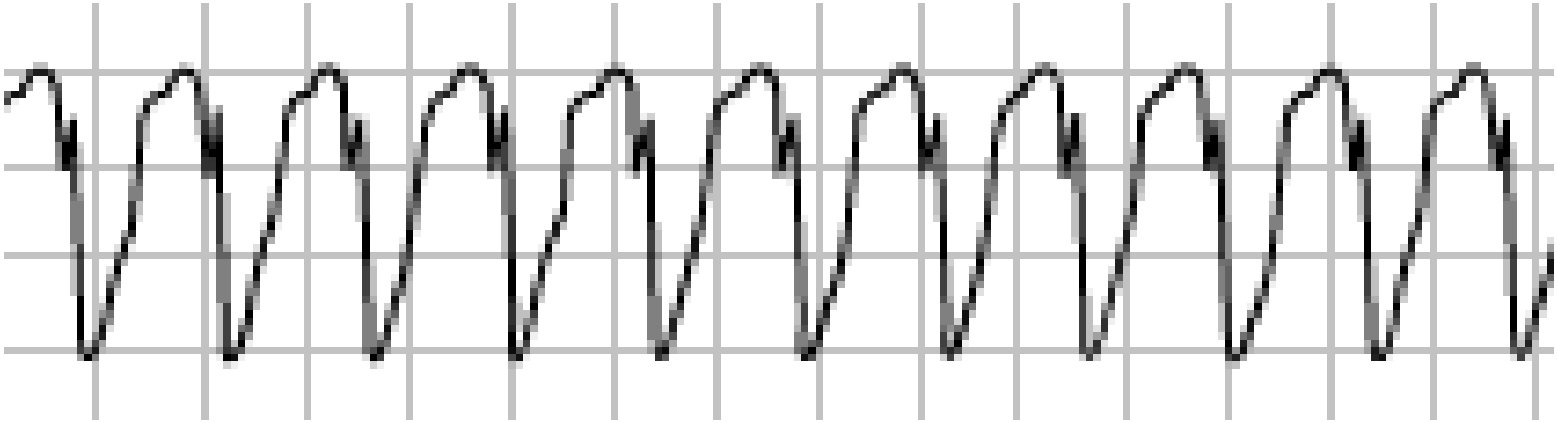
Sol atrial trombüs

AF tedavisi

- **İlk hedef ventrikül hız kontrolü**
  - Digoksin, ß bloker, Verapamil, Amiodaron
  - Kardiyoversiyon
- **Sinüs ritminin sağlanması**
  - Amiodaron
  - Kardiyoversiyon
- **Antikoagülasyon**
  - Warfarin, Heparin, Direkt oral antikoagülanlar (DOAK)

VENTRİKÜLER TAŞİKARDİ (VT)

- Kalp hızı 70-250 atım/dak
- P dalgası yoktur, QRS geniştir, ritim genellikle düzenlidir
- Akut VT yaşam tehdit edici bir aritmidir



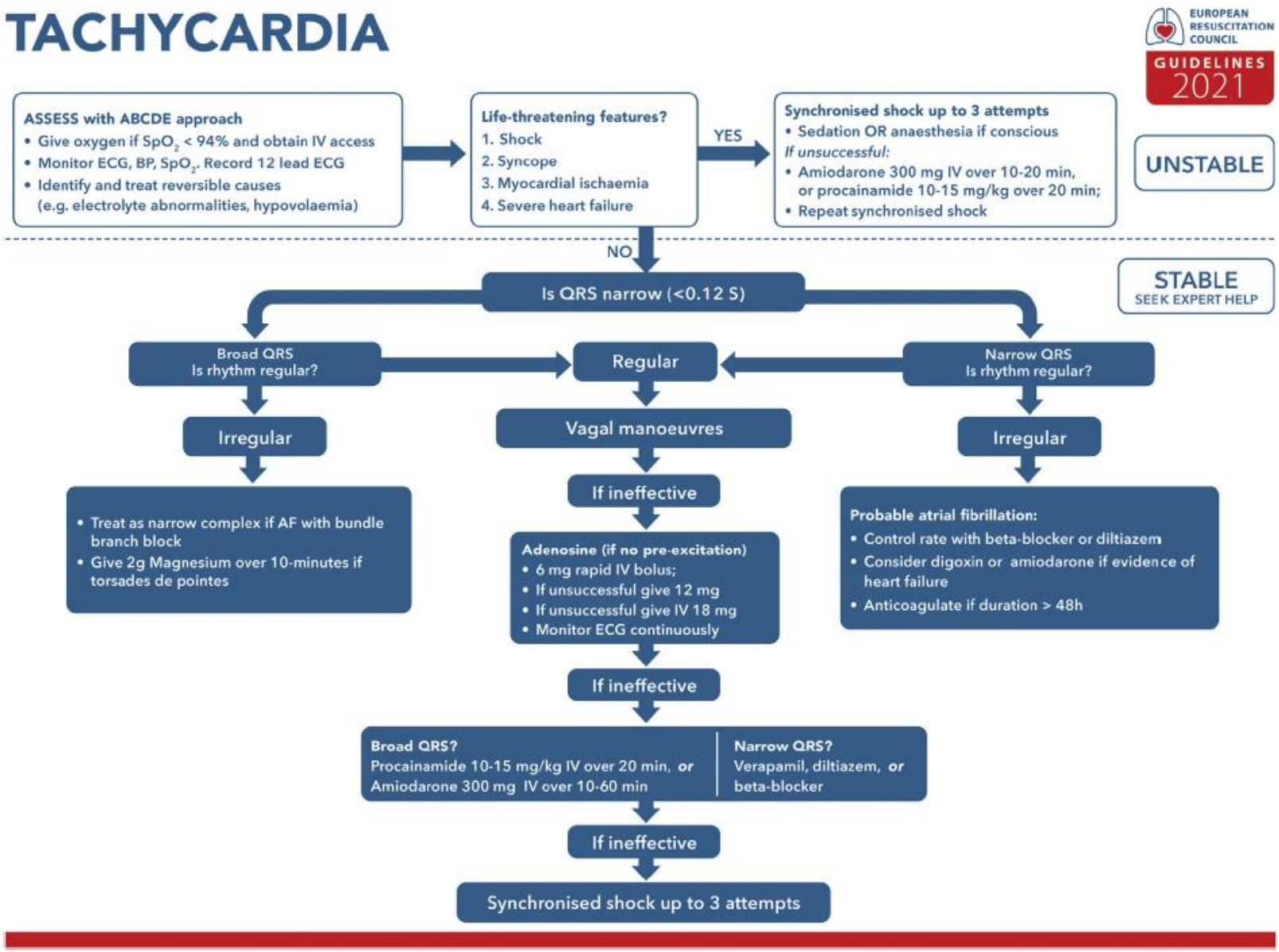


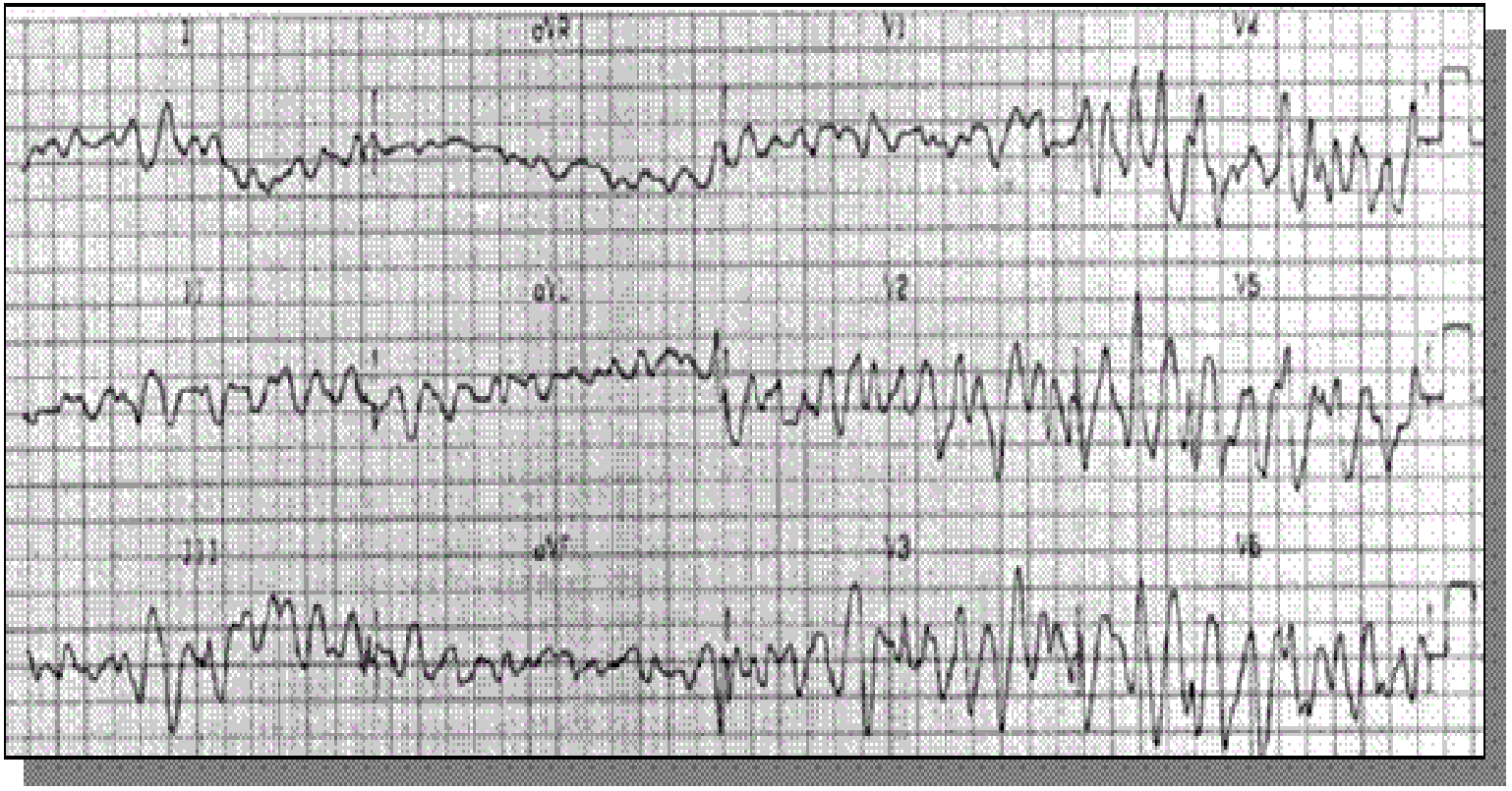
Fig. 5 – Tachycardia algorithm. ABCDE airway, breathing, circulation, disability, exposure BP blood pressure; DC direct current; ECG electrocardiogram; IV intravenous; SpO_2 arterial oxygen saturation; VT ventricular tachycardia.

VT Tedavisi

- Stabil hasta
  - Vagal manevra
  - Adenozin
  - Procainamide veya Amiodarone
  - Senkronize şok
- Anstabil hasta
  - Şok, senkop, miyokardiyal iskemi, ciddi kalp yetmezliği
  - Senkronize şok

VENTRİKÜLER FİBRİLASYON (VF)

- Kaotik ritim
- QRS kompleksleri tanınamaz
- Nabız YOK

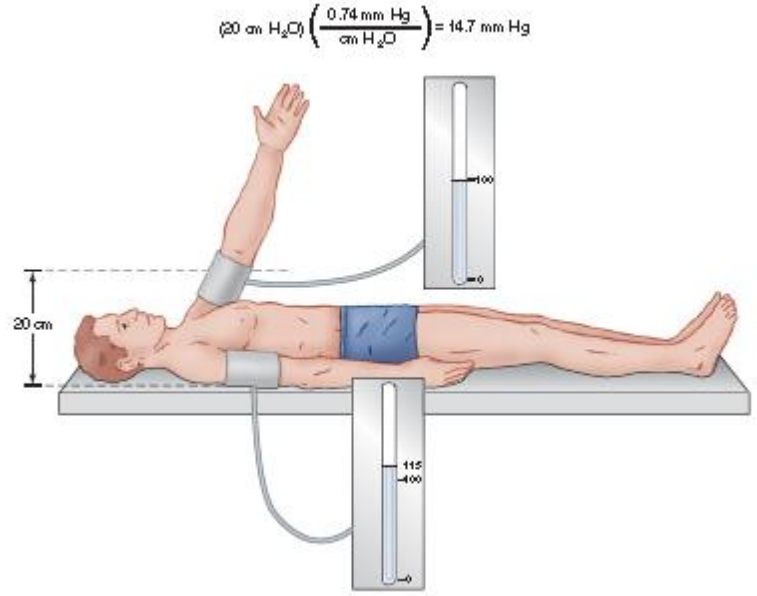


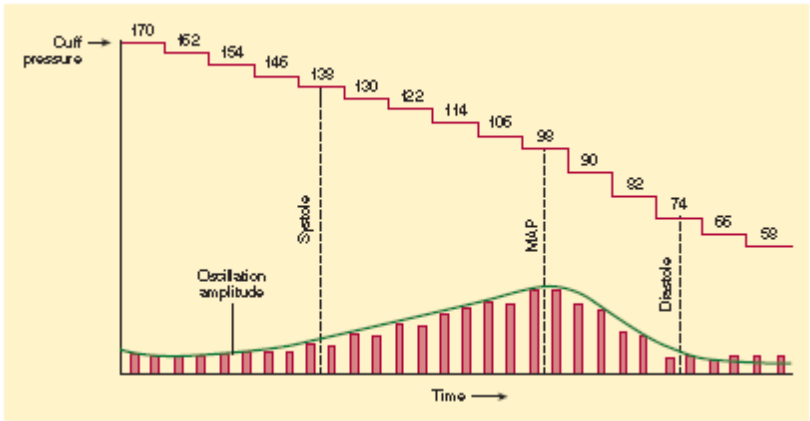
VF Tedavisi

- Derhal KPR
- Erken defibrilasyon uygulanmalı

Kan Basıncı Monitörizasyonu

- **İndirekt**
  - Palpasyon
  - Doppler
  - Oskültasyon
  - Osilometri
  - Arteriyel tonometri
- **Direkt**
  - İnvaziv (20-22G kanül ve transdüser)

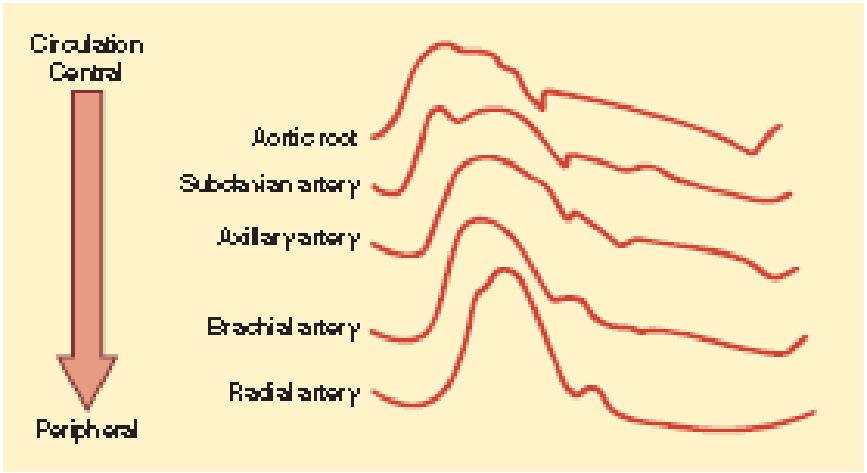


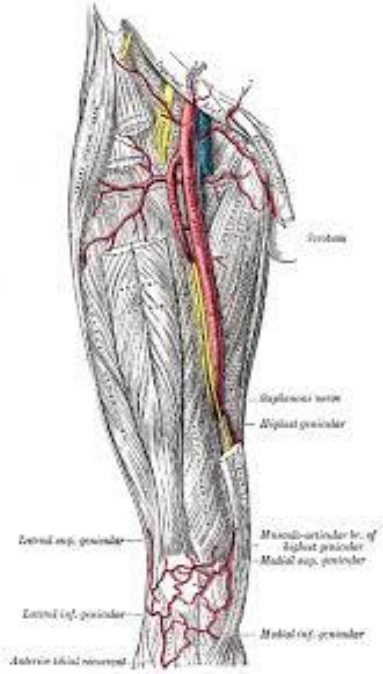


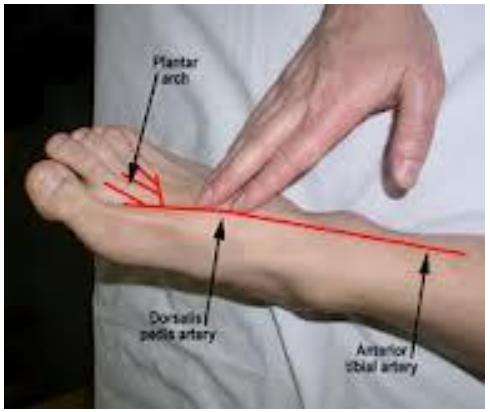

Adult
HR /min
50 150
0 /min
Art 1 mmHg
Sys 80
338/143
(207)
PR
84
/min
mmHg Adult
SYS 80
M
(---)
Manual
23:25
SpO2 %
89 OFF
50
100
PR
83 /min

Direkt basınç ölçümü için arterler

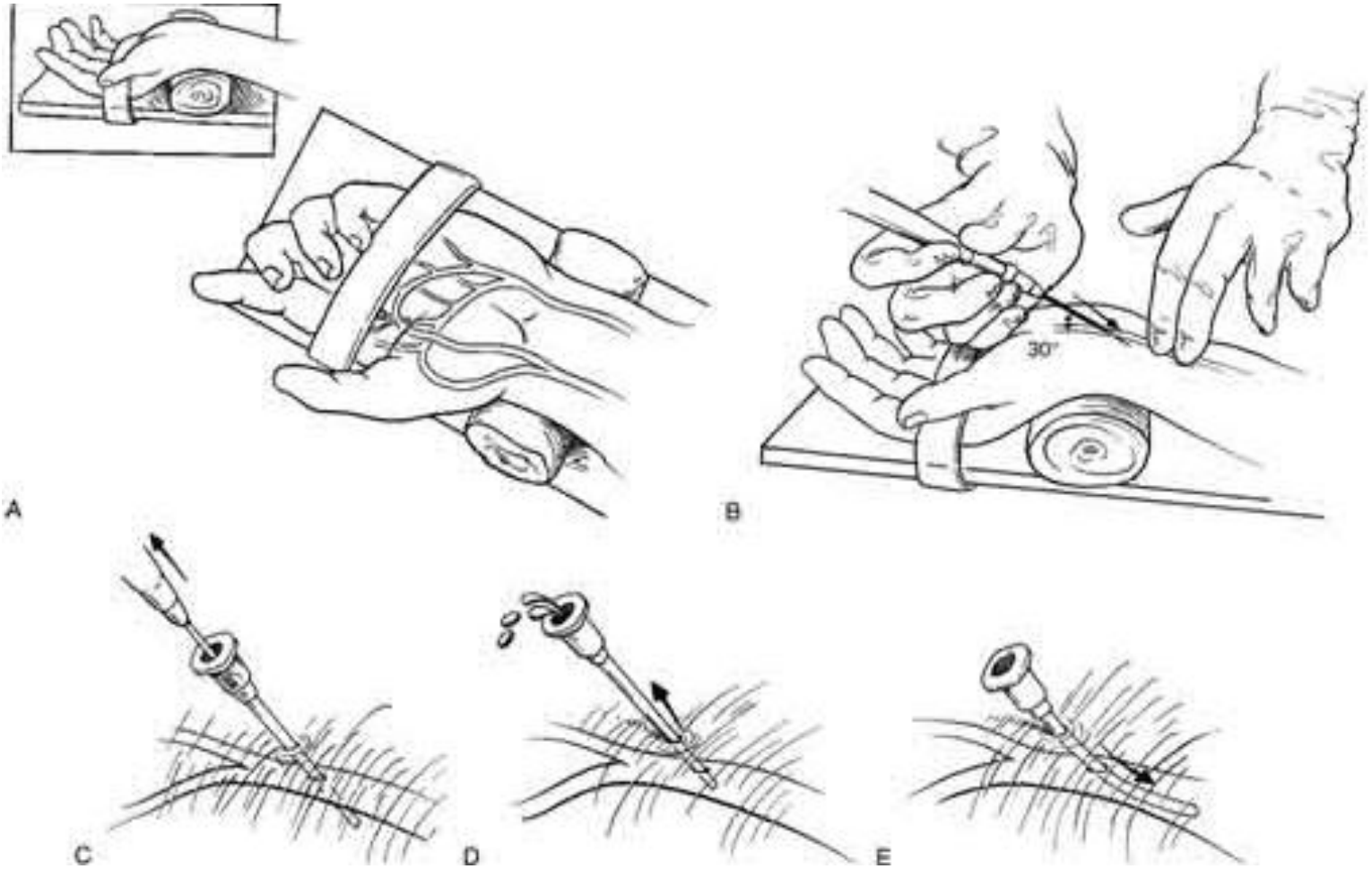
- Radiyal
- Brakiyal
- Dorsalis pedis
- Femoral





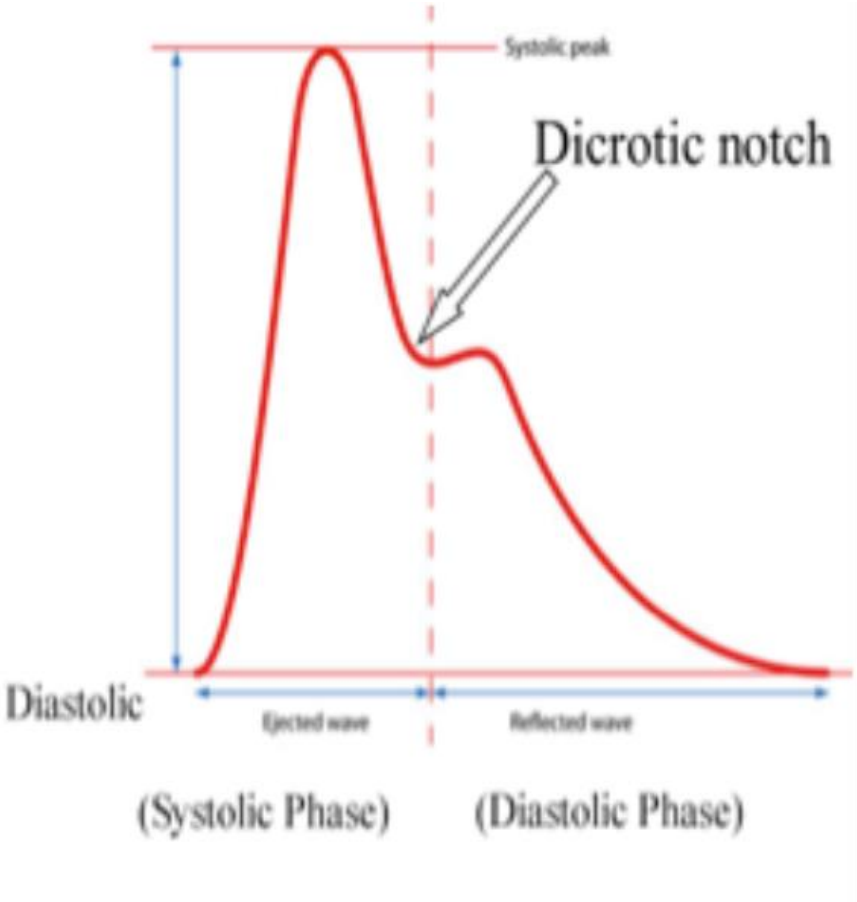


İnvasiv radiyal arter basınç ölçümü



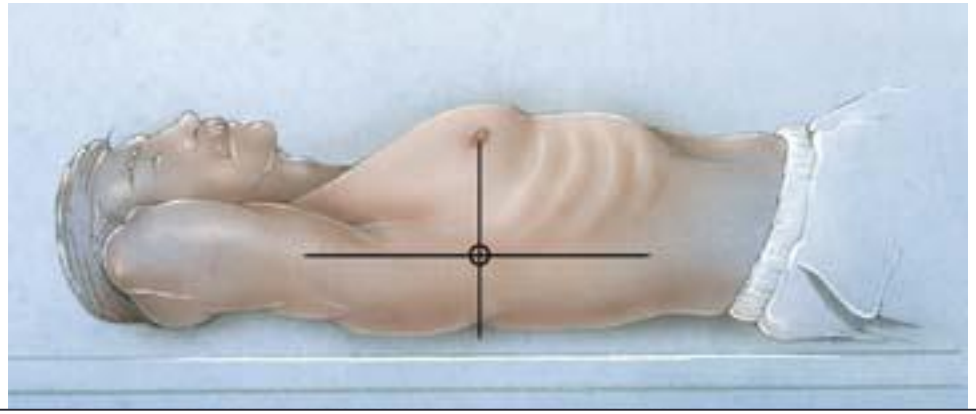
Ölçüm mekanizması

- Transduser
- Elektriksel sinyal
- Monitörde dalga formu



Doğru ölçüm için seviye ayarı

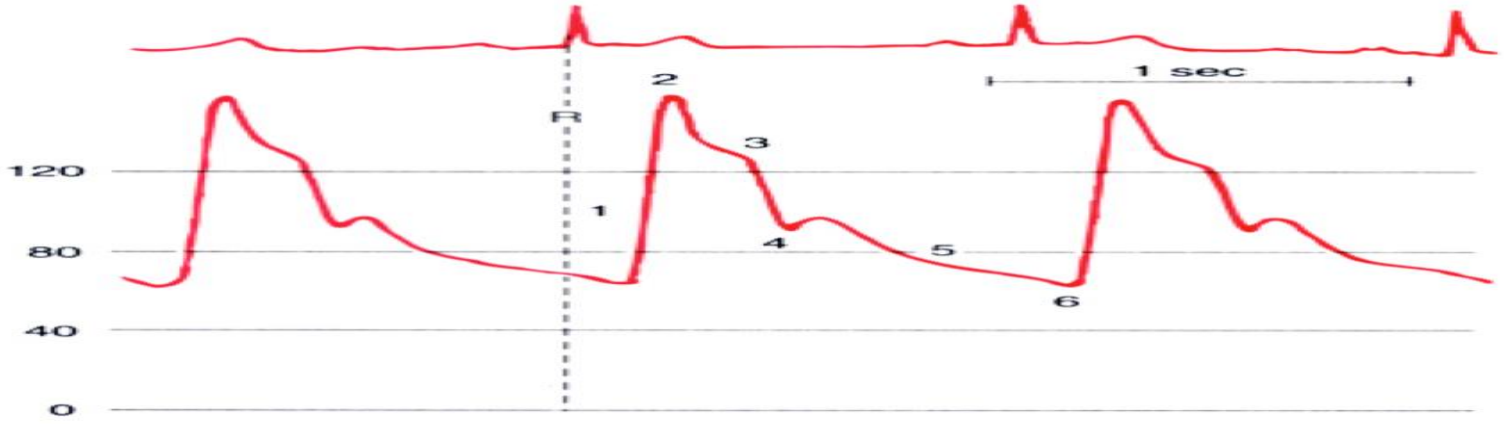
BAŞ 60 DERECEYE KADAR KALDIRILABİLİR



’Phlebostatic’’ Aks

4.KOSTA ARALIĞI-MİDAKSİLLER ÇİZGİ

Arteriyel basınç trasesi



1 → Ventrikül ejeksiyonu

2 → Pik sistolik basınç (sistolik ejeksiyon sırasında elde edilen basınç)

3 → Sistolik iniş (ventrikül kontraksiyonunun bitişi)

4 → Dikrotik çentik (normalde aoort kapağının kapanması)

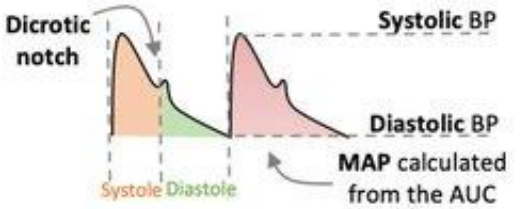
5 → Diyastolik boşalma (ventrikül foksiyonunun bitişi)

ARTERIAL LINE by Nick Mark MD

ONE onepagericu.com @nickmmark Link to the most current version →

UTILITY

Arterial lines permit continuous invasive **blood pressure measurement**, frequent **arterial blood sampling**, and analysis of the waveform can be used to **estimate cardiac output, predict volume responsiveness**, and **identify specific pathologies**.

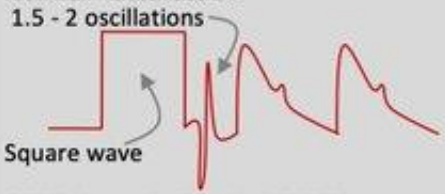


SQUARE WAVE TEST

The arterial line can measure BP inaccurately unless properly calibrated. Rapidly flushing the line (by pulling the release on the **flush device**) generates a **square wave**. Counting oscillations after the square wave indicates if the arterial line is working properly.

Normal = accurate BP

1.5 - 2 oscillations



OVERdamped = falsely LOW BP

<1.5 oscillations

Absence of dicrotic notch

Fix: Remove extra tubing & any air bubbles.

UNDERdamped = falsely HIGH BP

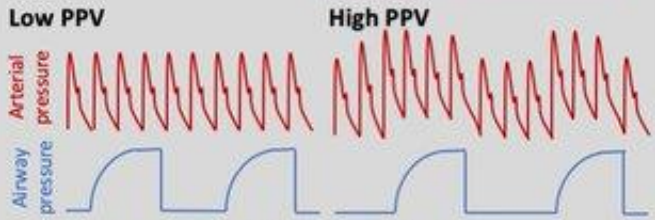
>2 oscillations

Additional artifactual spikes

Fix: Adjust filter settings on monitor

PULSE PRESSURE VARIATION (PPV)

Pulse pressure is proportional to stroke volume. Pulse Pressure Variation (PPV) represents an interaction between lungs and heart. Ventilation (either spontaneous or mechanical) alters the intrathoracic pressure and causes stroke volume to vary. Greater variability in stoke volume (increased PPV) may suggest fluid responsiveness.



$$PPV = \frac{PP_{max} - PP_{min}}{PP_{mean}}$$

Specifically, a **PPV > 12% is suggestive that there will be an increase in stroke volume with fluid challenge**. However in order to interpret PPV **3 conditions** must be met:

1. Sinus rhythm (consistent filling time)
2. Mechanically ventilated w/o spontaneous respirations; TV= 8 cc/kg (consistent effect of ventilator)
3. Must not have an open chest (heart/lungs interacting)

In contrast to an increase in BP with respiration causing high PPV, ***pulsus pardoxus*** is the decrease in SBP > 10 mmHg with respiration, associated with tamponade & other conditions.

SPECIFIC ARTERIAL WAVEFORM PATTERNS

Pulsus alternans - alternating strong and weak pulses; seen in low cardiac output shock states

Pulsus bisfirens - double peaked pulse in severe AR ± AS

Pulsus tardus - late peaking pulse; seen in severe AS

CARDIAC OUTPUT ESTIMATION

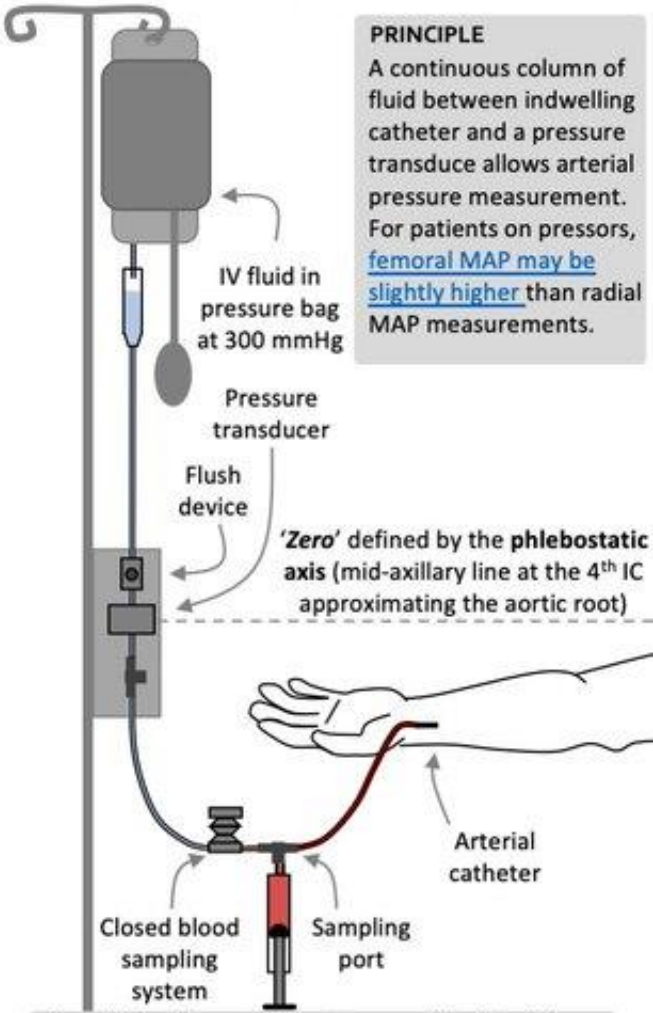
Several techniques can be used to estimate cardiac output using an algorithm to analyze the waveform. There are two types: uncalibrated and calibrated. None is proven superior.

CARDIAC ARREST

During cardiac arrest, an arterial line can be used to gauge adequacy of CPR (e.g. DBP > 25mmg on waveform), to identify ROSC, and to differentiate PEA from pseudo-PEA. See *Cardiac Arrest OnePager* for more.

PRINCIPLE

A continuous column of fluid between indwelling catheter and a pressure transduce allows arterial pressure measurement. For patients on pressors, femoral MAP may be slightly higher than radial MAP measurements.



Closed blood sampling systems enable blood draws with minimal waste. They are associated with lower risk of bacterial contamination and when combined with smaller size sample tubes and decreased lab frequency they can reduce blood transfusions.

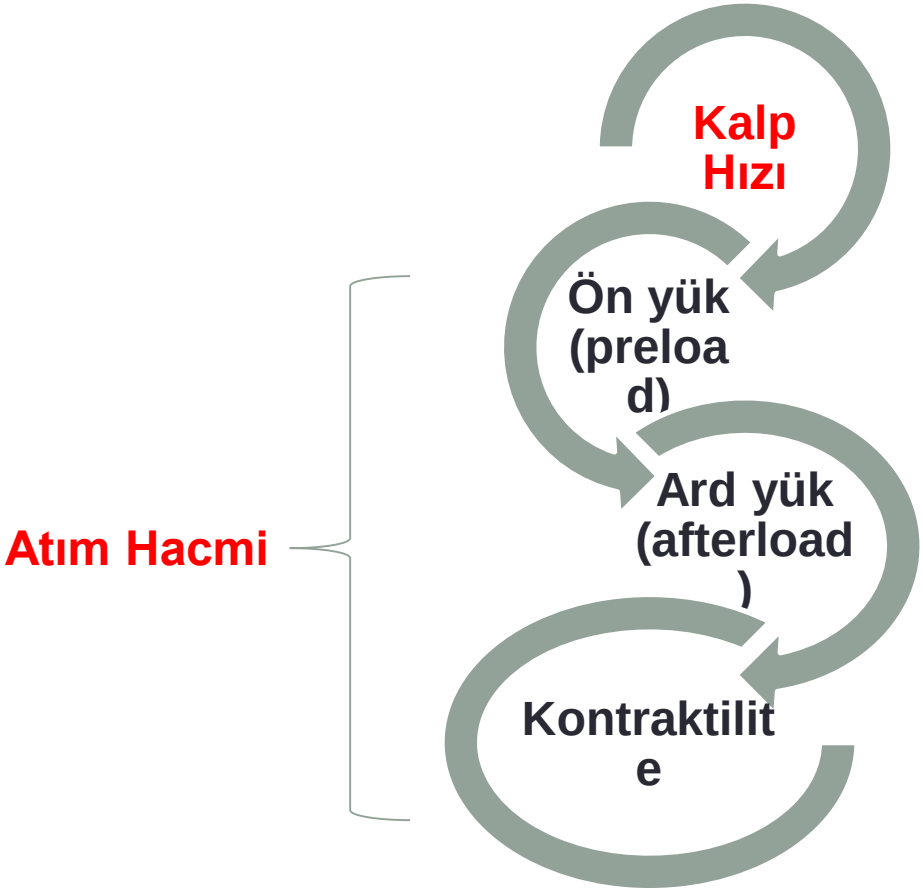
v1.0 (2020-09-14)

Kan Basıncının Yorumlanması

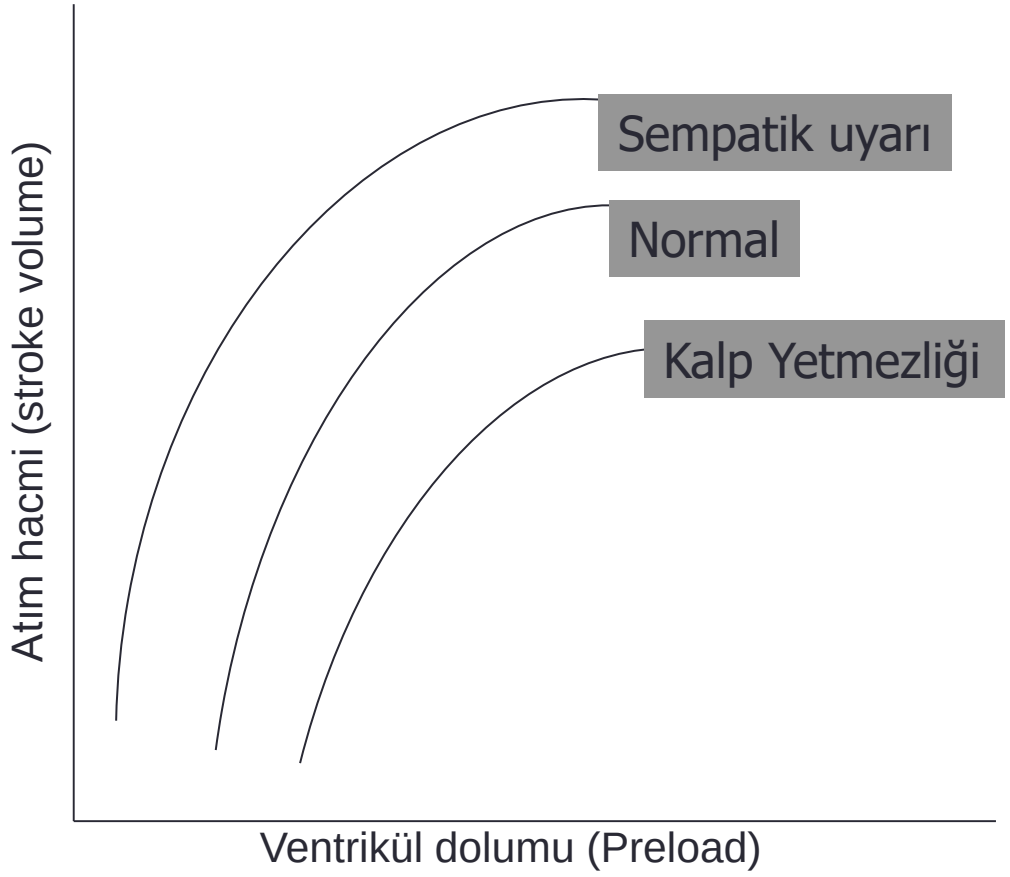
- SAB
  - Kardiyak oksijen tüketimi
- DAB
  - Koroner perfüzyon
- OAB
  - Organ perfüzyonu

OAB= (SAB + 2 DAB) / 3

Kalp debisi


Kalp Hızı
Ön yük (preload)
Ard yük (afterload)
Kontraktilite
Atım Hacmi

Frank Starling eğrisi



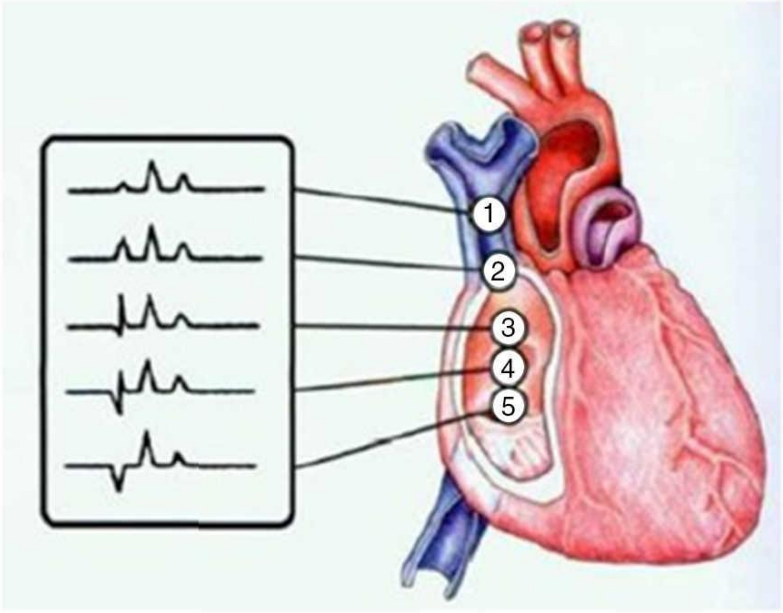
Ölçümler

- **Statik ölçümler**
  - Santral ven bacıncı (SVB)
  - Pulmoner arter tıkama basıncı (PATK)
  - Sol ventrikül diyastol sonu alanı (LVEDA)
  - Global enddiyastolik volüm (GEDV)

- **Dinamik ölçümler**
  - SAB değişikliği
  - Nabız basıncı değişikliği
  - Atım hacmi değişikliği (SVV
  - İnen aorta akım hızı değişikliği
  - VCI boyut değişikliği

Santral Venöz Basınç (SVB)

- VCS veya RA basıncı
- **3-10 cmH_2O ???**
- RA girişine kadar ilerletilmeli

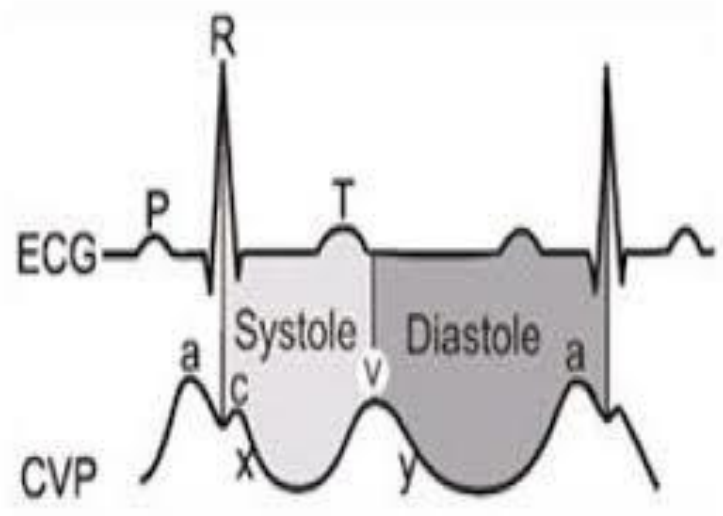


Rev Med Hosp Gen Mex. 2018;81:262–7

IJV kanülasyonu

CVP dalgaları

- Üç yukarı ⟹ a,c ve v dalgaları
- İki aşağı ⟹ x ve y inişleri



a dalgası: atrial kontraksiyon

c dalgası: vent. kont. (erken sistol)

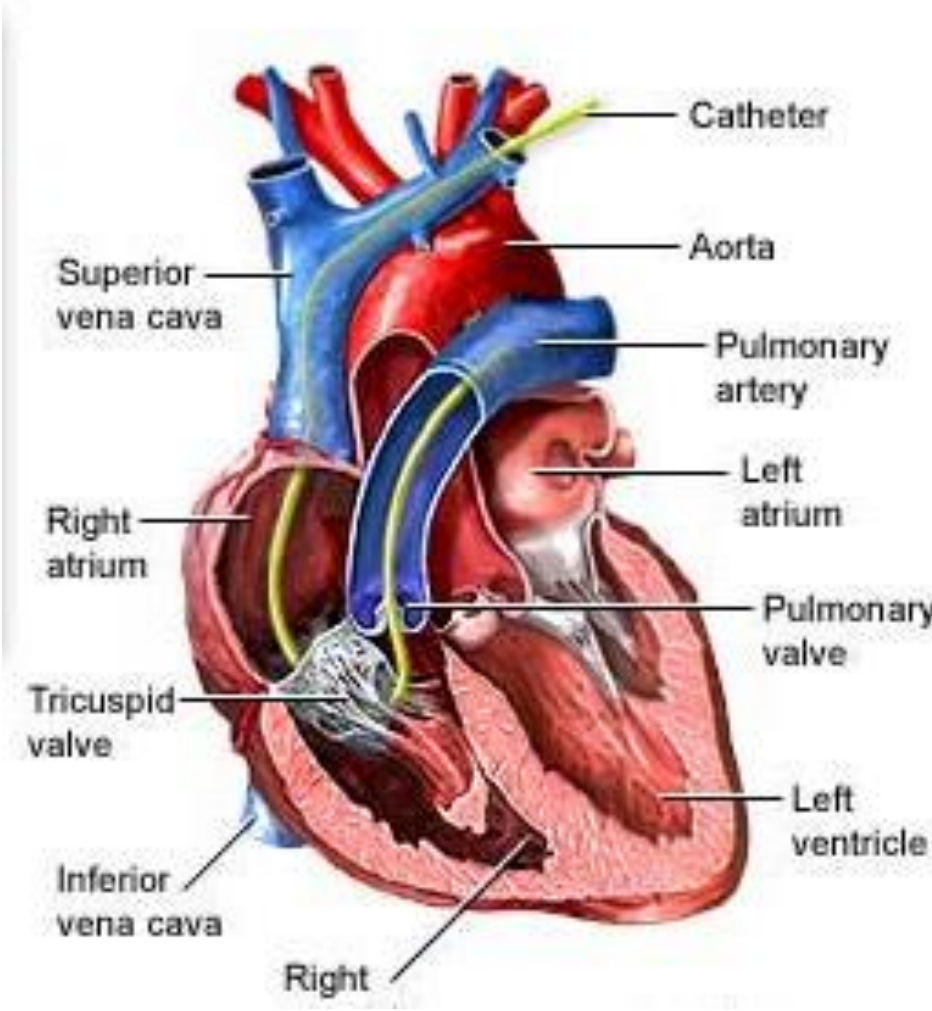
x dalgası: kanın boşaldığı ventrikül ejeksiyonu (orta sistol)

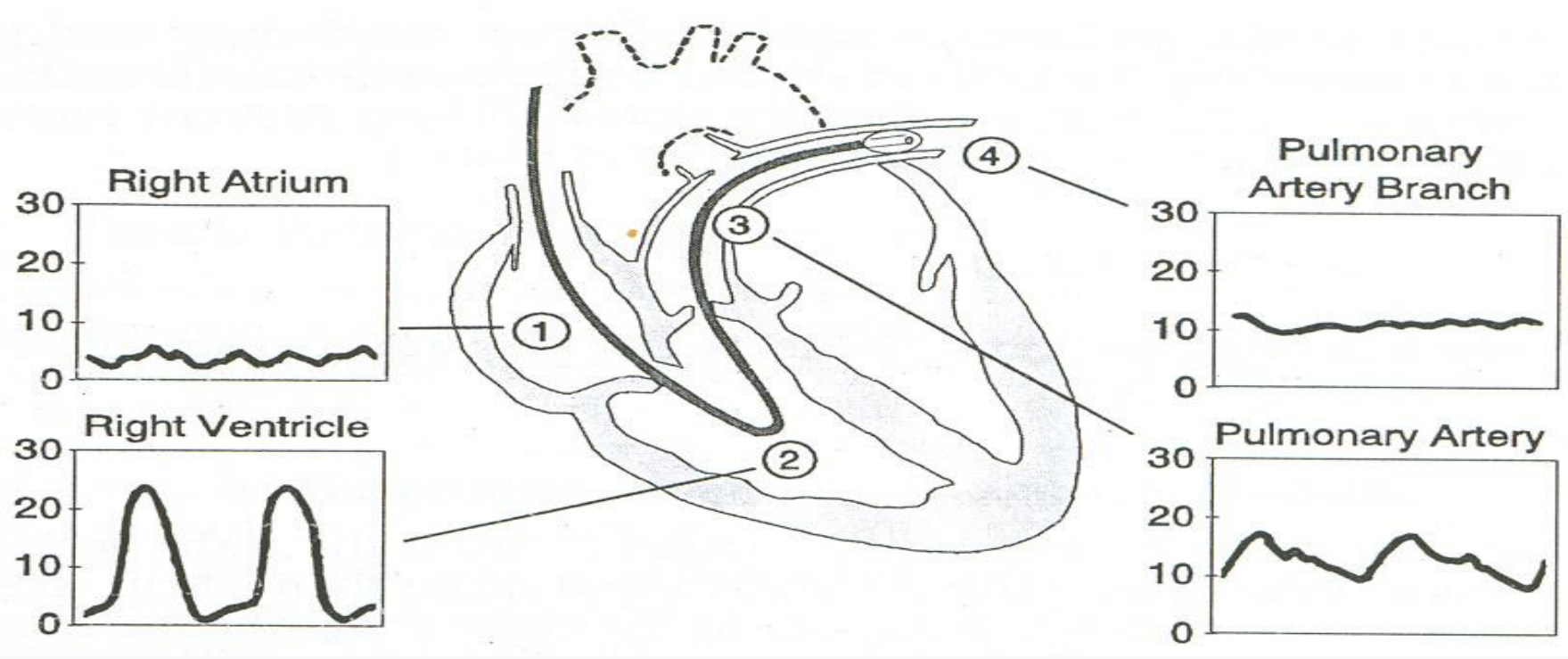
v dalgası: atriumun hızla dolması (geç sistol)

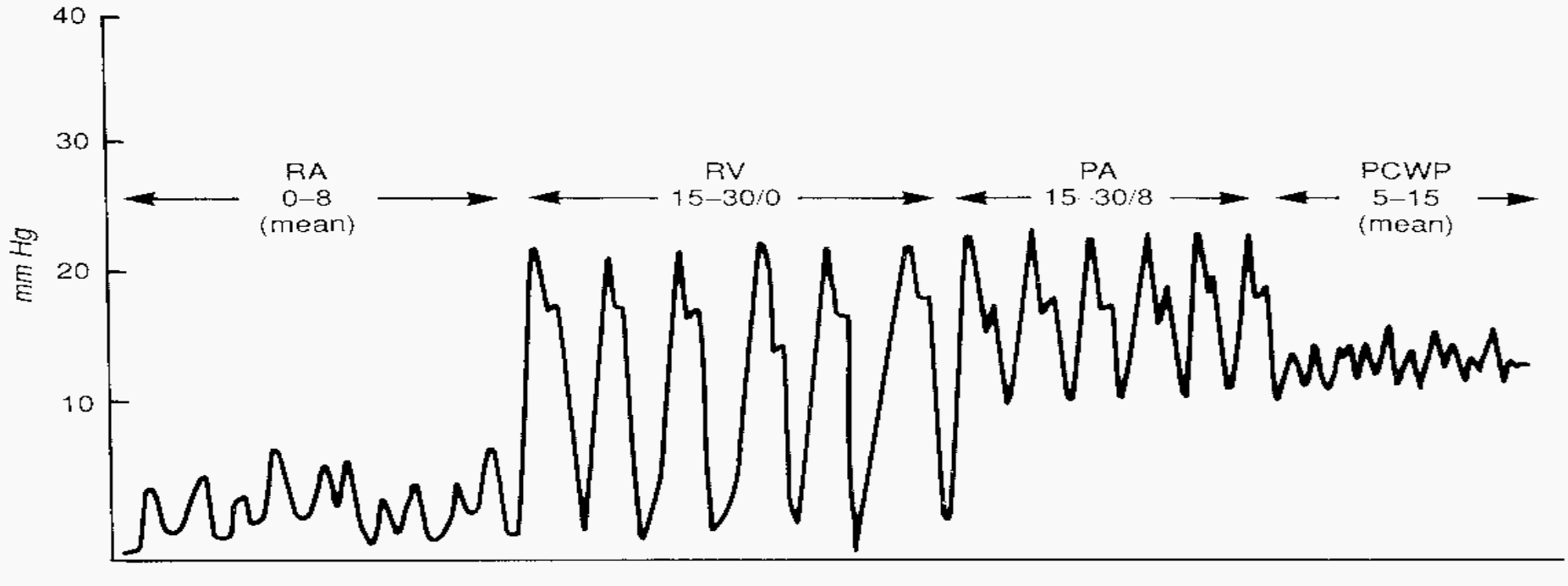
y dalgası: sağ ventrikülün dolması (erken diyastol)

PATB

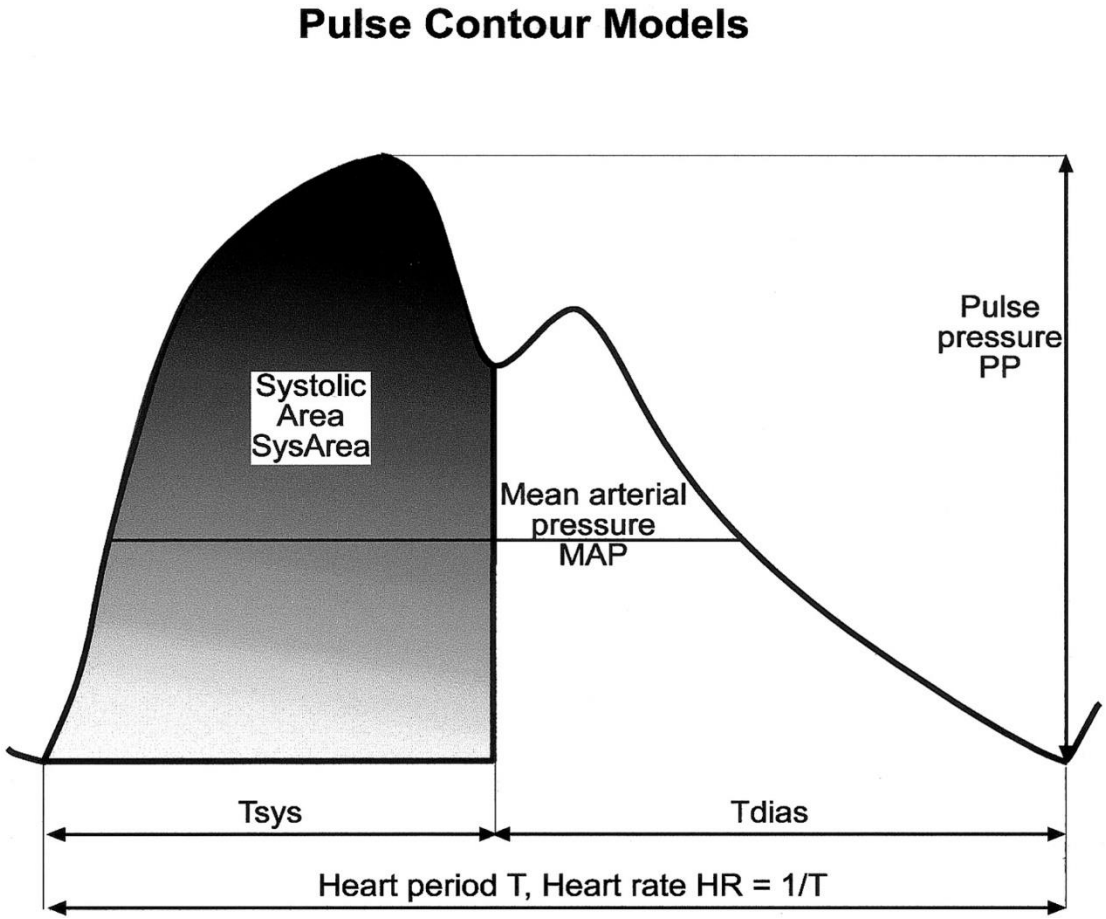
- LA basınç (Swan-Ganz 1970)
- ***Preload*** için altın standart
- Pulmoner arter kateterizasyonu
- 12-18mmHg



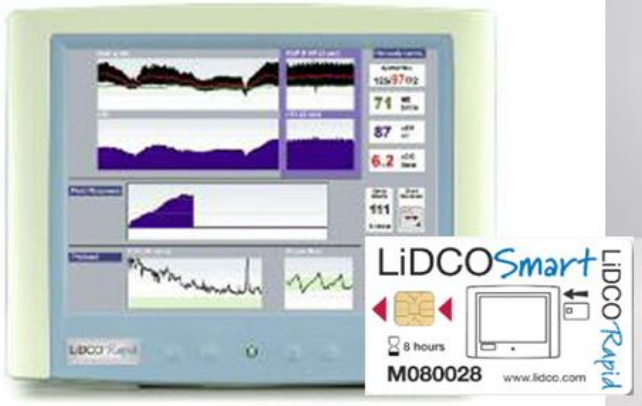

Right Atrium
30
20
10
0
Right Ventricle
30
20
10
0
1
2
3
4
Pulmonary Artery Branch
30
20
10
0
Pulmonary Artery
30
20
10
0


40
30
20
10
mm Hg
RA
0–8
(mean)
RV
15–30/0
PA
15–30/8
PCWP
5–15
(mean)

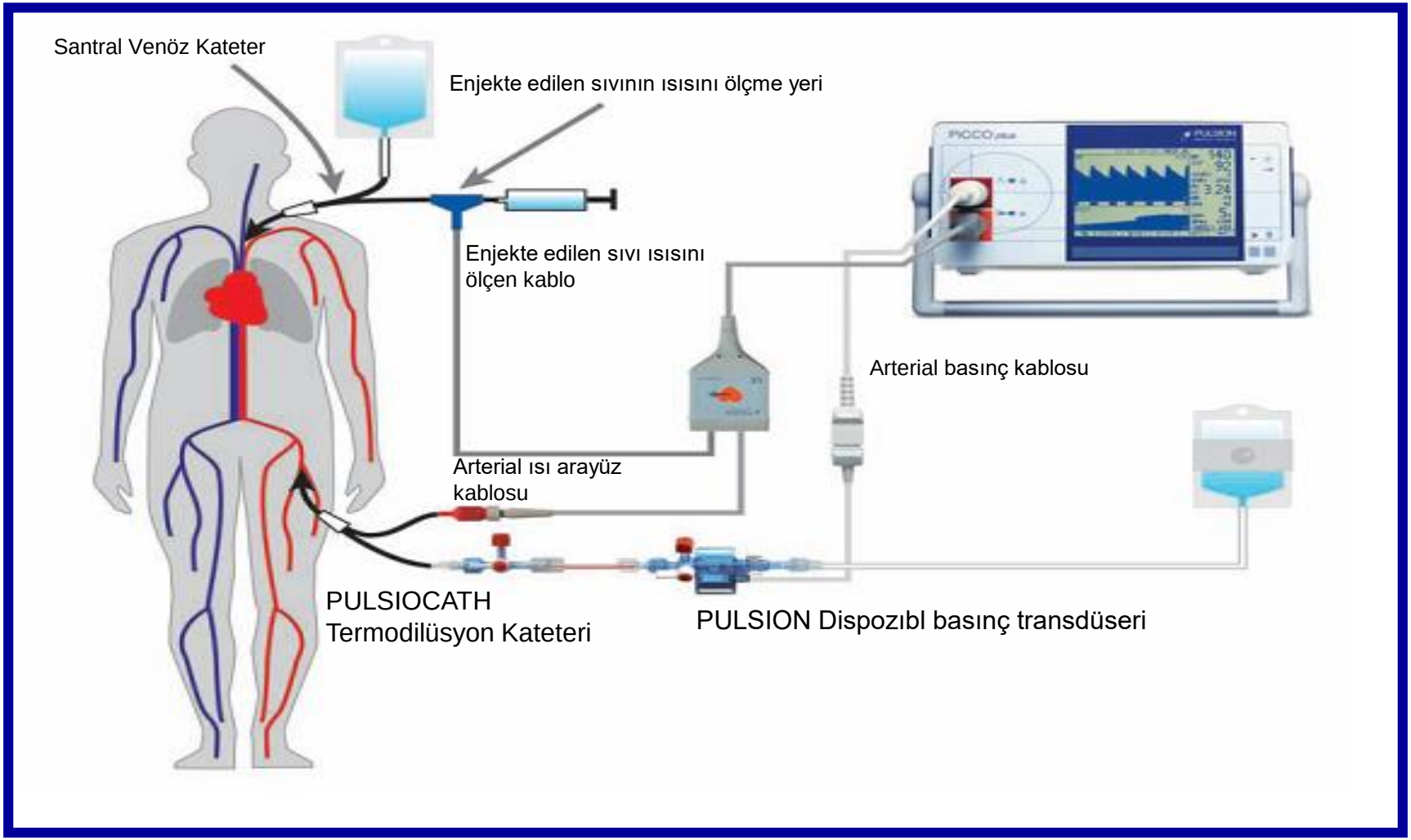
Puls Kontur Analizi ve SVV



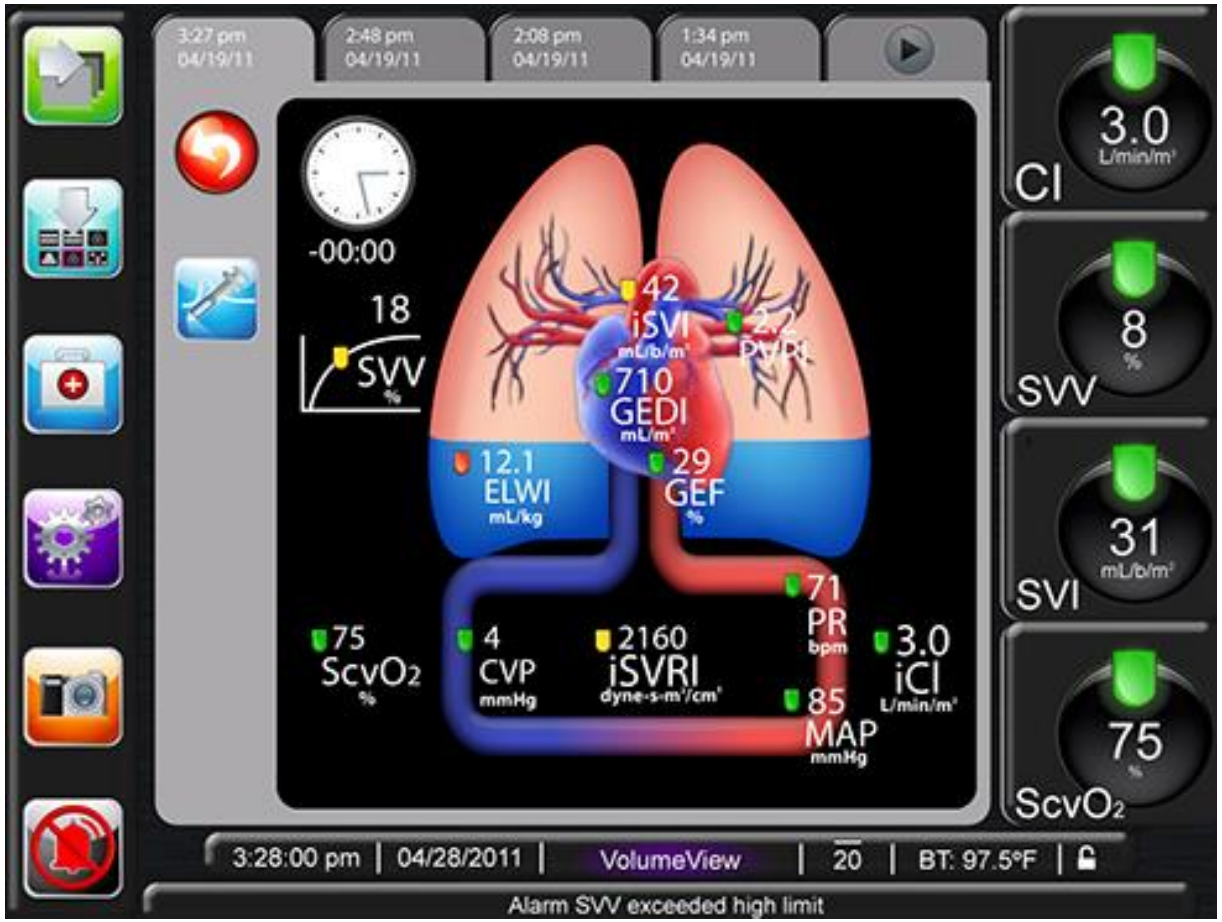
Minimal invazif CO monitörleri



PiCCO (Pulsion Medical)



VolumeView (Edwards Med)

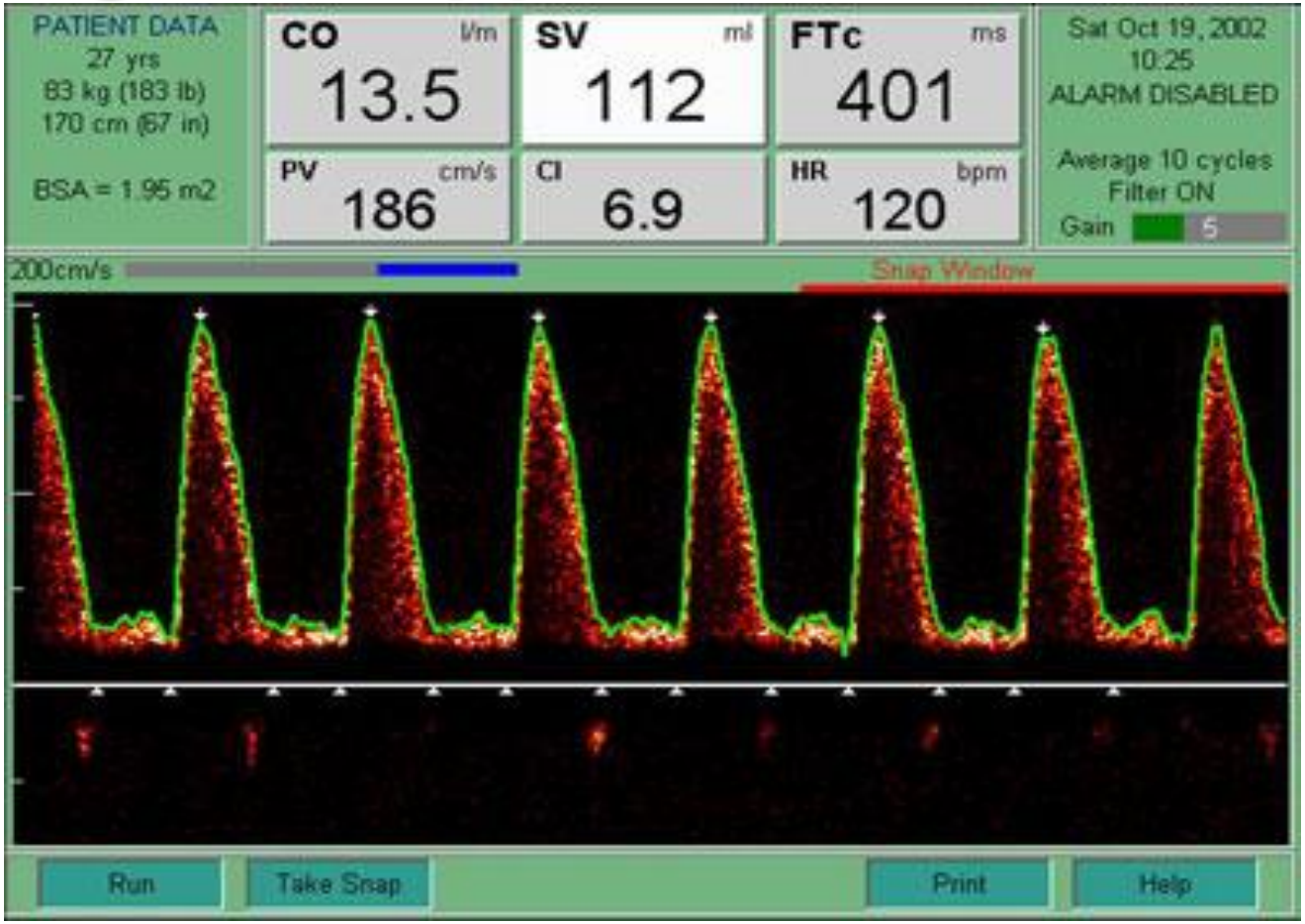


Özefageal Doppler

Ölçülen Değerler

CO	Cardiac Output
CI	Cardiac Index
SV	Stroke Volume
SVI	Stroke Volume Index
SVR	Sistemik Vasküler Rezistans

Özefageal Doppler



Non-invazif monitör

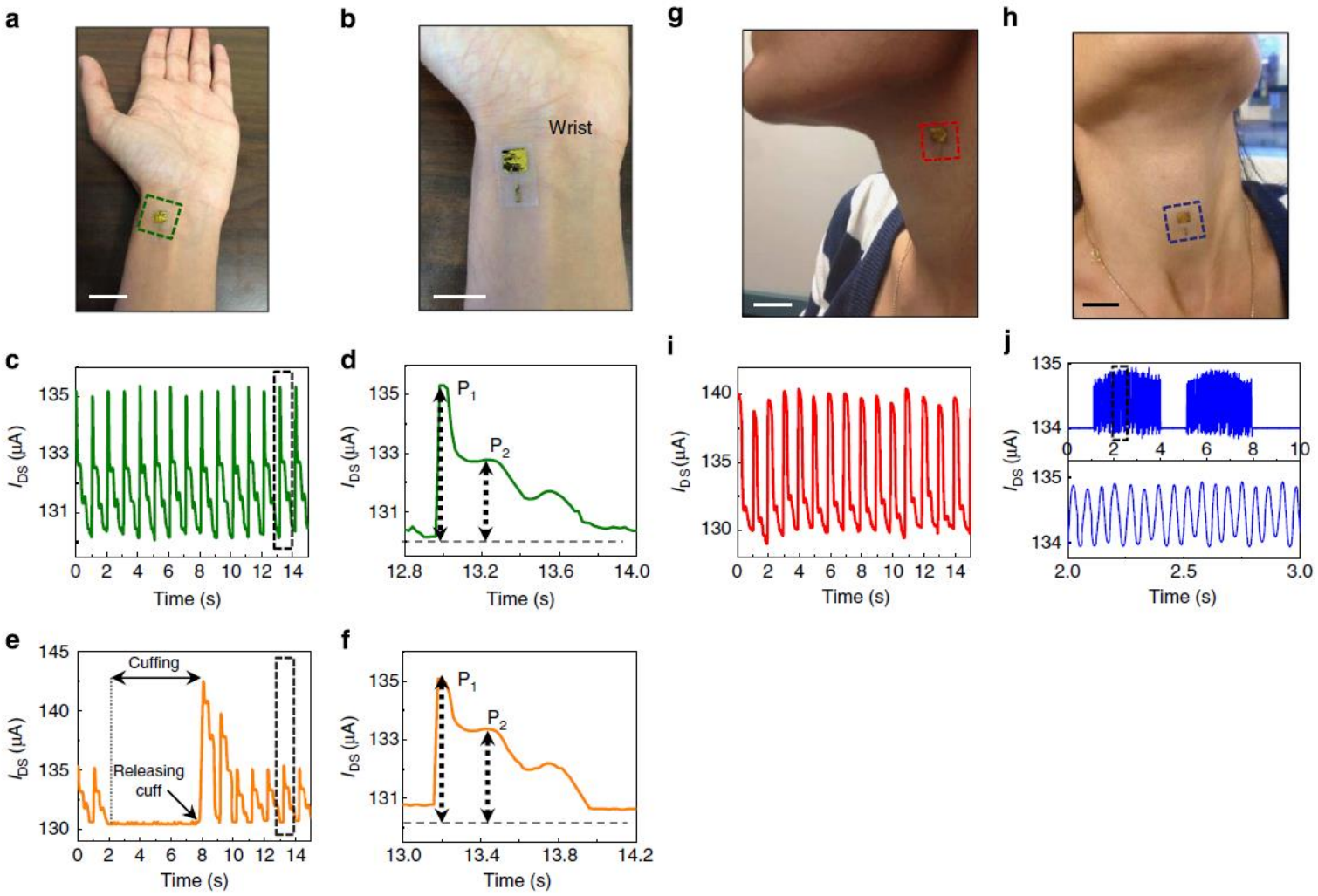


Figure 4 | Blood pressure wave measurements on the wrist and neck. Photograph of (**a**; scale bar, 2 cm) the sensor placed on a wrist for measuring fast

Solunumun Monitorizasyonu

- Solunum seslerinin dinlenmesi
- Pulse oksimetre
- ETCO2 analizi
- Anestezik gaz analizleri

PULSE OKSİMETRE

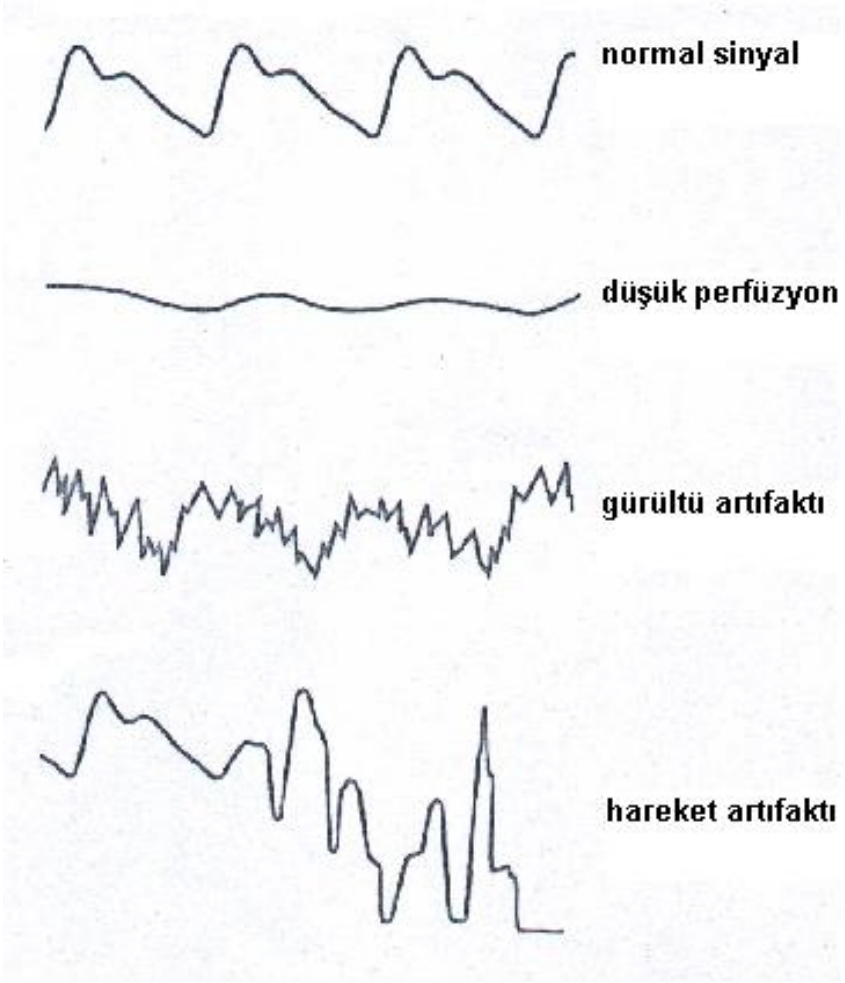
- Kızıl ötesi ışık kaynağı
- Işığı alacak dedektörlü prob

Pulse oksimetreyi etkileyen faktörler

1-Sinyallerin iyi alınamaması
-Hipotansiyon
-Zayıf nabız
-Hareket artefaktı

2-Yanlış yüksek ölçüm
- Karboksihemoglobin
- Methemoglobin
- Ortam ışığı

3-Yanlış düşük ölçüm
- Malpozisyon
- Vazokonstriksiyon
- Hipotermi
- Hiperlipemi
- Ortam ışığı
- Koyu deri
- Oje

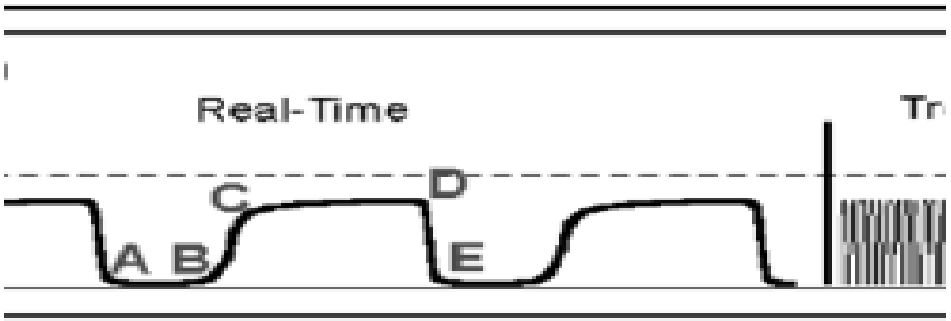


$ETCO_2$

- $PaCO_2$ ile yakın ilişki
- Normalde PETCO2 - PaCO2 5 mmHg'dır.
- Normal değer: 30-43 mmHg
- ETCO2 ani yükselme:
    - Malign Hipertermi / Titreme
- ETCO2 ani düşmesi
    - Hava embolisi
    - Kalp debisinde ani düşme
    - Pulmoner emboli?

KAPNOGRAF

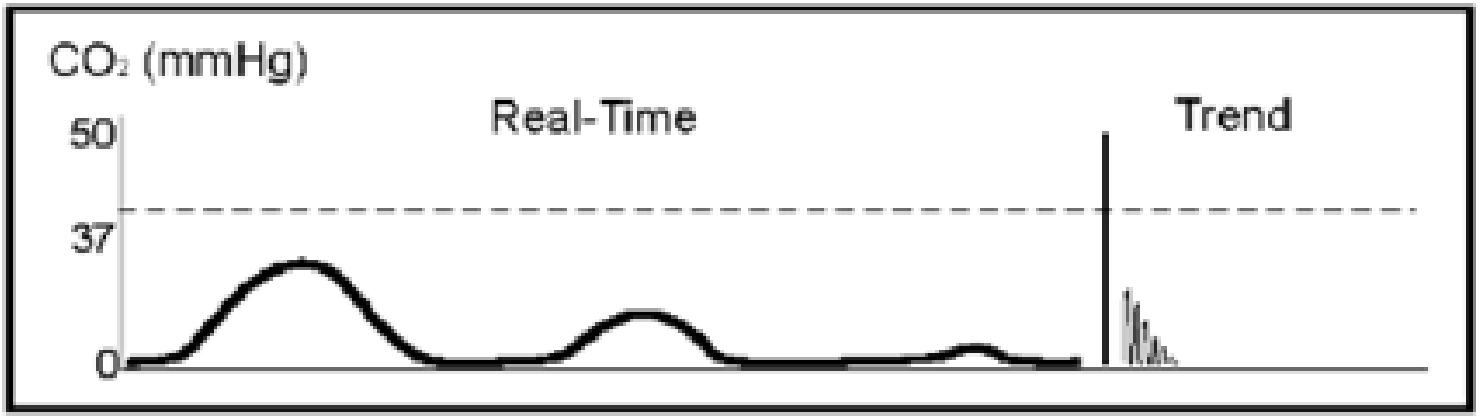
- ET tüp trakeada ☑
- Ventilatör-solunum devresi bağlı ☑



- A – B Baseline
- B – C Expiratory Upstroke
- C – D Expiratory Plateau
- D $ETCO_2$ value
- D – E Inspiration Begins

KAPNOGRAF
(özofageal entübasyon)

Endotracheal Tube in Esophagus

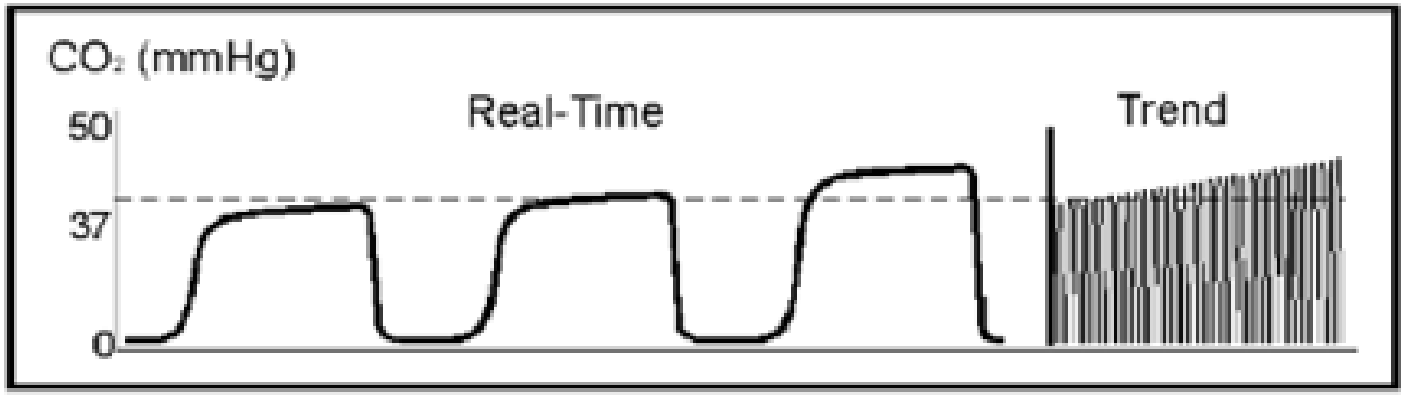


Possible Causes:

- Missed intubation
- A normal capnogram is the best evidence that the ET tube is correctly positioned
- With ET tube in the esophagus, little or no CO_2 is present

KAPNOGRAF
(hipoventilasyon)

Hypoventilation (Increase in $ETCO_2$)

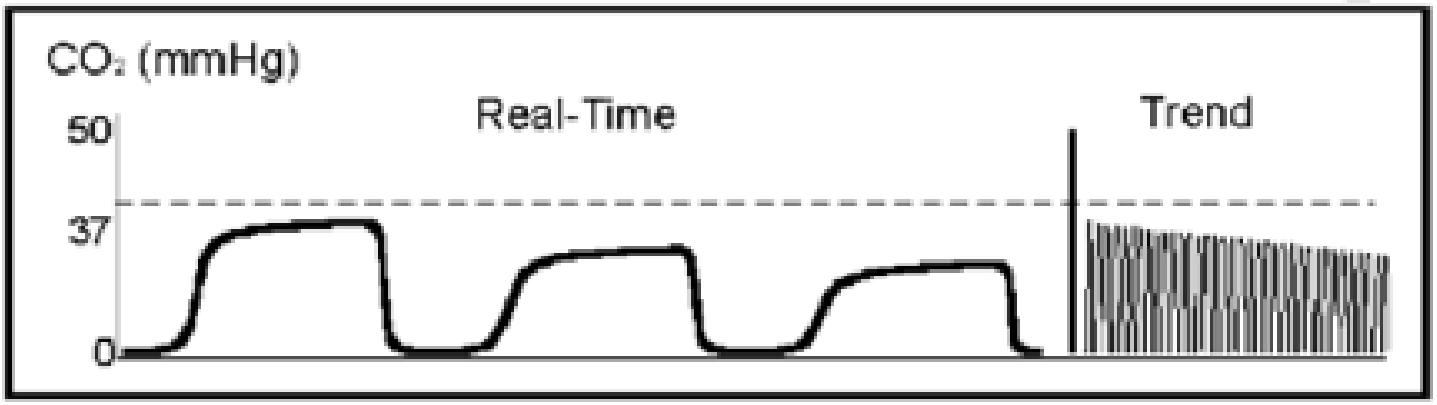


Possible Causes:

- Decrease in respiratory rate
- Decrease in tidal volume
- Increase in metabolic rate
- Rapid rise in body temperature (hyperthermia)

KAPNOGRAF
(hiperventilasyon)

Hyperventilation (Decrease in $ETCO_2$)

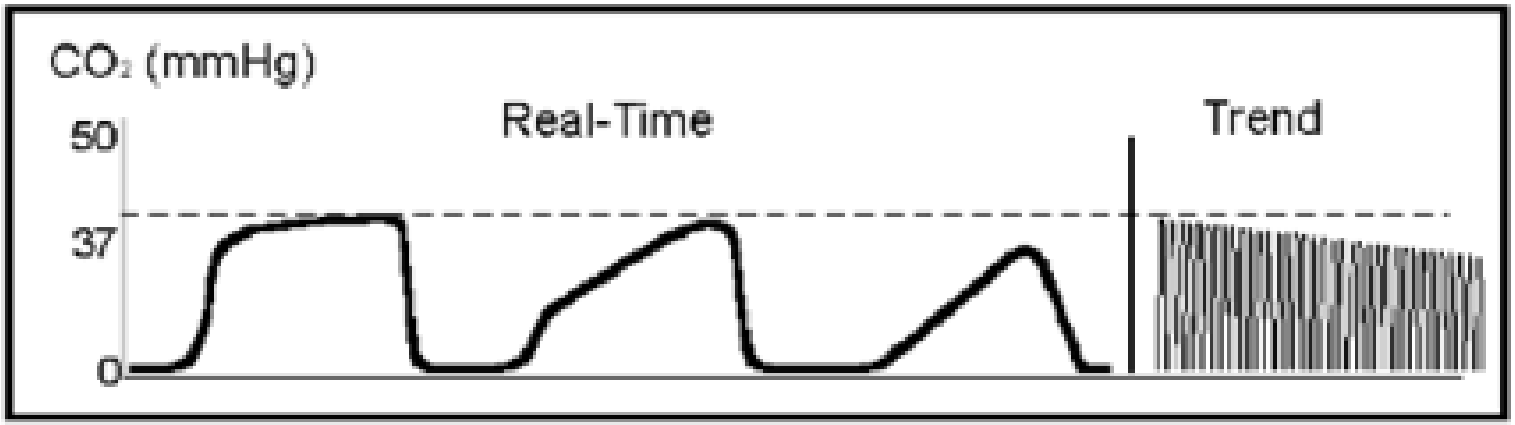


Possible Causes:

- Increase in respiratory rate
- Increase in tidal volume
- Decrease in metabolic rate
- Fall in body temperature

KAPNOGRAF
(y.c./ bronkospazm)

Obstruction in Airway or Breathing Circuit



Possible Causes:

- Partially kinked or occluded artificial airway
- Presence of foreign body in the airway
- Obstruction in expiratory limb of breathing circuit
- Bronchospasm

BISPEKTRAL INDEX (BIS)

Hipnotik komponenti ölçer

GAA'da = 40-60

Sedasyon = 60-85

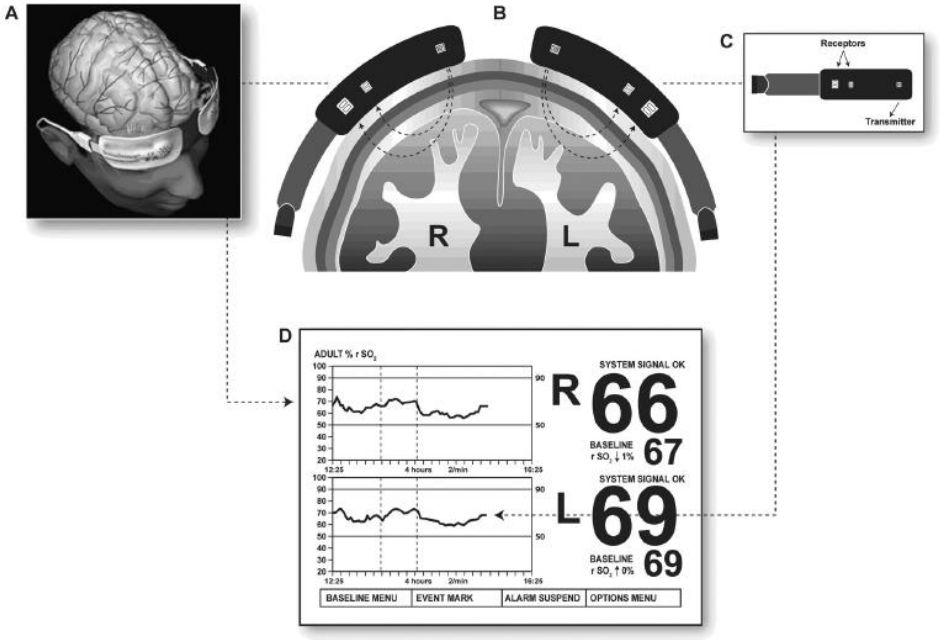
Uyanıklık = 85-100

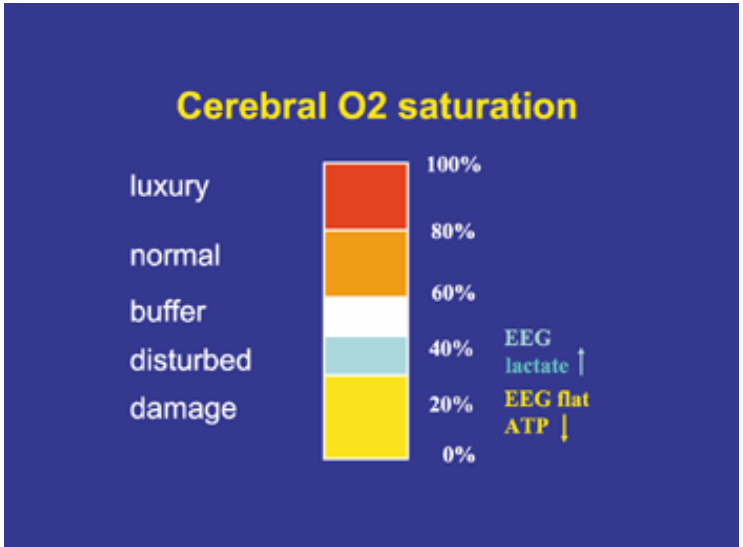
Anormal düşük/uzun süreli düşük BIS

kötü nörolojik fonksiyon

Yakın kızıl-ötesi spektroskopi (NIRS)

- Bölgesel serebral doku oksijenizasyonu
- Normal değer %60-80
- İlk değerden >%20 azalma !!
- %40 ve ↓ sorun (+)





EN İYİ MONİTÖR SİZSİNİZ