Intermediate ECG Course – Part 3

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Topics in Intermediate ECG

- Consolidation of prior information with additional details
- Not “advanced”, but feel free to ask advanced questions
- Causes of axis deviation and wide QRS (1)
- Infarction and causes of ST segment shifts (2)
- Electrolyte effects on the ECG (2)
- Flutter versus fib, and ventricular patterns (3)
- AV conduction and AV dissociation (4)
- Tachyarrhythmias, wide and narrow QRS (5, 6)
- Integrating ECG and clinical information (7,8)

Electrolyte Disturbances with Significant ECG Effects

- Hyperkalemia, hypokalemia
- Hypercalcemia, hypocalcemia
- Hypothermia

Hyperkalemia

- T waves become tall and peaked (>5.5)
- QRS widens uniformly (>6.5)
- QRS axis may shift either left or right
- Advanced hyperkalemia is indistinguishable from dying heart
- Advanced hyperkalemia may give ST elevation
- P wave amplitude decreases, PR interval prolongs
- Sinoventricular conduction
- Concomitant hypercalcemia mitigates changes
- Concomitant hyponatremia worsens changes and hypernatremia mitigates

Hypokalemia

- Progressive ST segment depression > 0.5 mm
- Decrease in T wave amplitude
- Increase in U wave amplitude
  - >1 mm
  - >T wave height in same lead
- No change in QT interval if measured before U wave
- Advanced hypokalemia – T and U are fused
- Concomitant hypocalcemia: aggravates findings

Calcium

- Ionized calcium, so correct for albumin level
- Mainly change in ST segment duration, little change in T wave morphology
- Hypercalcemia shortens ST segment, so shortens the QaT (onset of QRS to apex of T)
- Hypocalcemia lengthens ST segment

Situations that Don’t Affect the ECG

- Hyponatremia, hypernatremia
- Hypomagnesemia, hypermagnesemia
- Hyperthermia
- Alkalosis, acidosis
- Alcohol, coffee, tobacco

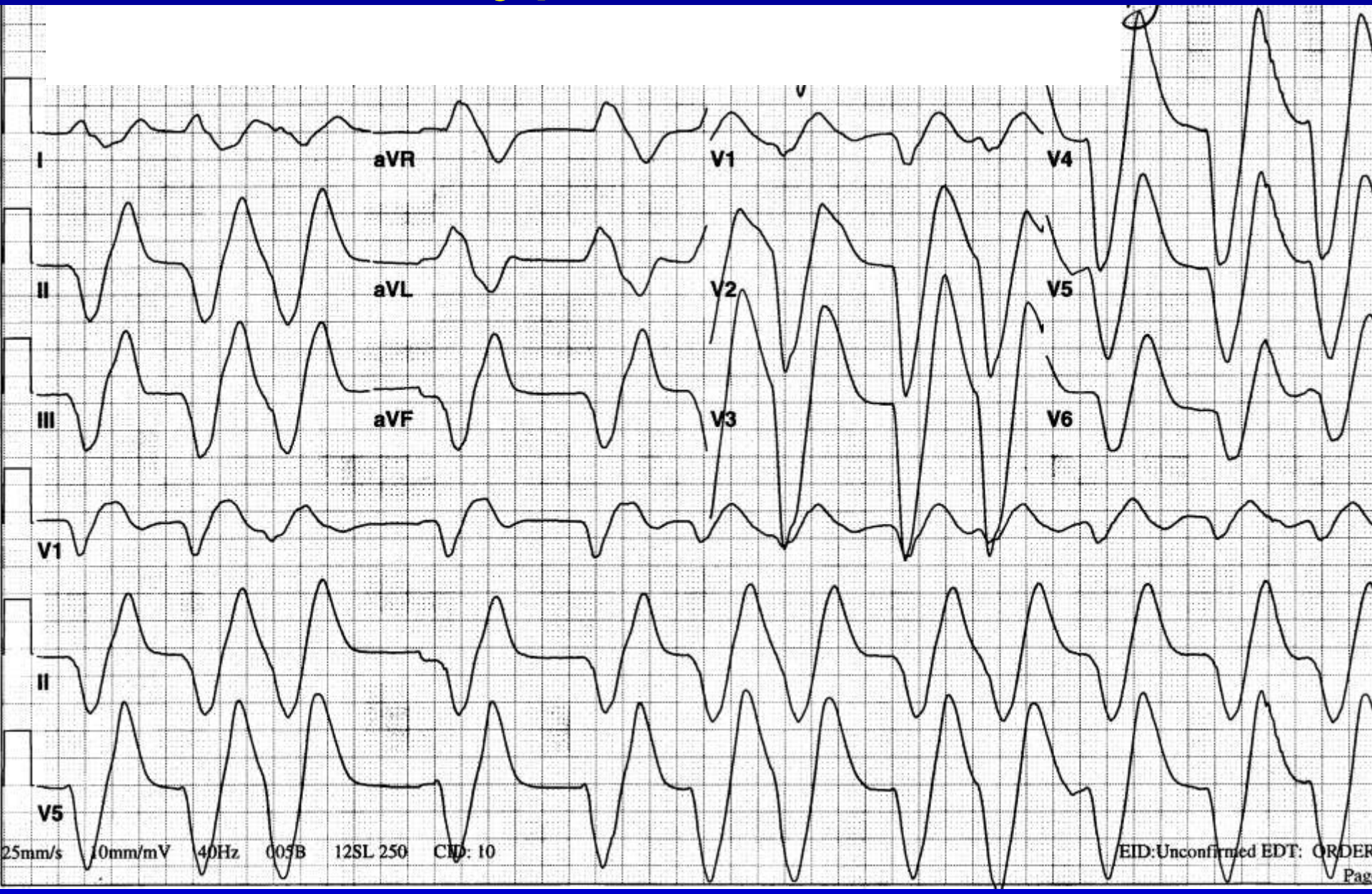
- But a drink of cold water can affect T wave direction

CNS Disorders

- Diffuse T inversion
- Particularly giant T inversion in precordial leads
- Prolongation of QT interval
- Can also have ST segment elevation or depression
- LV wall motion abnormalities have been described

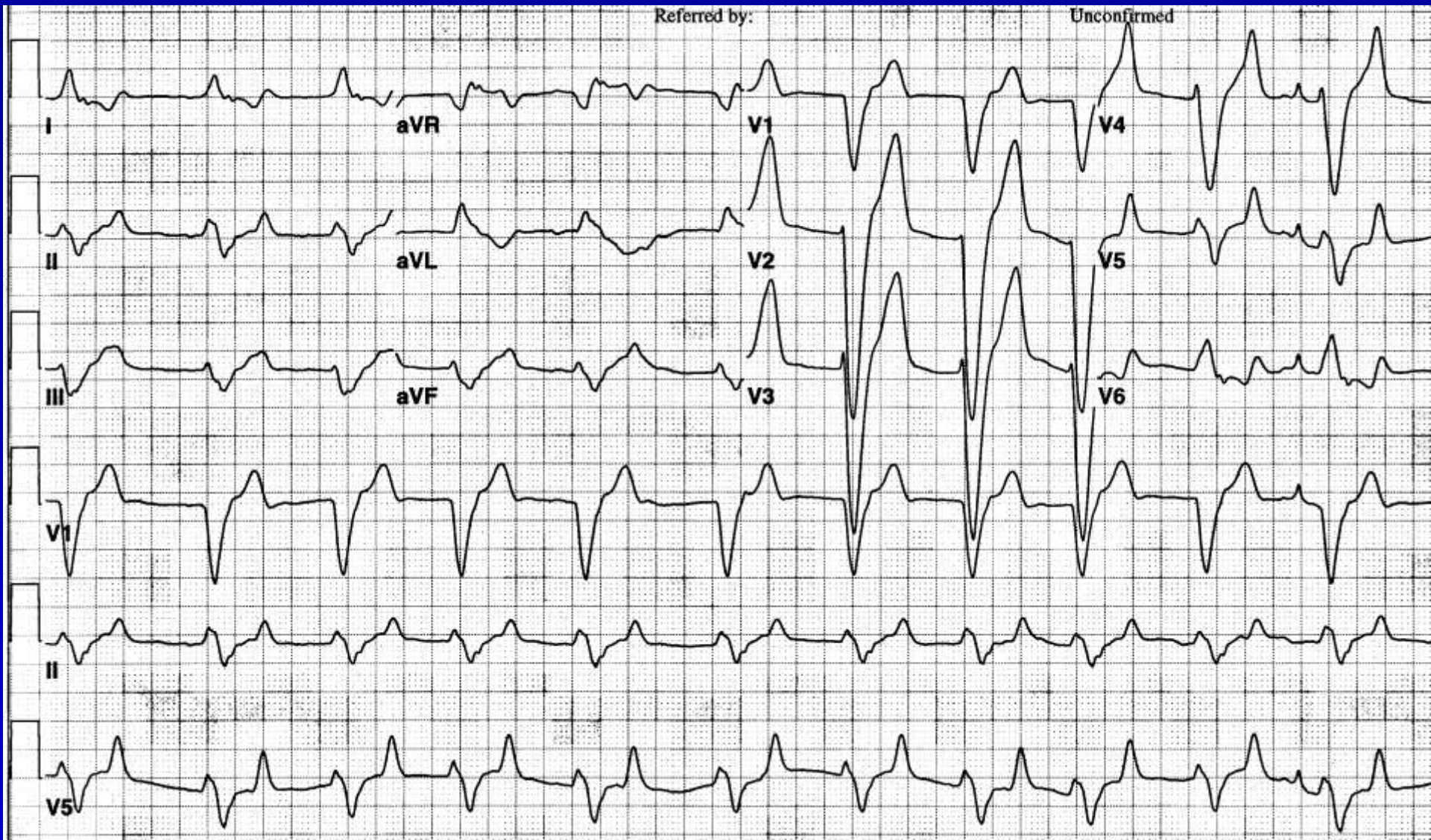
6:04

Hyperkalemia



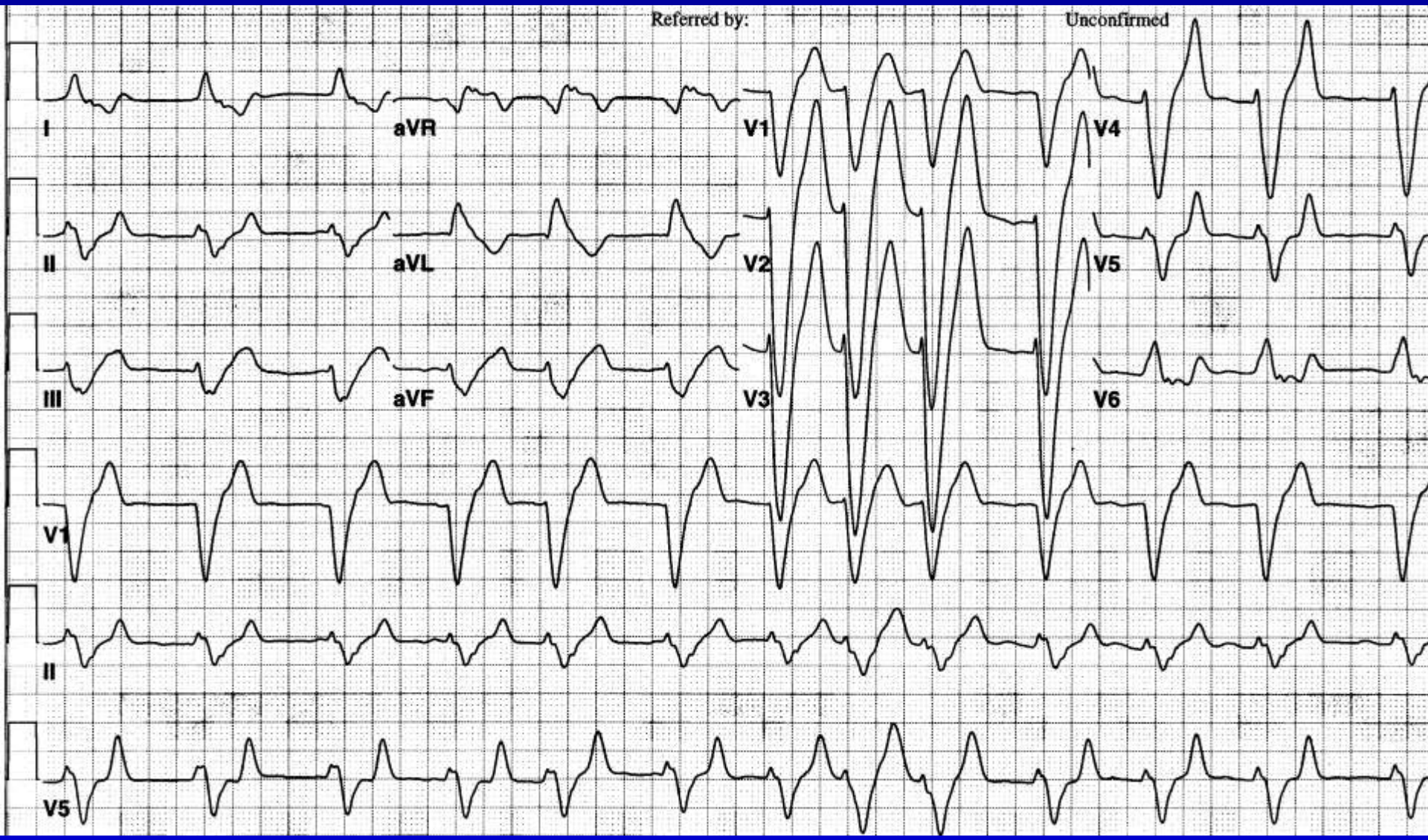
6:44

Hyperkalemia



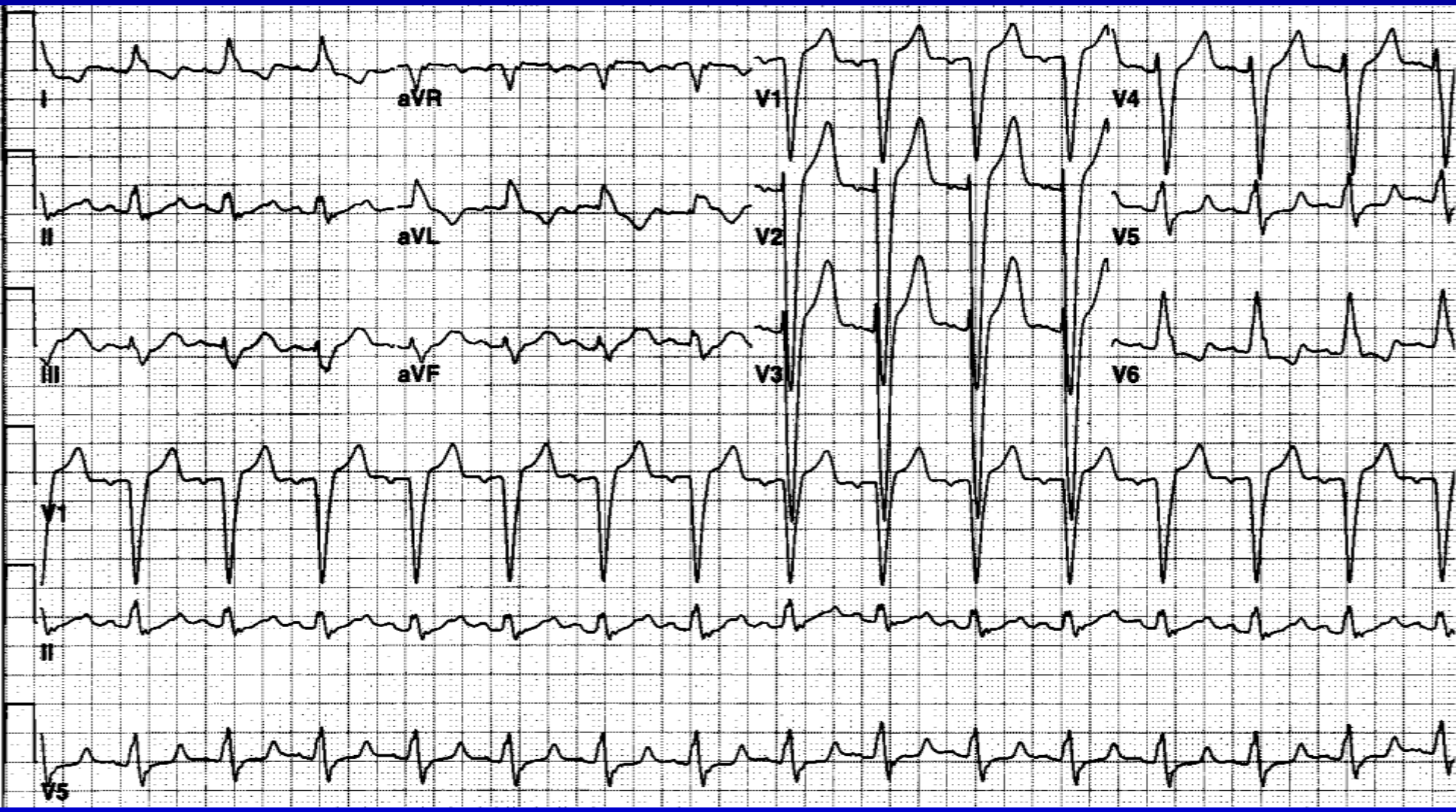
6:58

Hyperkalemia

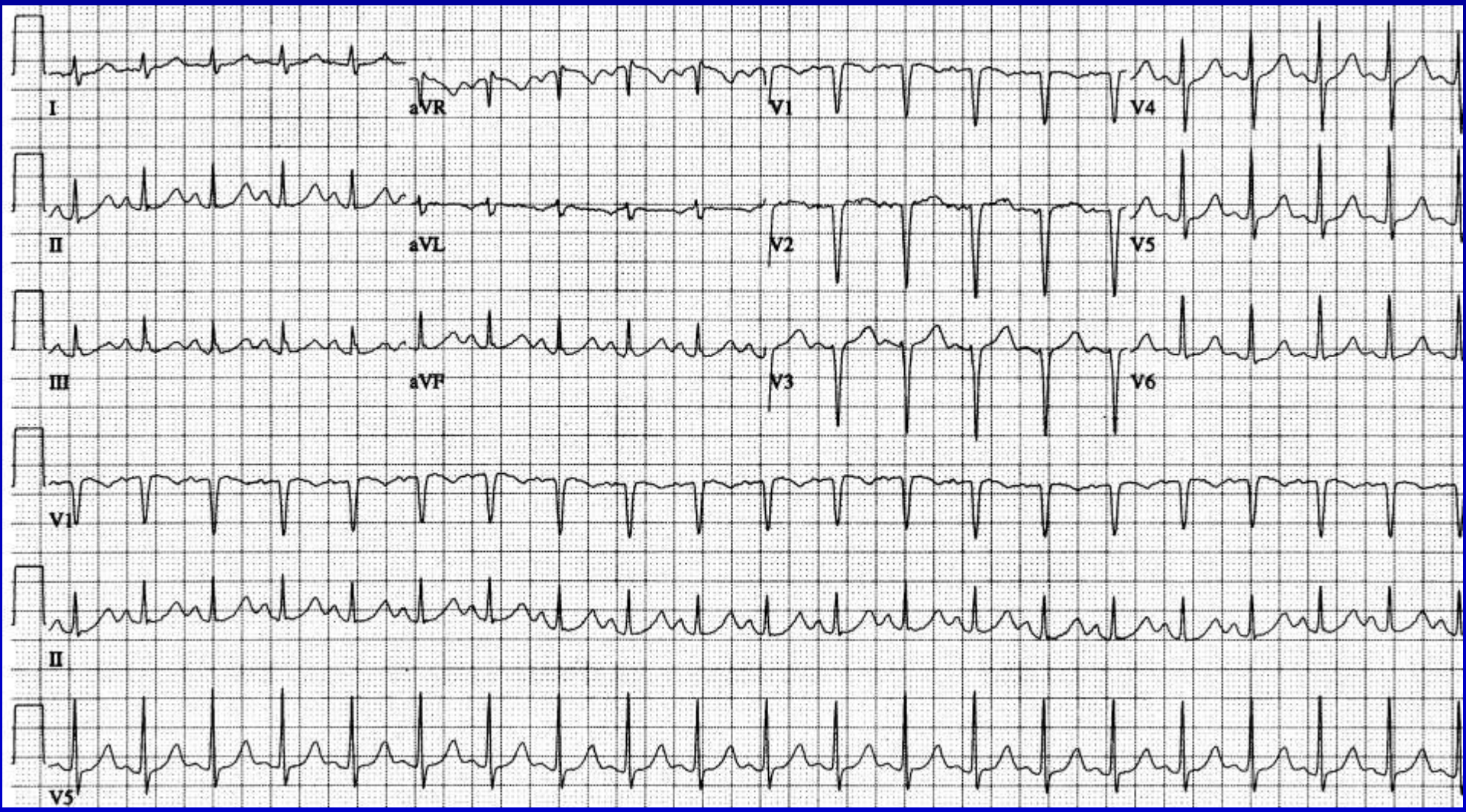


9:19

Hyperkalemia

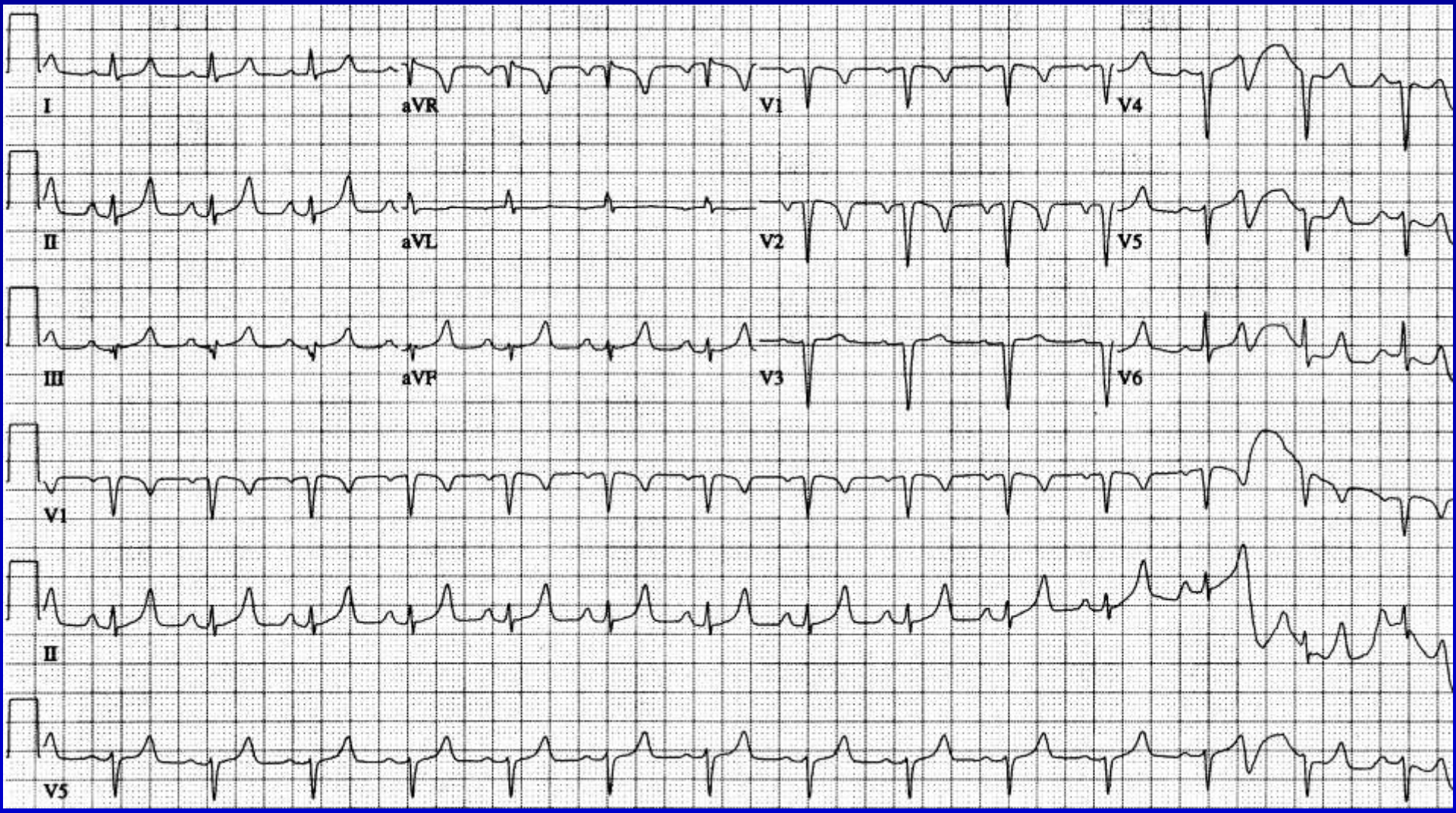


1996 Baseline Hyperkalemia case 2



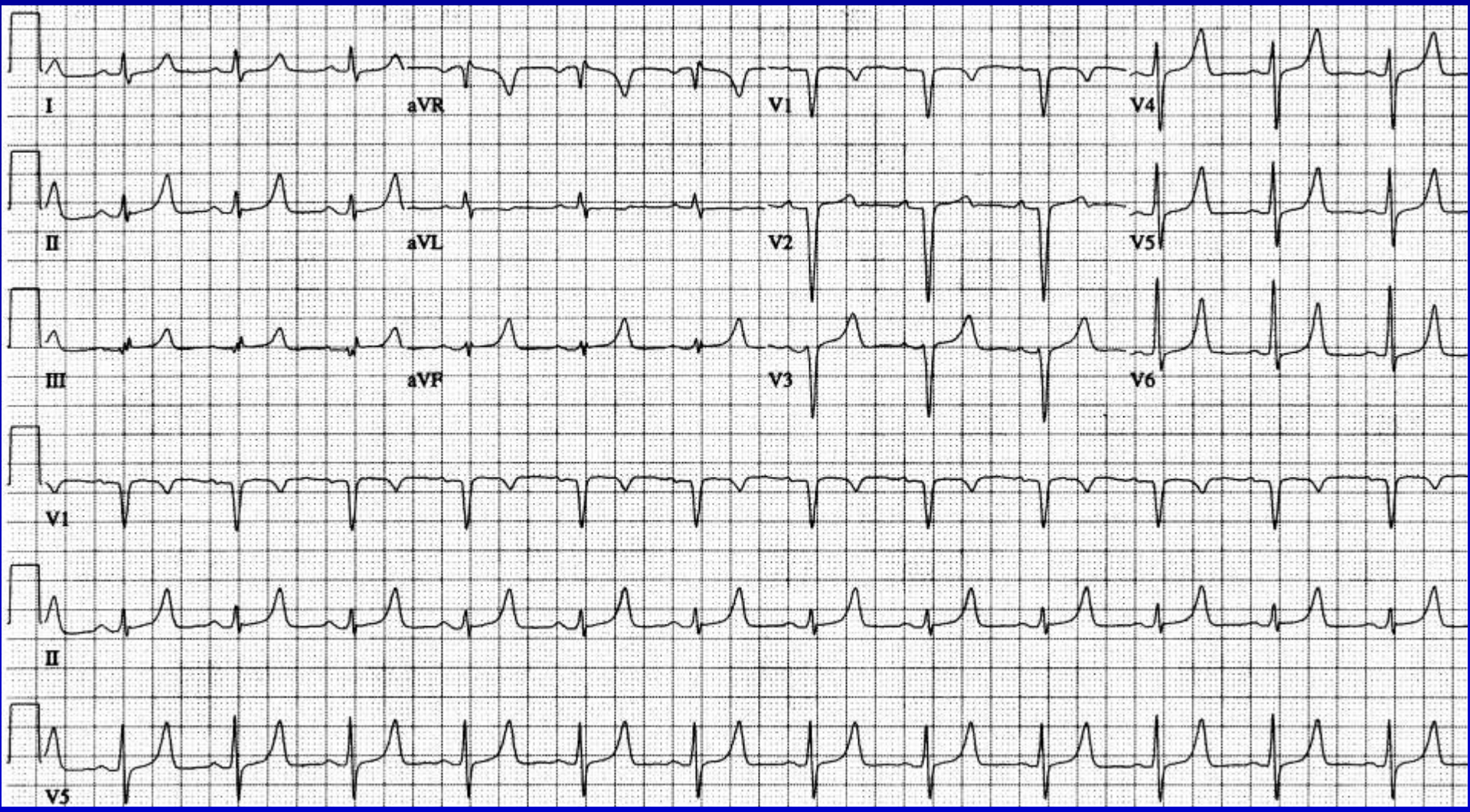
21 June 1998

Hyperkalemia case 2



23 June 1998

Hyperkalemia case 2

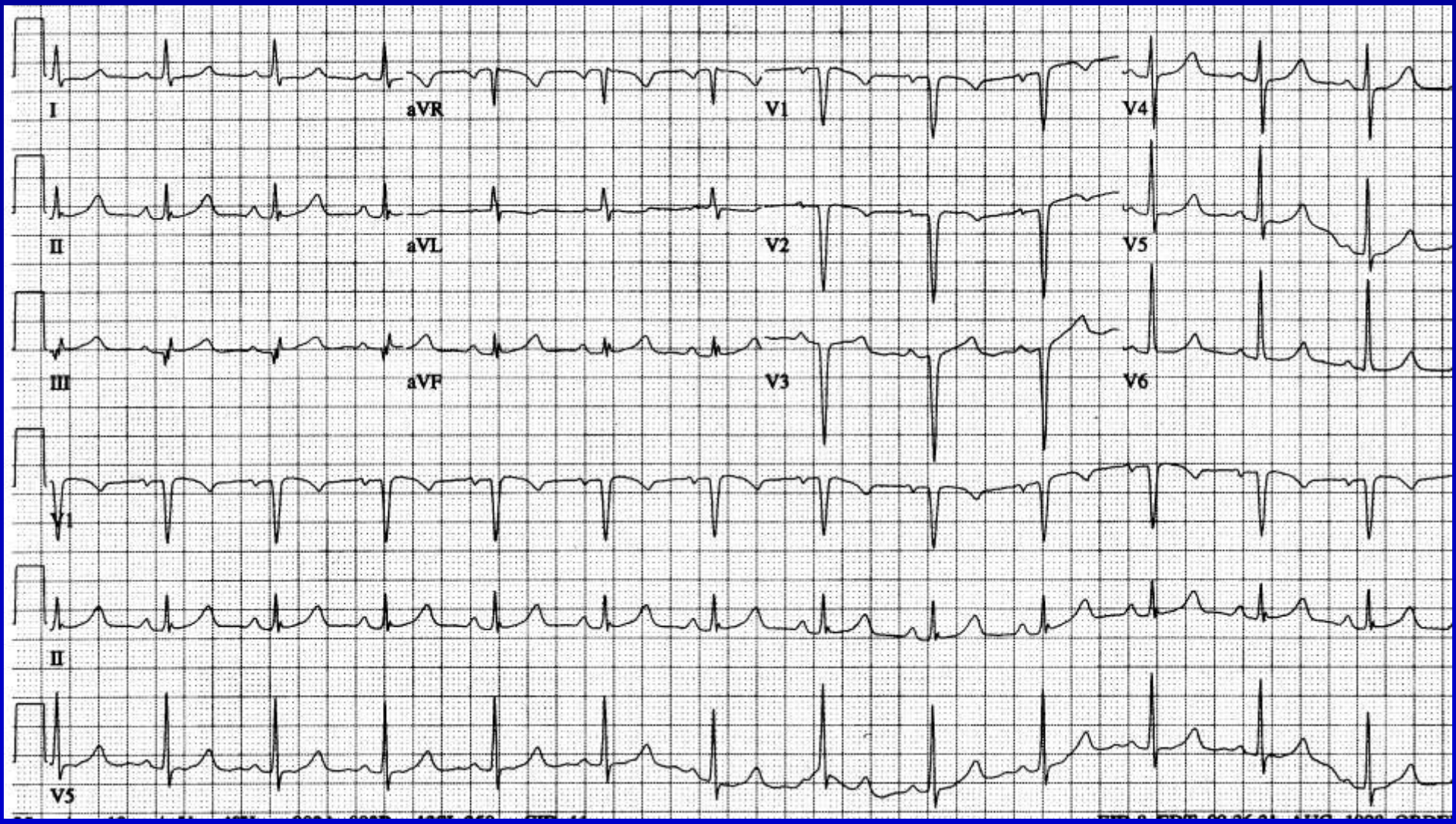


27 June 1998

Hyperkalemia case 2

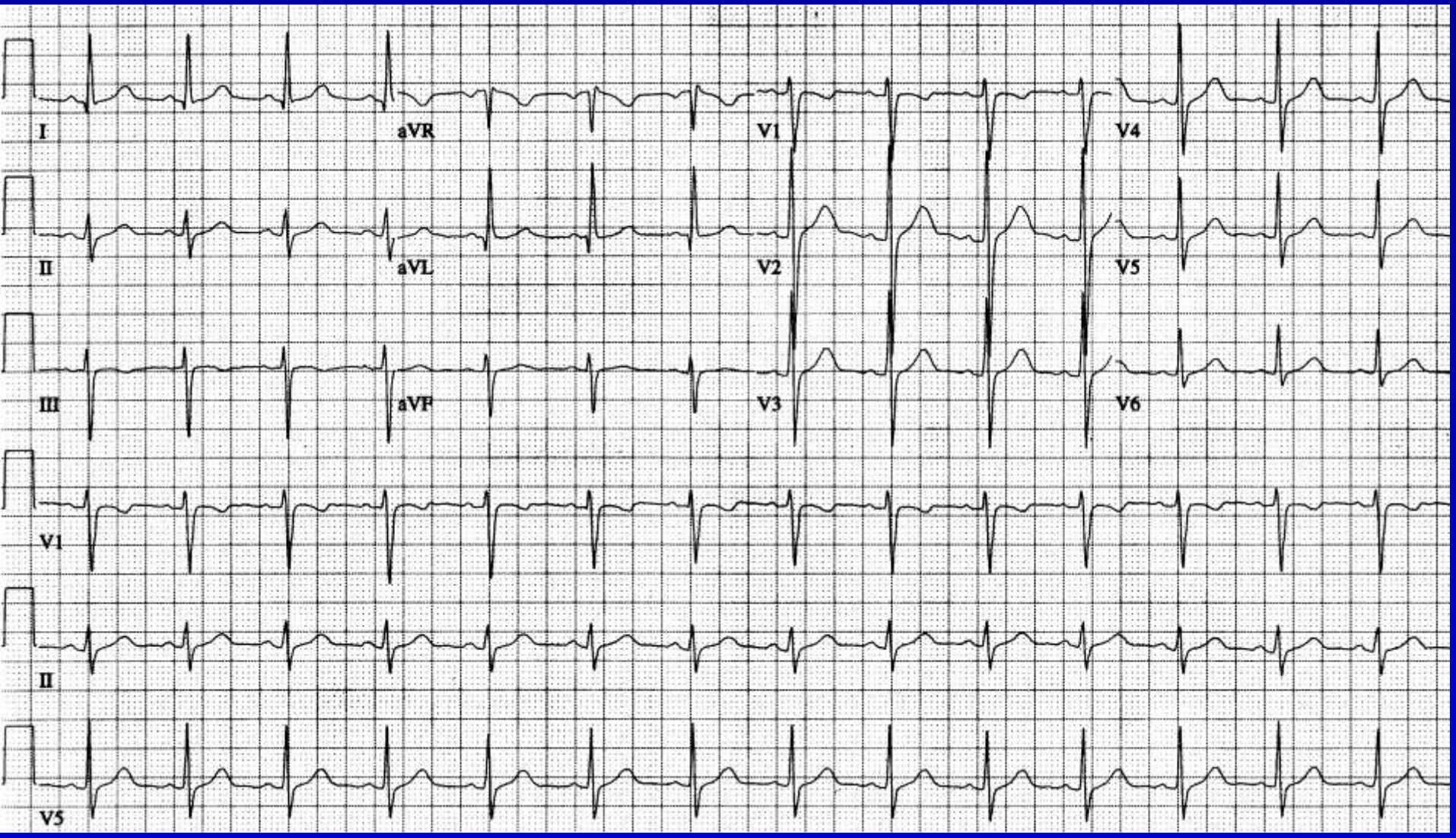
24 July 1998

Hyperkalemia case 2



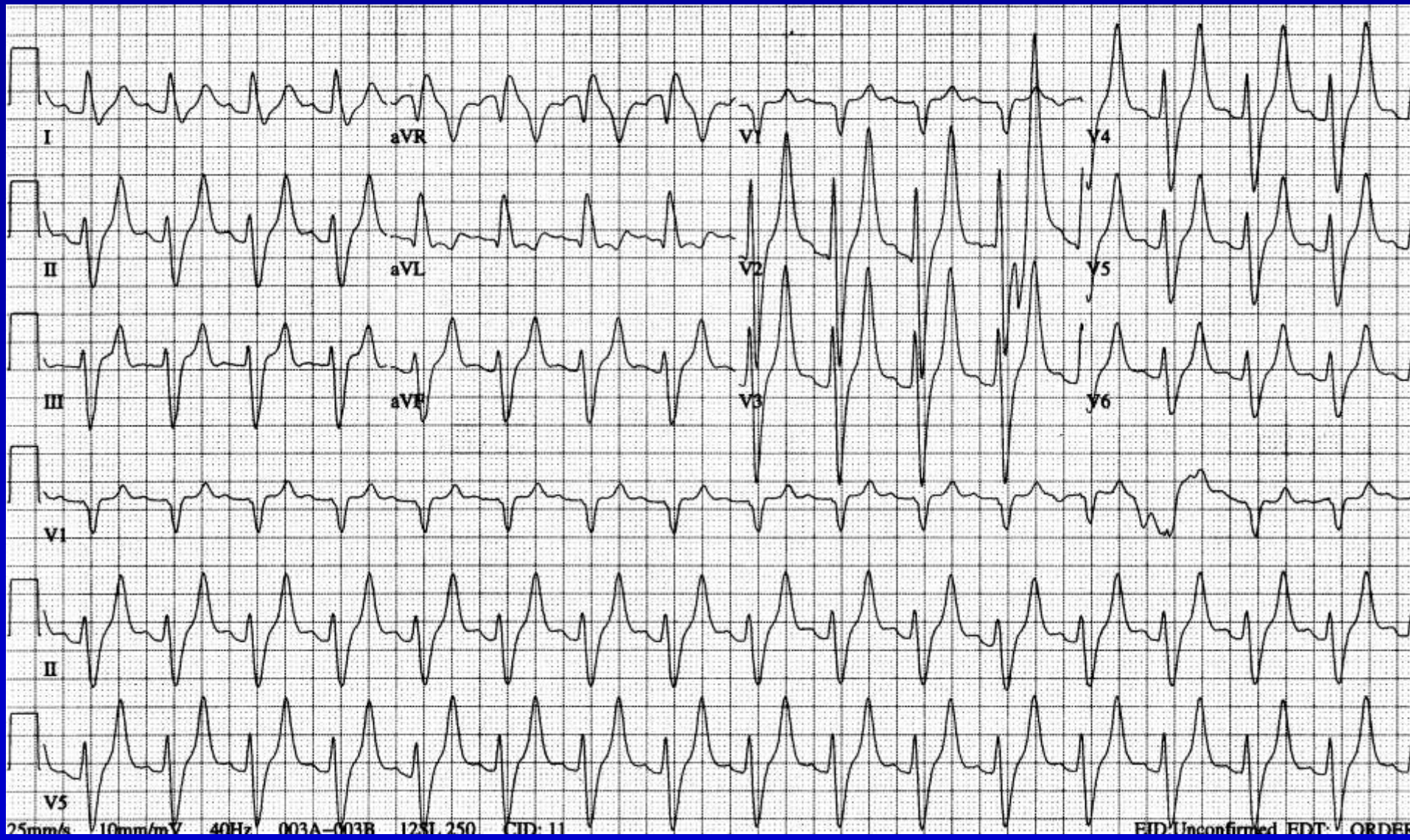
Baseline 1997

Hyperkalemia case 3



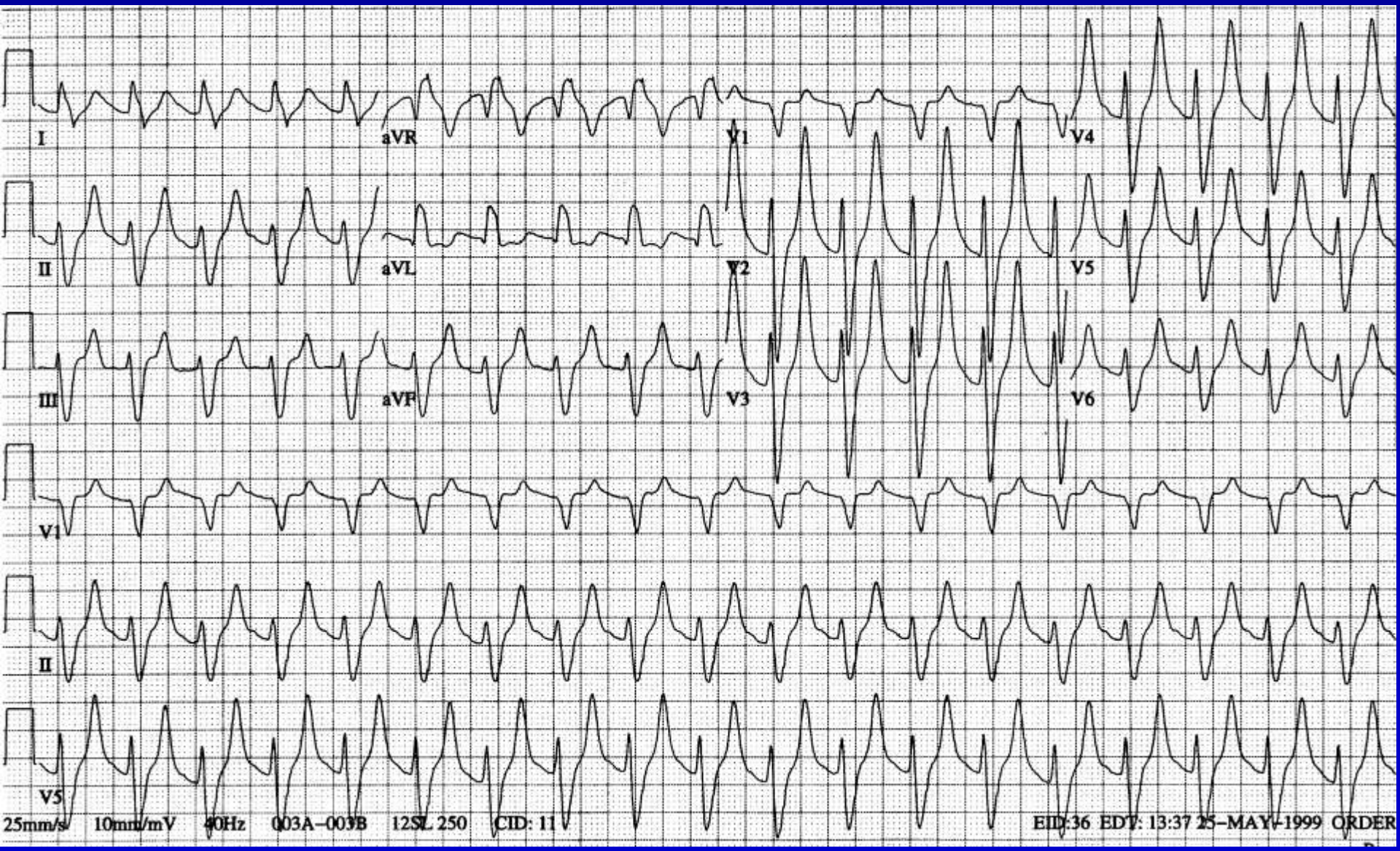
1999

Hyperkalemia case 3

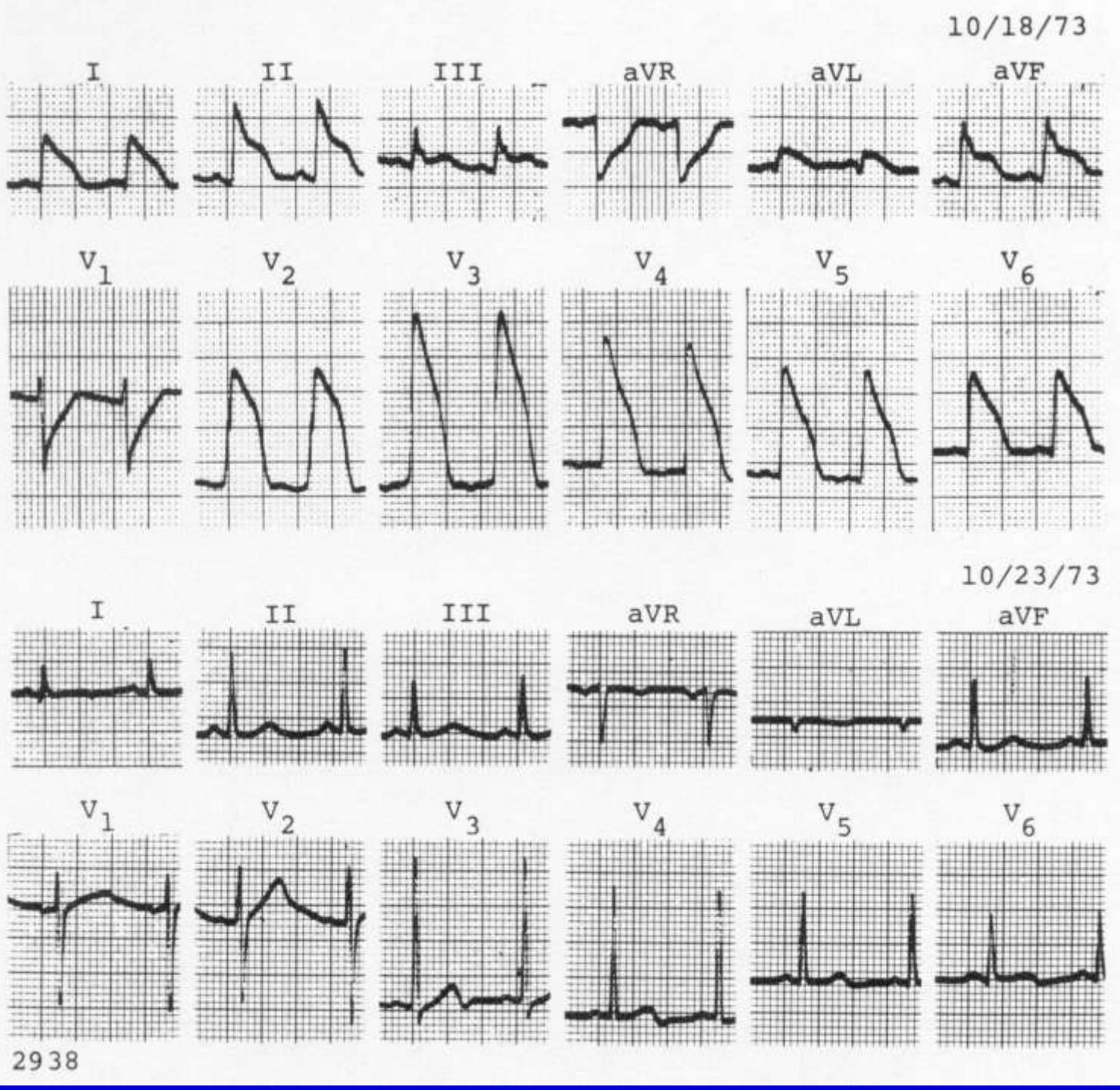


1999 plus 2 hours

Hyperkalemia case 3



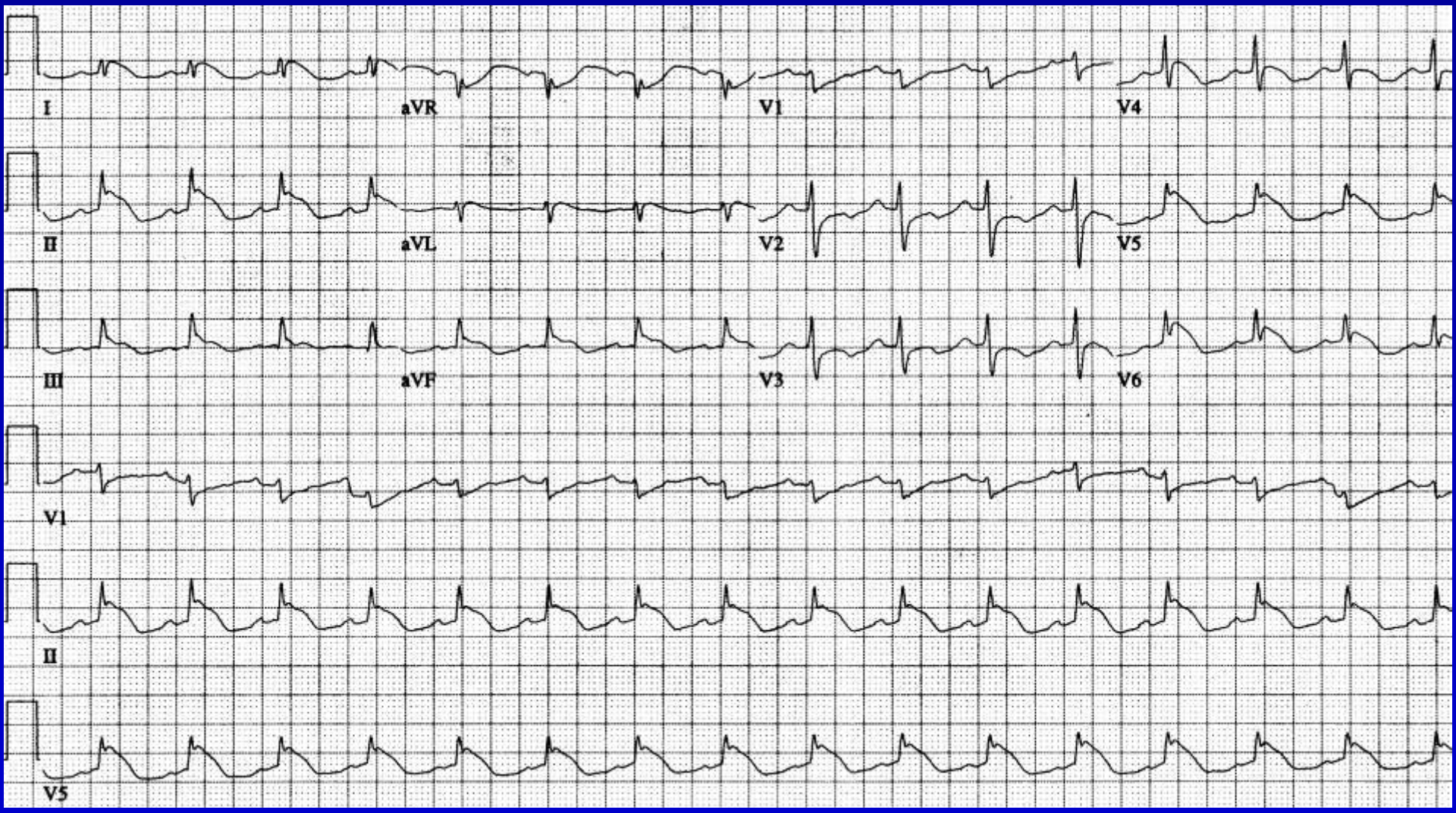
Hyper-kalemia with ST elevation



Surawicz, p. 520

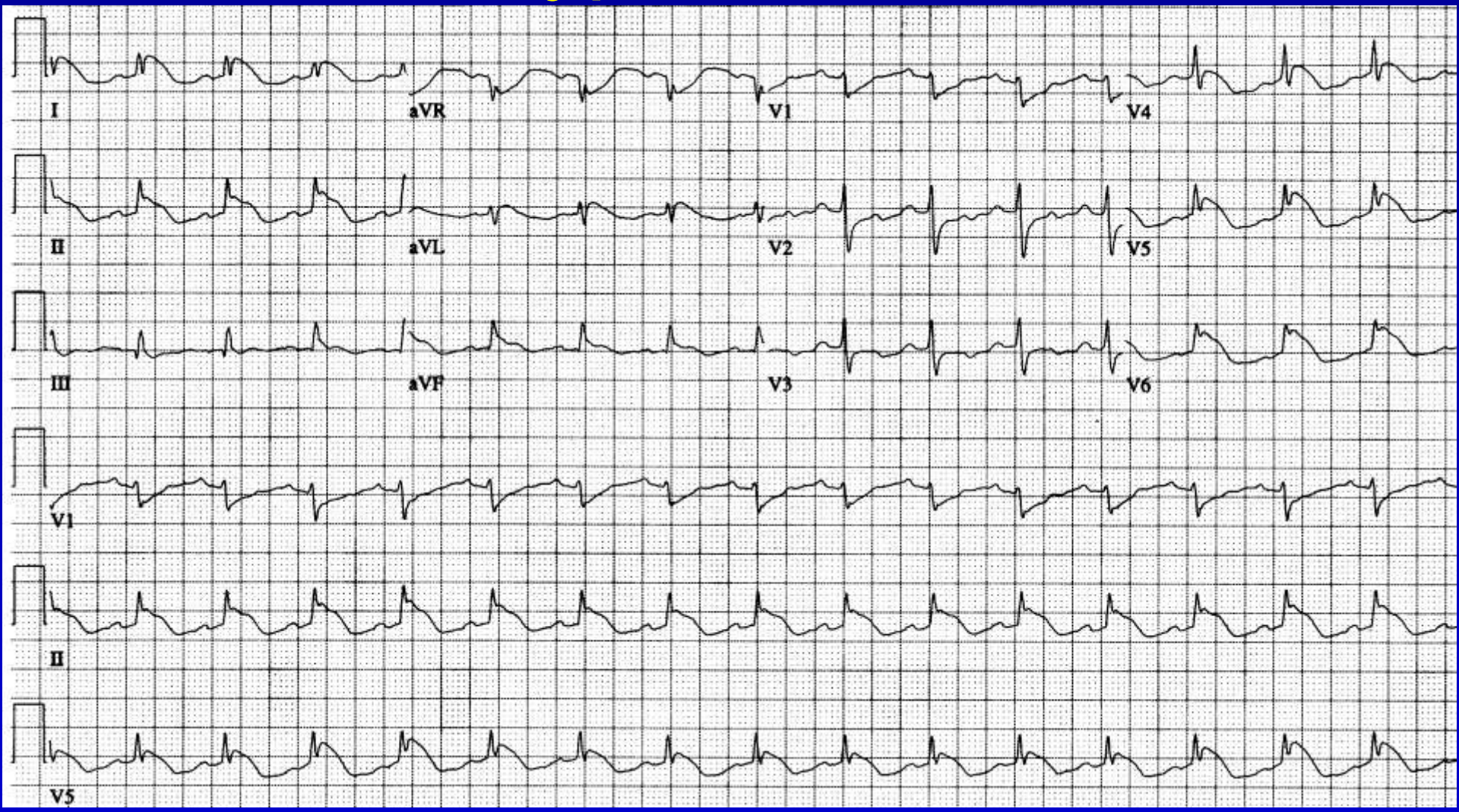
Initial

Hyperkalemia case 4



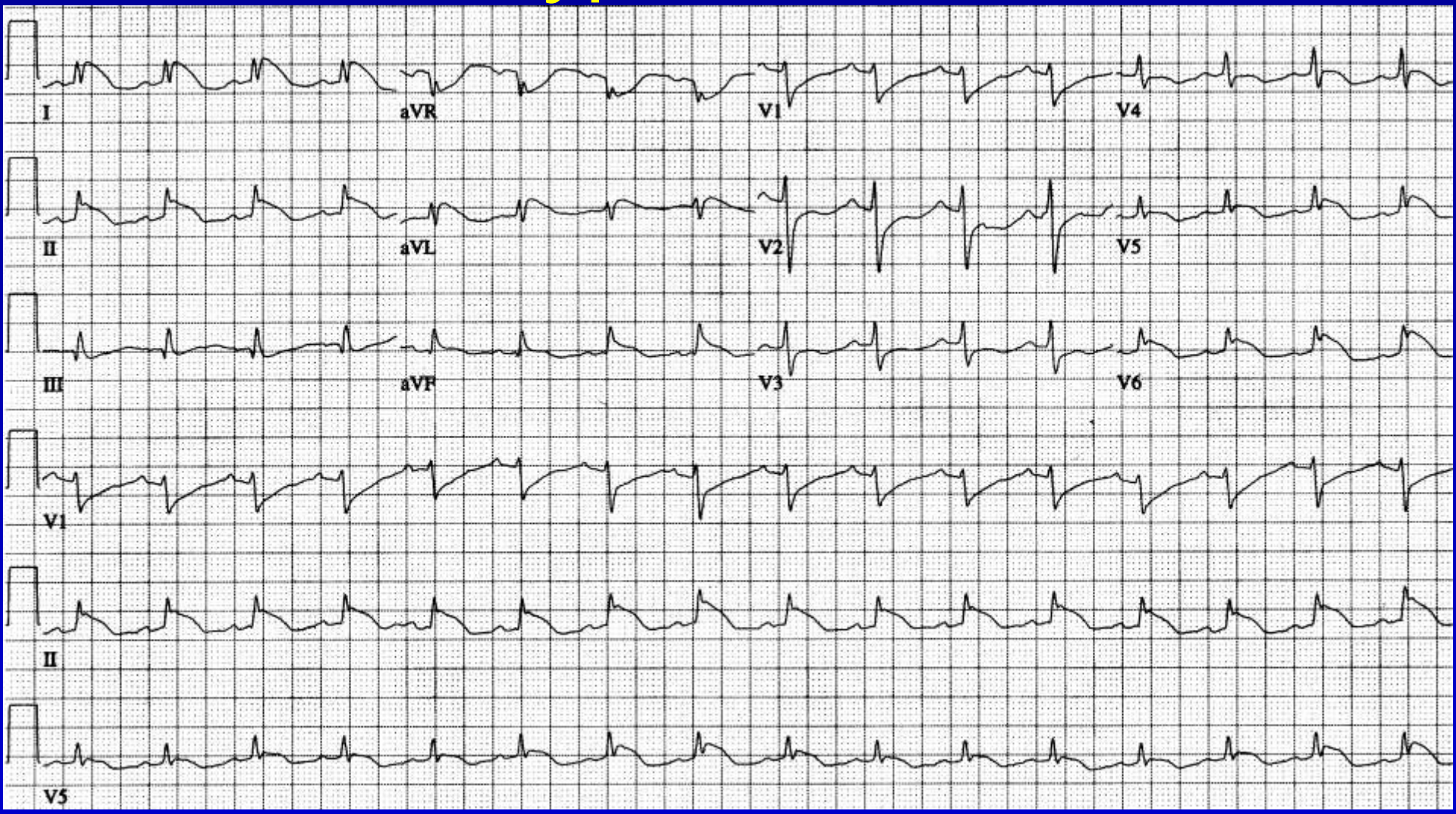
Plus 18 minutes

Hyperkalemia case 4

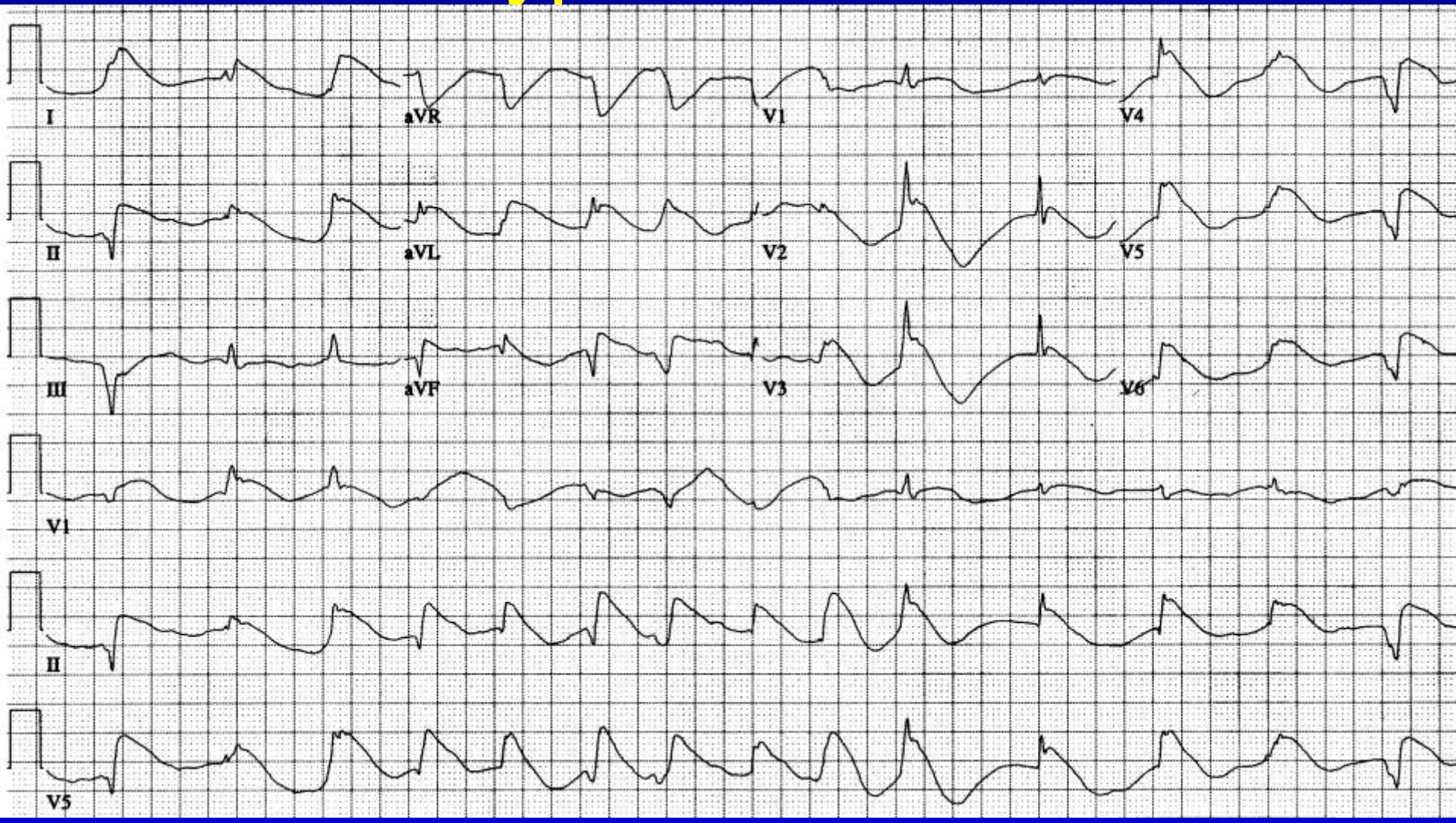


Plus 36 minutes

Hyperkalemia case 4



Hyperkalemia case 4



Plus 3 hours; died 6 hours later

Hypokalemia case 1

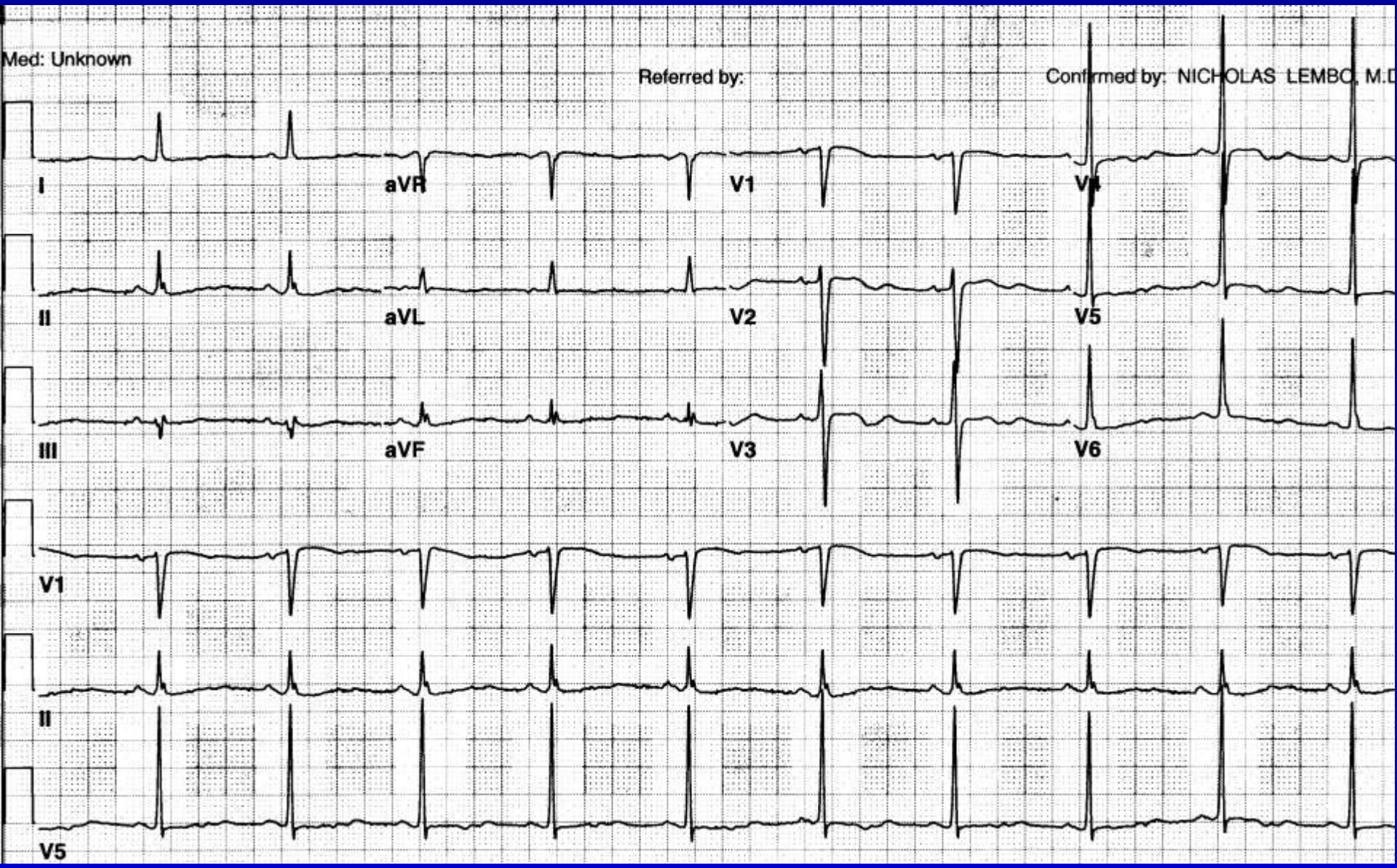
Limb leads – K = 2.8

Hypokalemia case 1

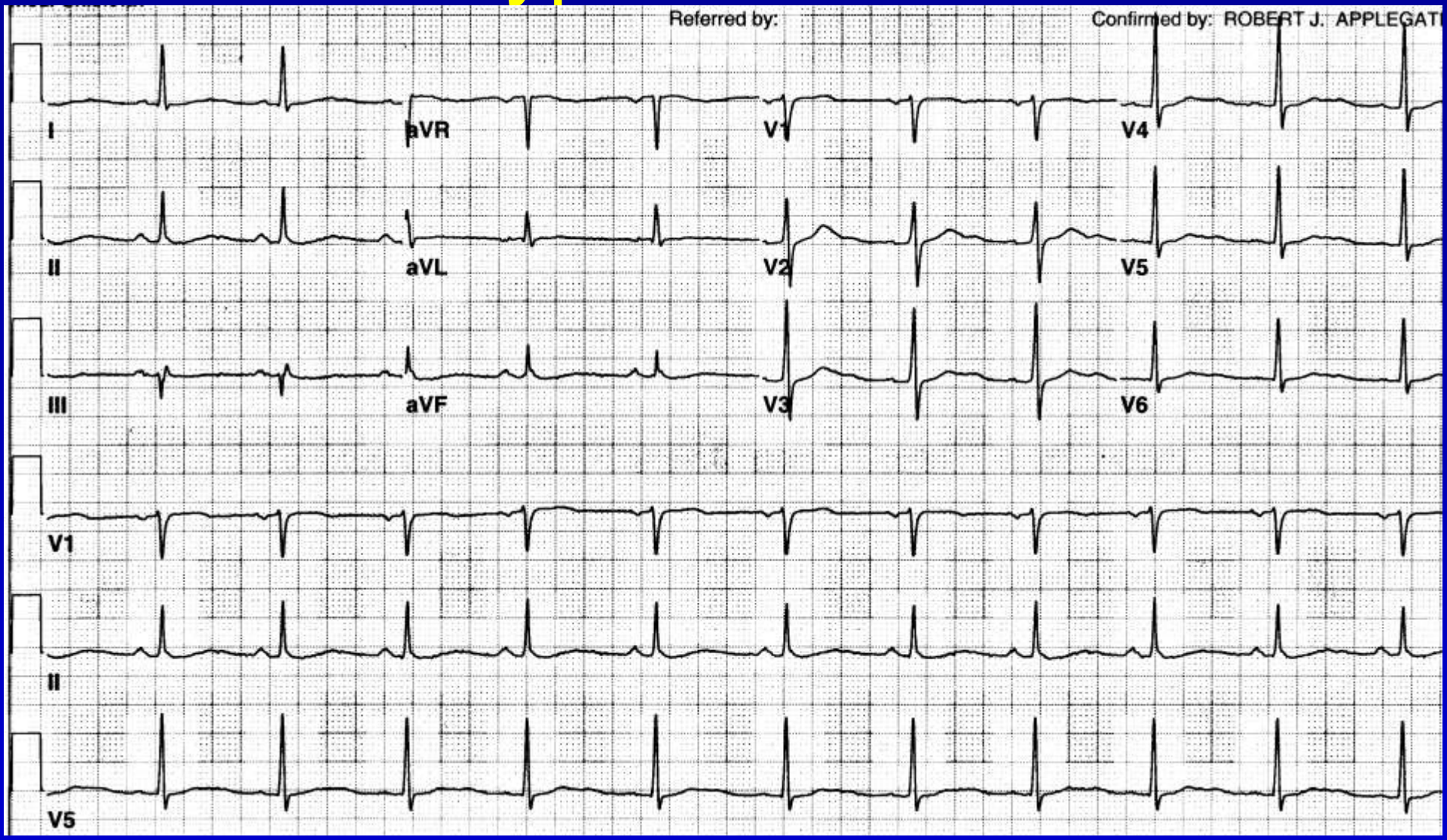
Chest leads

K unknown

Hypokalemia case 2

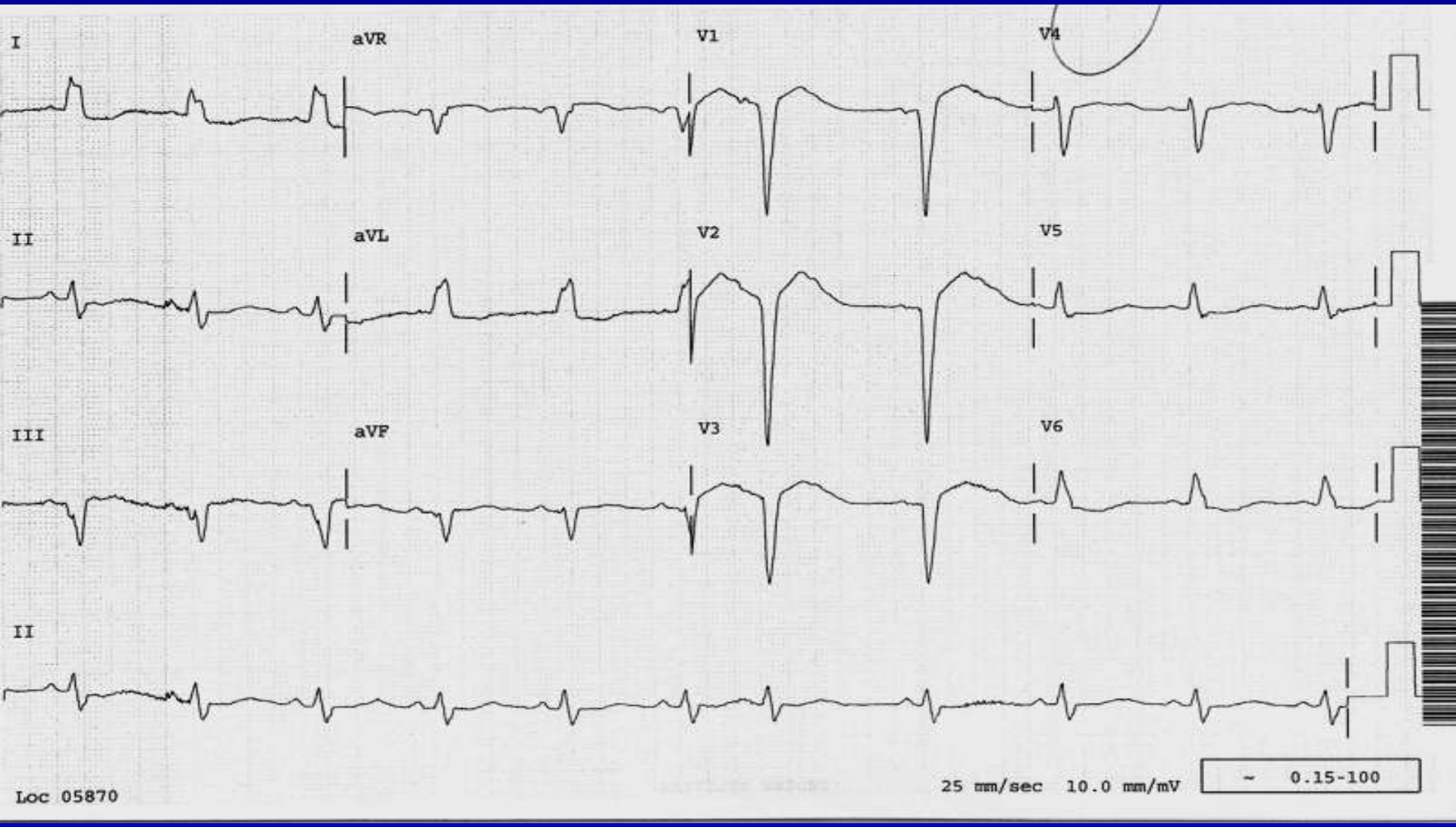


Hypokalemia case 3



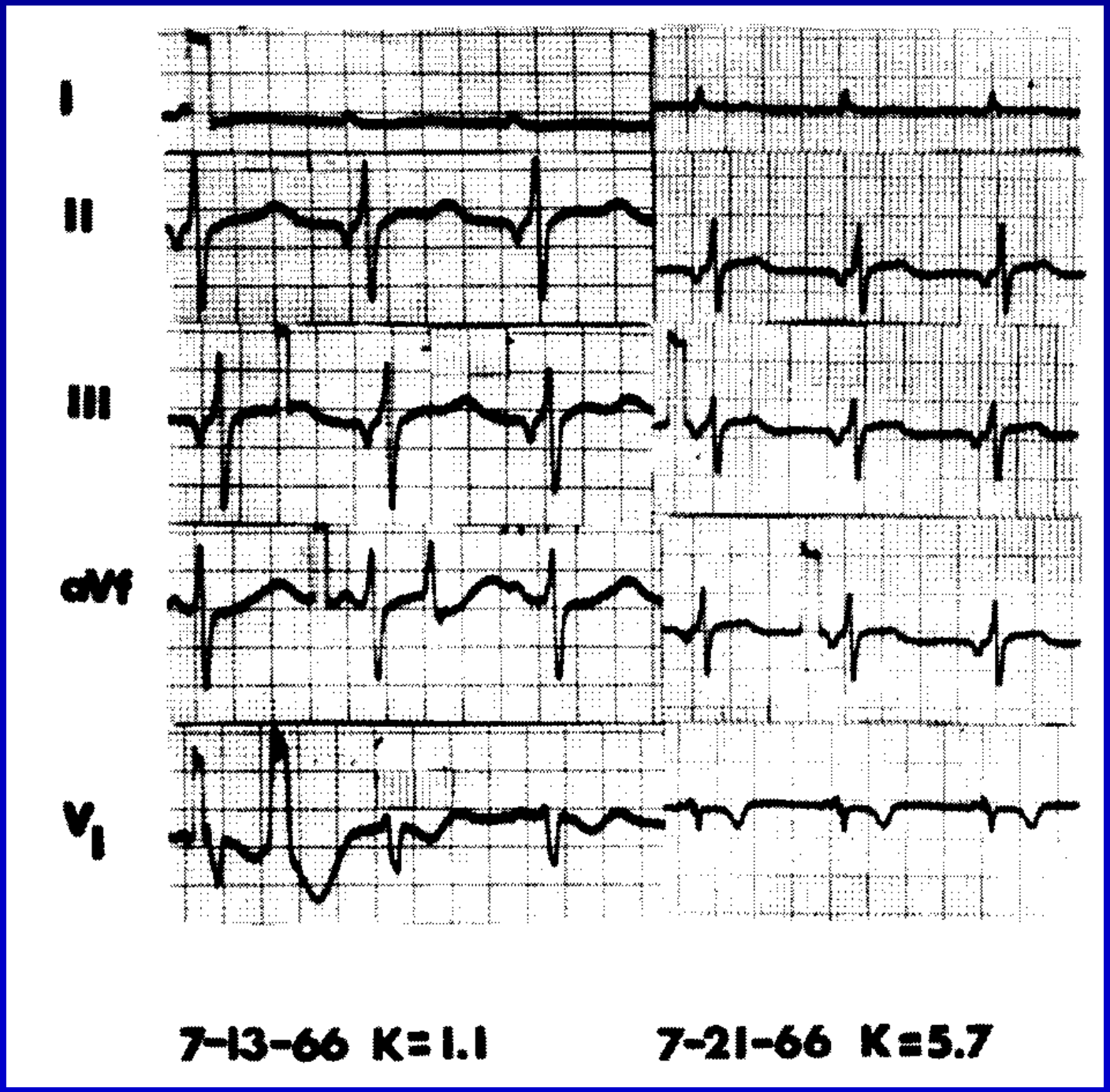
K unknown

Hypokalemia case 4



K 2.0

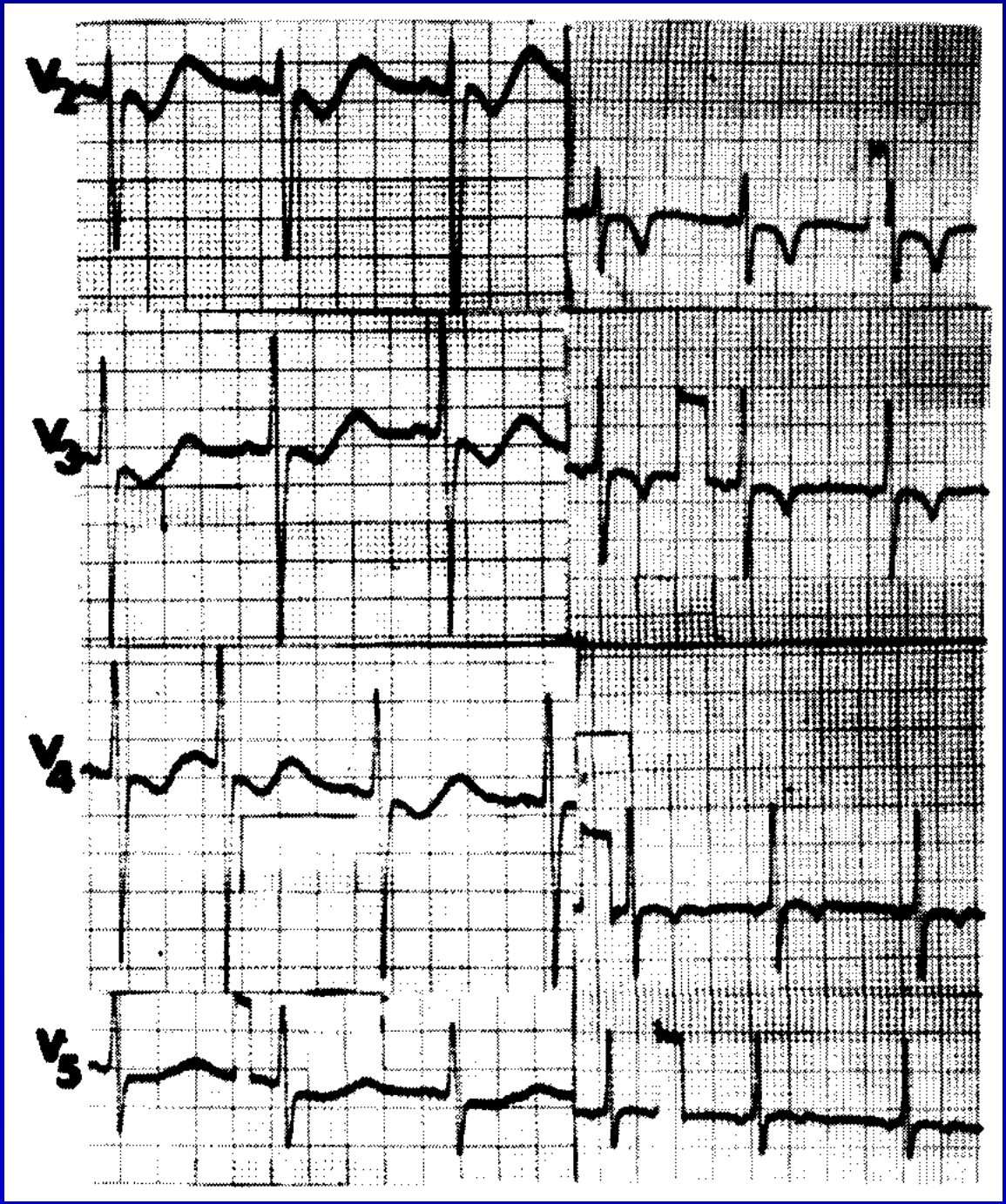
Hypo-kalemia



Surawicz, p. 526

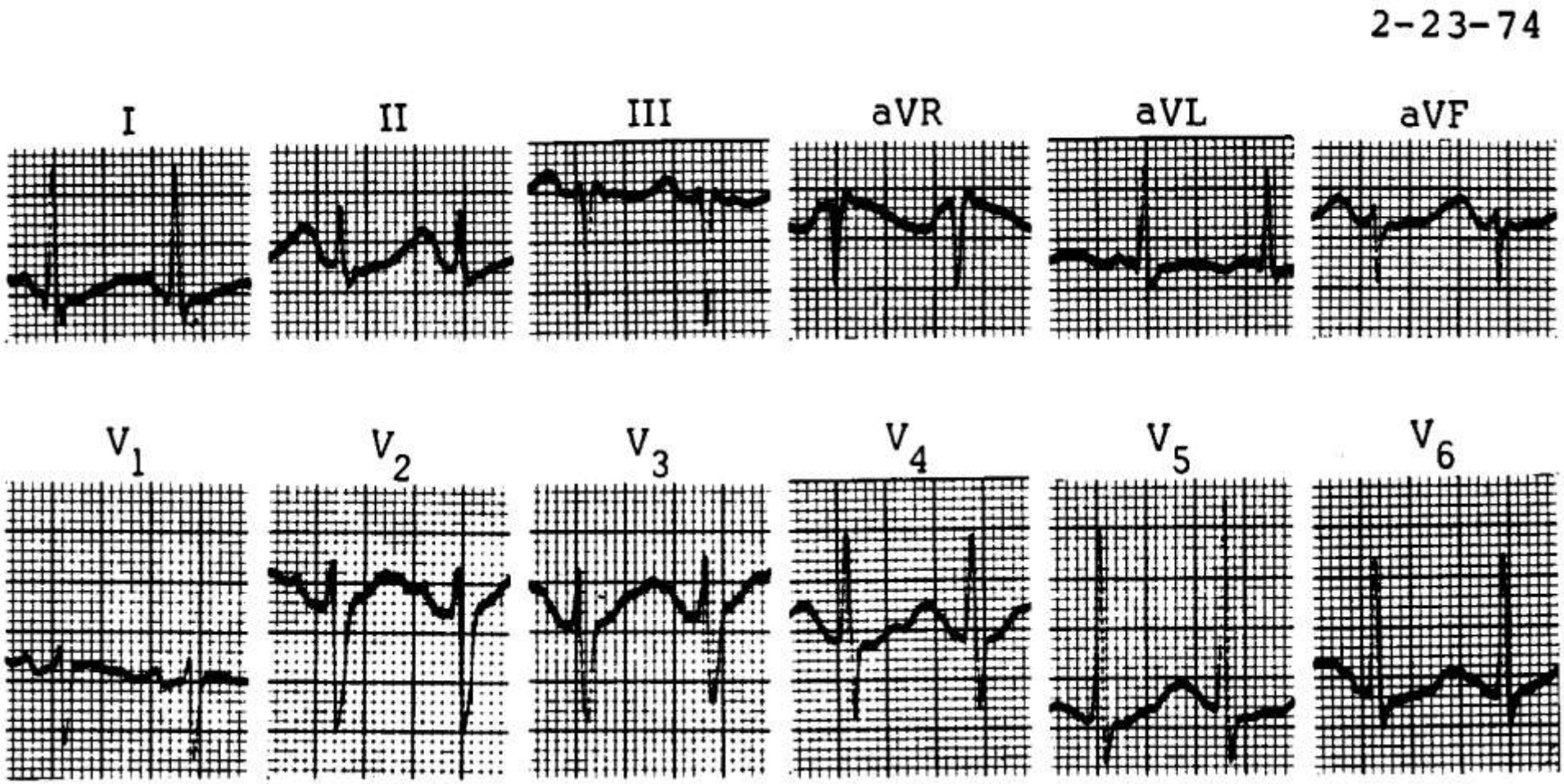
Hypo-kalemia

Left: K 1.1
Right: K 5.7



Surawicz,
p. 526

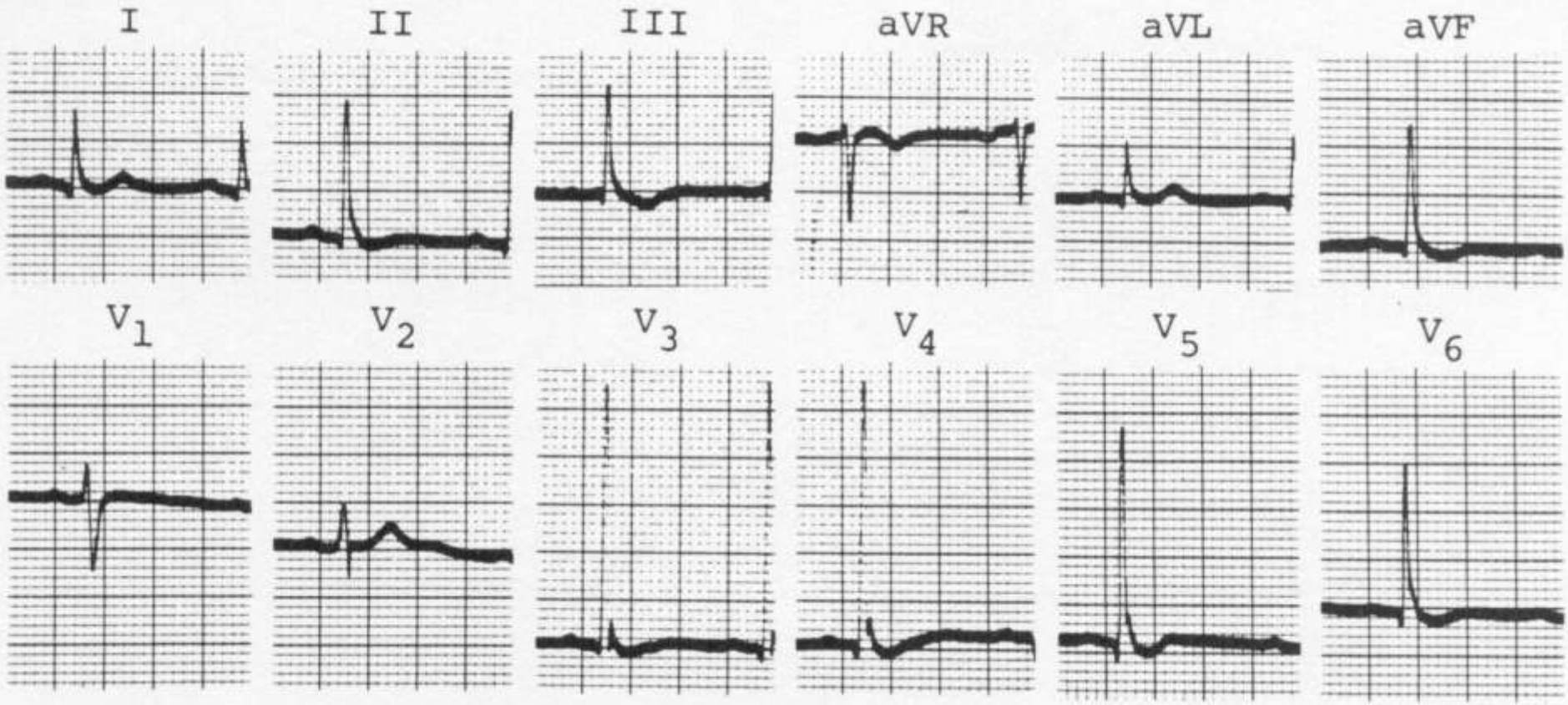
Hypokalemia



K = 2.4

Surawicz,
p. 525

Hypercalcemia

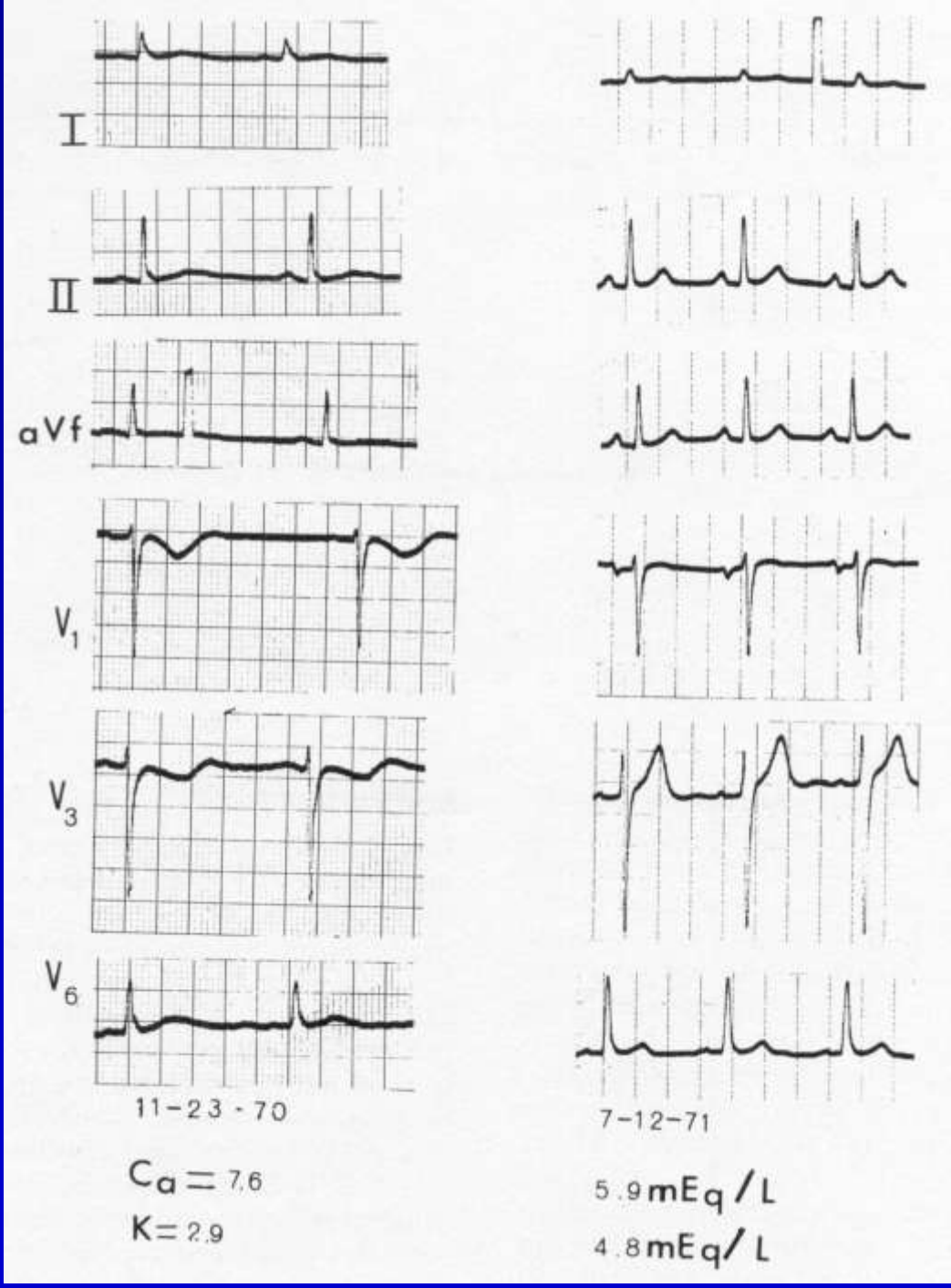


29-year old woman with lymphoma and bone involvement with Calcium 17.4

Surawicz, p. 529

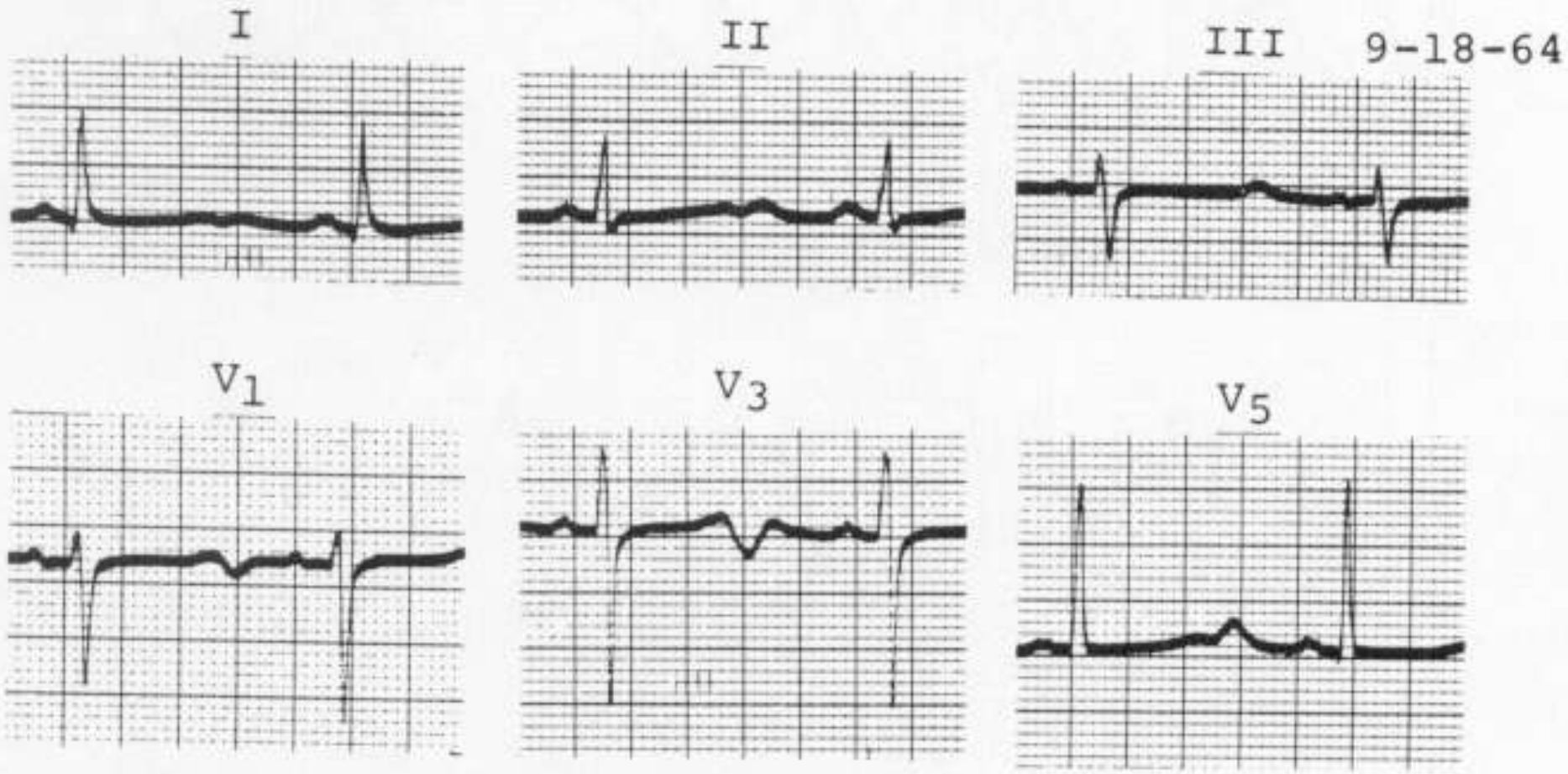
Hypercalcemia and Hypokalemia

41-year old man with multiple myeloma , later normalized



Surawicz, p. 530

Hypocalcemia



31-year old man with chronic renal failure
Calcium 5.8 and K 3.3

Surawicz, p. 528

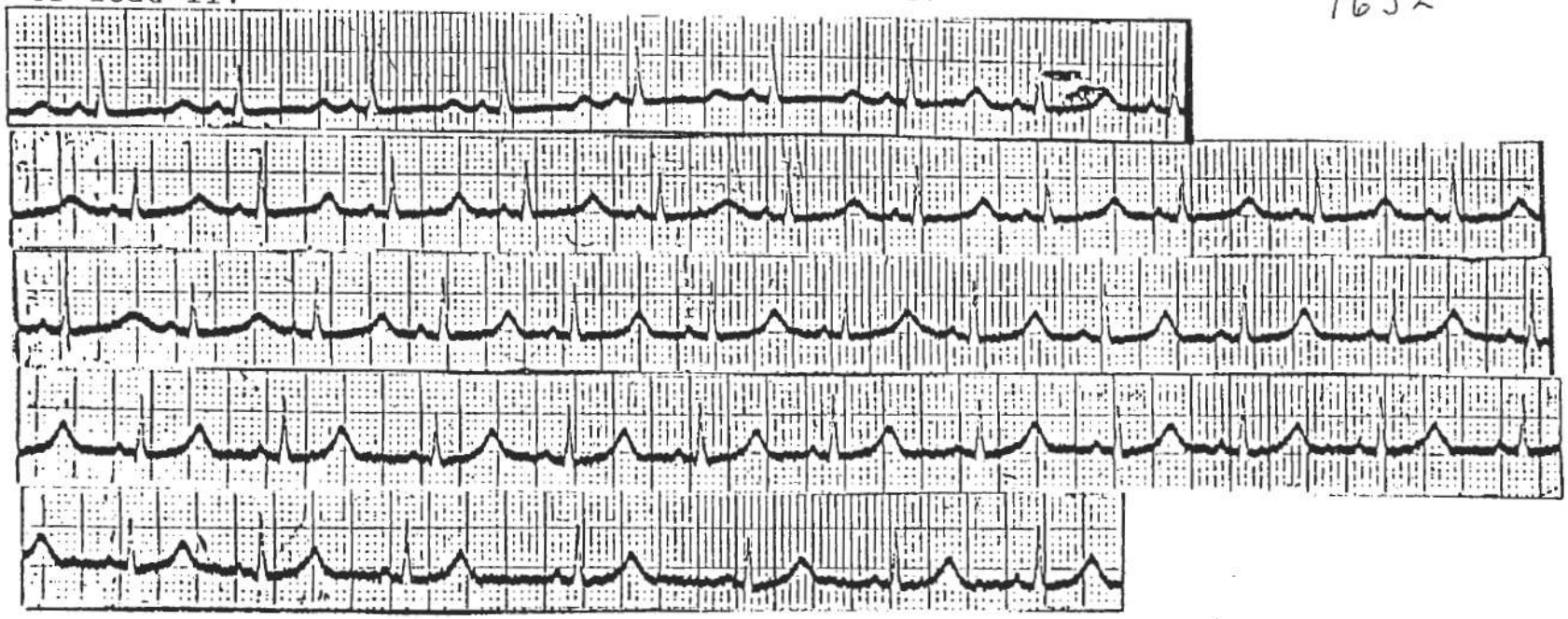
Hypocalcemia

William Nelson, MD

Kindly make an observation on this continuous recording of lead II.

What IV medication is being administered?

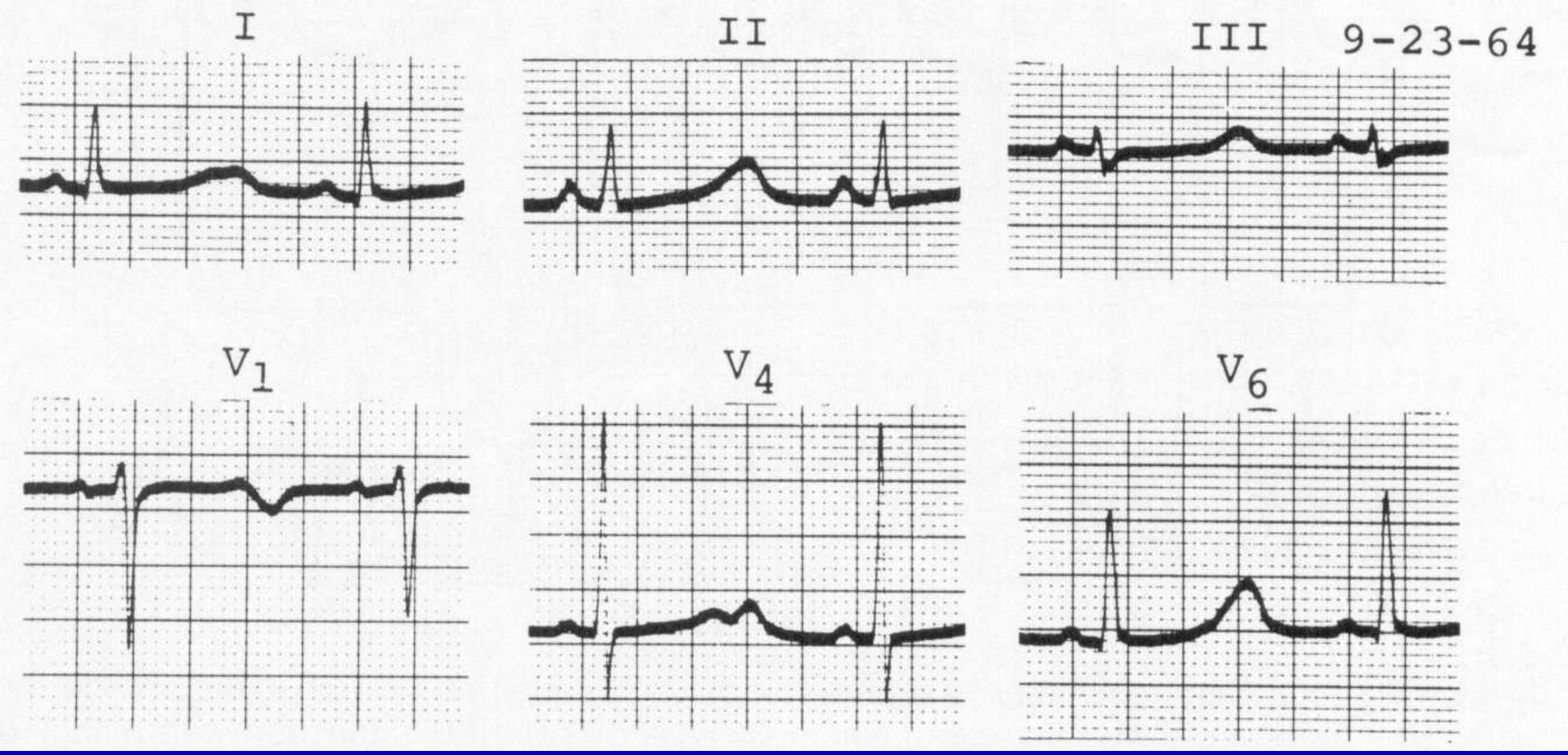
1632



This tracing was obtained from a 15 year old girl with hypoparathyroidism and is a dramatic example of the resolution of the ECG EKG changes of hypocalcemia with IV administration of calcium gluconate. The characteristic abnormality ϕ$ the prolongation of the "QoT" interval (the interlude between the onset of the QRS and the appearance of the T wave). Her serum calcium transiently increased from 4.2 to 8.6 after injection of 2 grams of calcium gluconate.

Kind of nifty - huh?

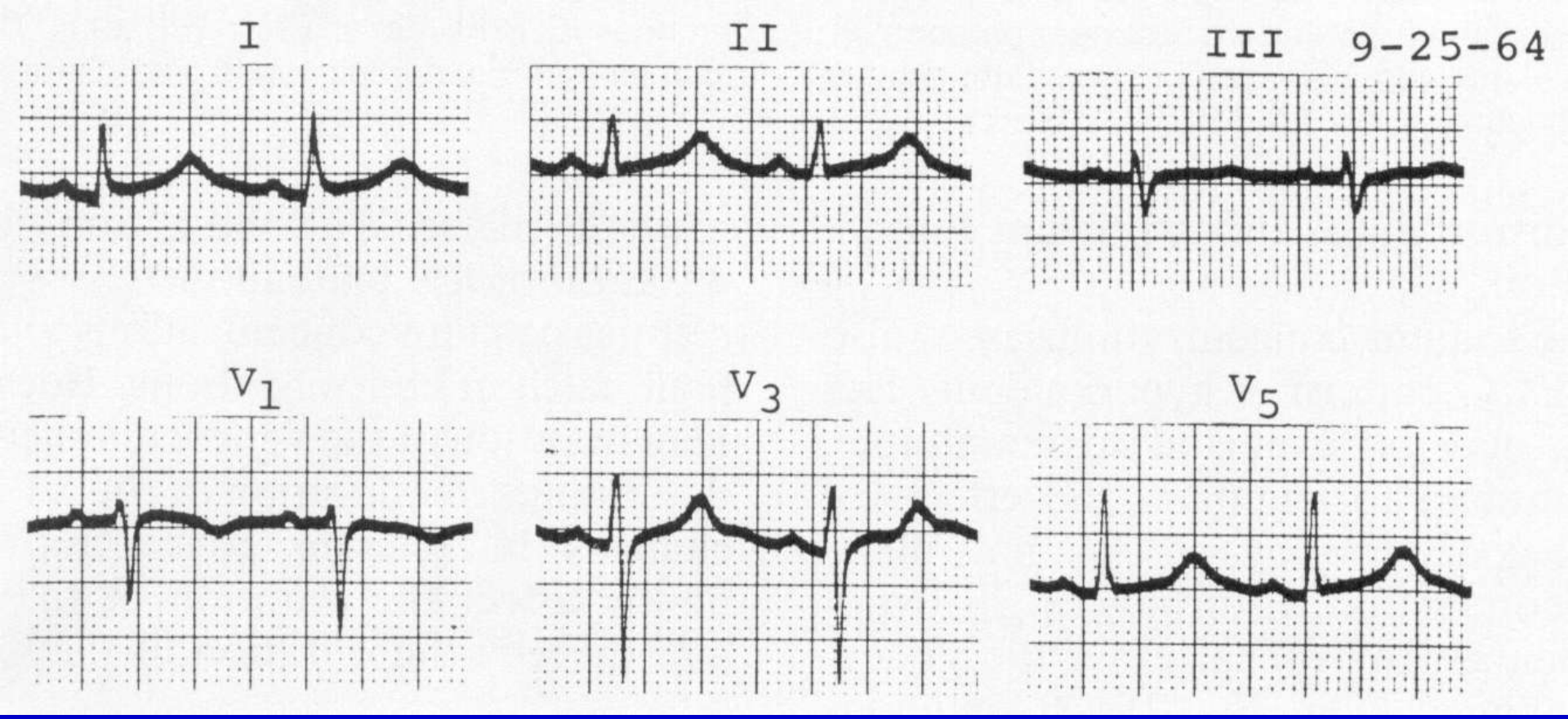
Hypocalcemia



31-year old man with chronic renal failure
K now down to 2.8

Surawicz, p. 528

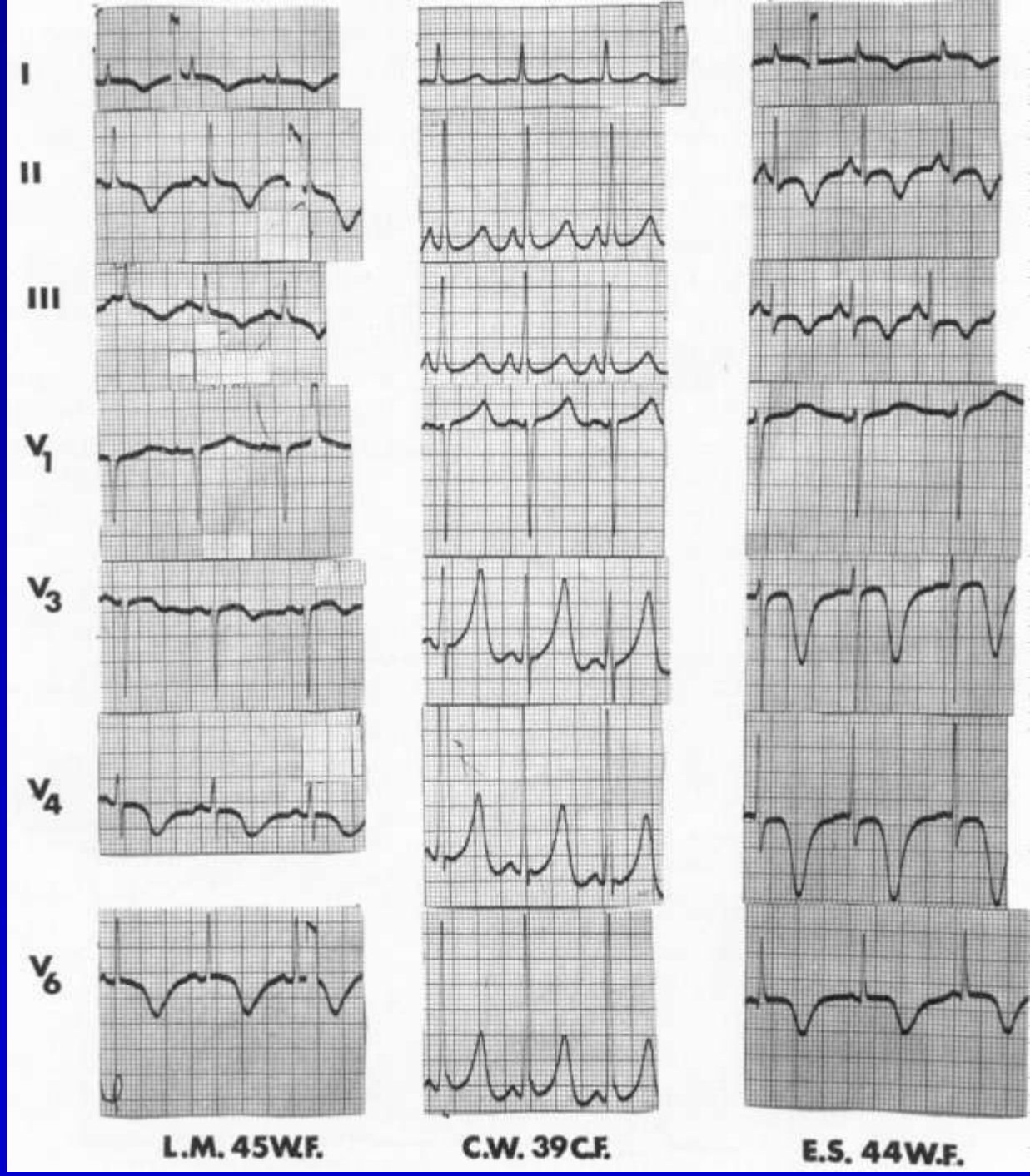
Hypocalcemia



31-year old man with chronic renal failure
K now up to 3.5 and Calcium up to 6.5

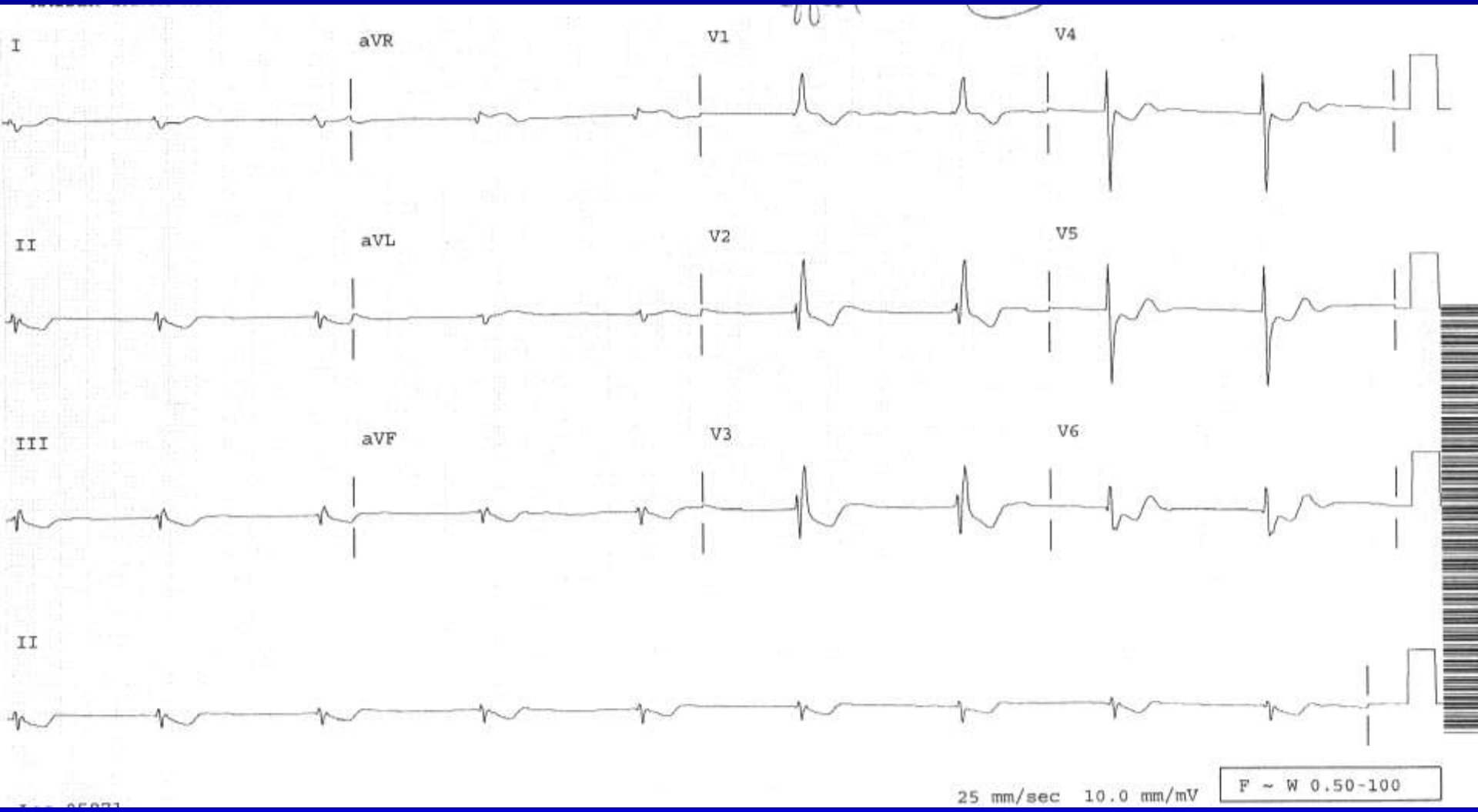
Surawicz, p. 528

CNS: Subarachnoid Bleed



Surawicz p. 534

Digitalis Intoxication



Short QT; Increase in automaticity; decrease in AV conduction