

# **RABDOMIOLISIS**

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H. "La Paz". Madrid*



Hospital Universitario La Paz



Madrid



HRG

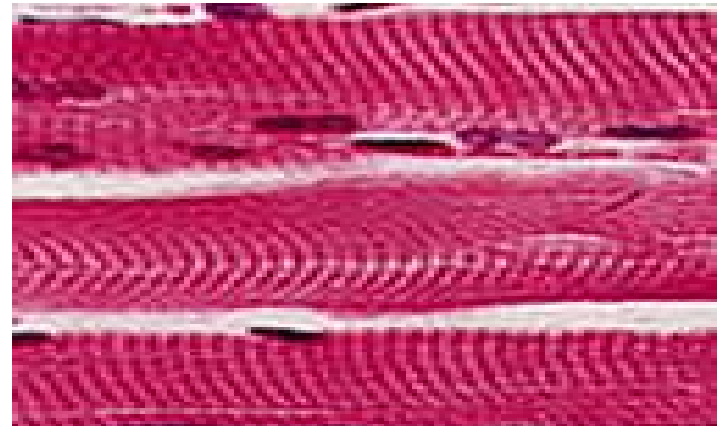
CONSORCI  
HOSPITAL GENERAL  
UNIVERSITARI  
VALÈNCIA

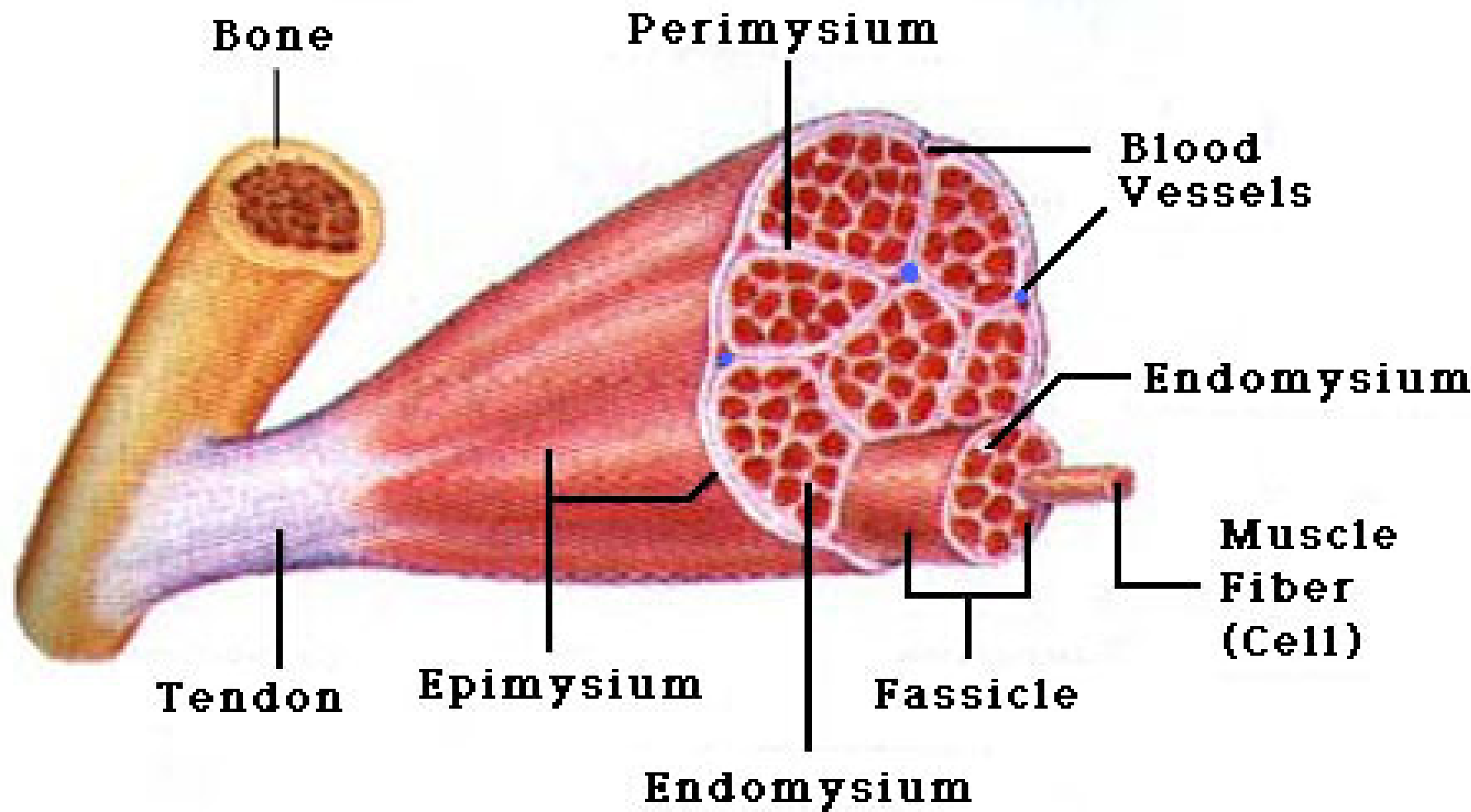
# **RABDOMIOLISIS**

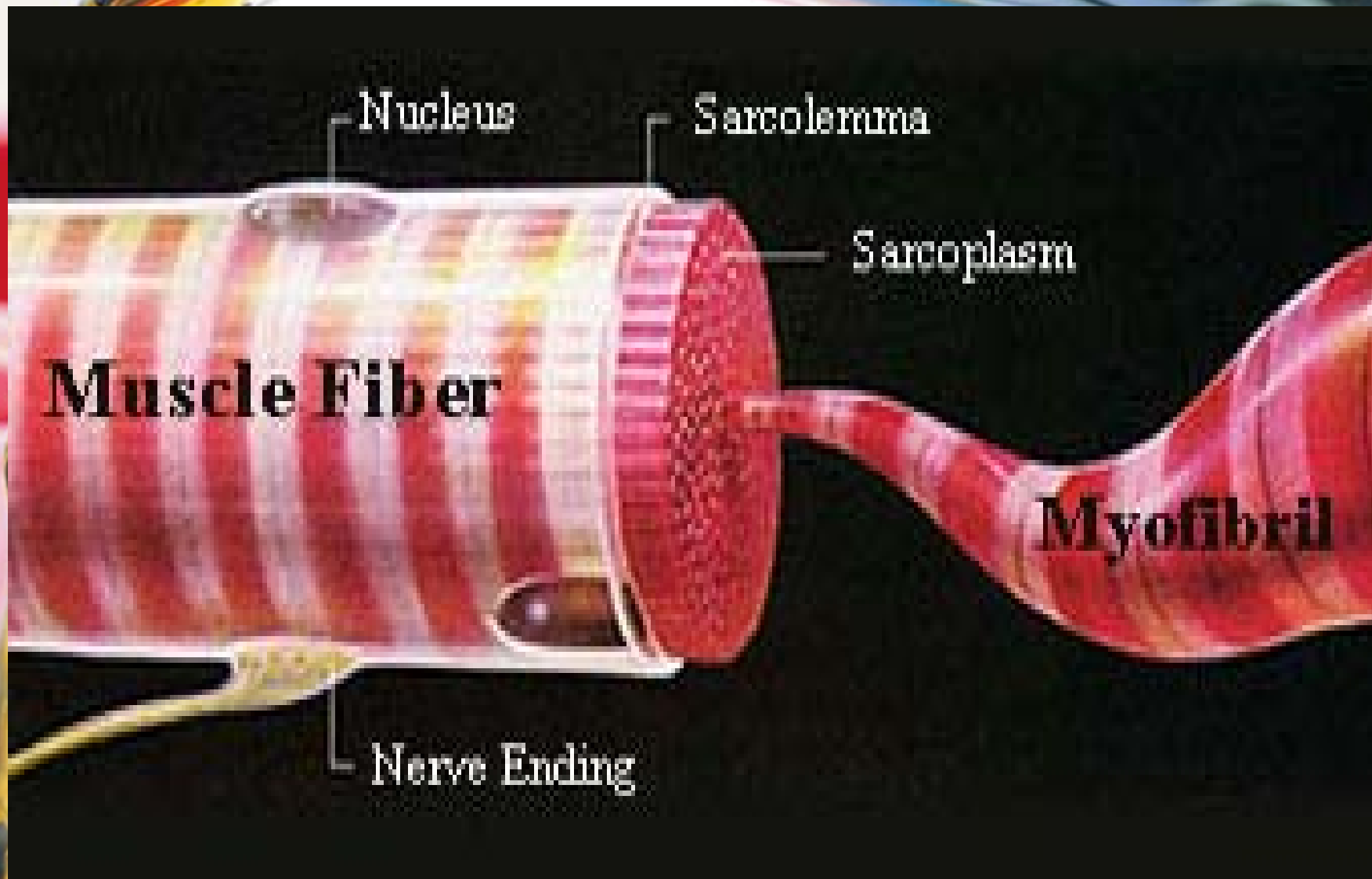
**LISIS** = **DESTRUCCIÓN**

**MIO** = **MUSCULO**

**RABDO** = **BASTONES**







# **RABDOMIOLISIS**

- 1. La causa más frecuente de rabdomiolisis en nuestro medio es la isquemia arterial**
- 2. LA CPK proporciona la energía necesaria para la contracción muscular actuando sobre la fosfocreatina**
- 3. Elevaciones de la CPK, junto con un test (+) de ortotoluidina hacen muy sospechoso el diagnóstico**
- 4. La interacción de la proteína de Tamm- Horsfall con la mioglobina es la responsable de las características de la orina en estos pacientes**
- 5. El uso de manitol y la alcalinización urinaria es la base del tratamiento del fracaso renal asociado**
- 6. El uso de técnicas continuas de reemplazo renal es muy útil en el aclaramiento de la mioglobulinemia**
- 7. ¿Cuáles son los “5” mejores pintores valencianos?**

# **RABDOMIOLISIS**





# RABDOMIOLISIS : ETIOLOGIA



# **RABDOMIOLISIS**

## **ETIOLOGIA**

### **1. PREDOMINIO ISQUÉMICO**

**ISQUEMIA ARTERIAL AGUDA**

**EJERCICIO INTENSO**

**GOLPE DE CALOR**

**SINDROME POSTURAL**

**DREPANOCITOSIS**





# **RABDOMIOLISIS**

## **ETIOLOGIA**

### **2. FRAGILIDAD MUSCULAR**

**ADICCIÓN A DROGAS**

**SINDROME NEUROLEPTICO MALIGNO**

**COMA CETOACIDOTICO**

**ALT. HIDROELECTROLITICAS**

### **3. ENFERMEDADES MUSCULARES**

**HIPERTERMIA MALIGNA**

**MIOPATIAS HEREDITARIAS**

**(Duchenne, Glucogenosis)**



# **RABDOMIOLISIS**

## **ETIOLOGIA**

### **4. OTRAS CAUSAS**

**LESION MITOCONDRIAL**

**LESION RETICULAR (receptores RyR)**

**SHOCK SEPTICO**

**FARMACOLOGICOS (estatinas)**



# ***RABDOMIOLISIS: FISIOPATOLOGIA***

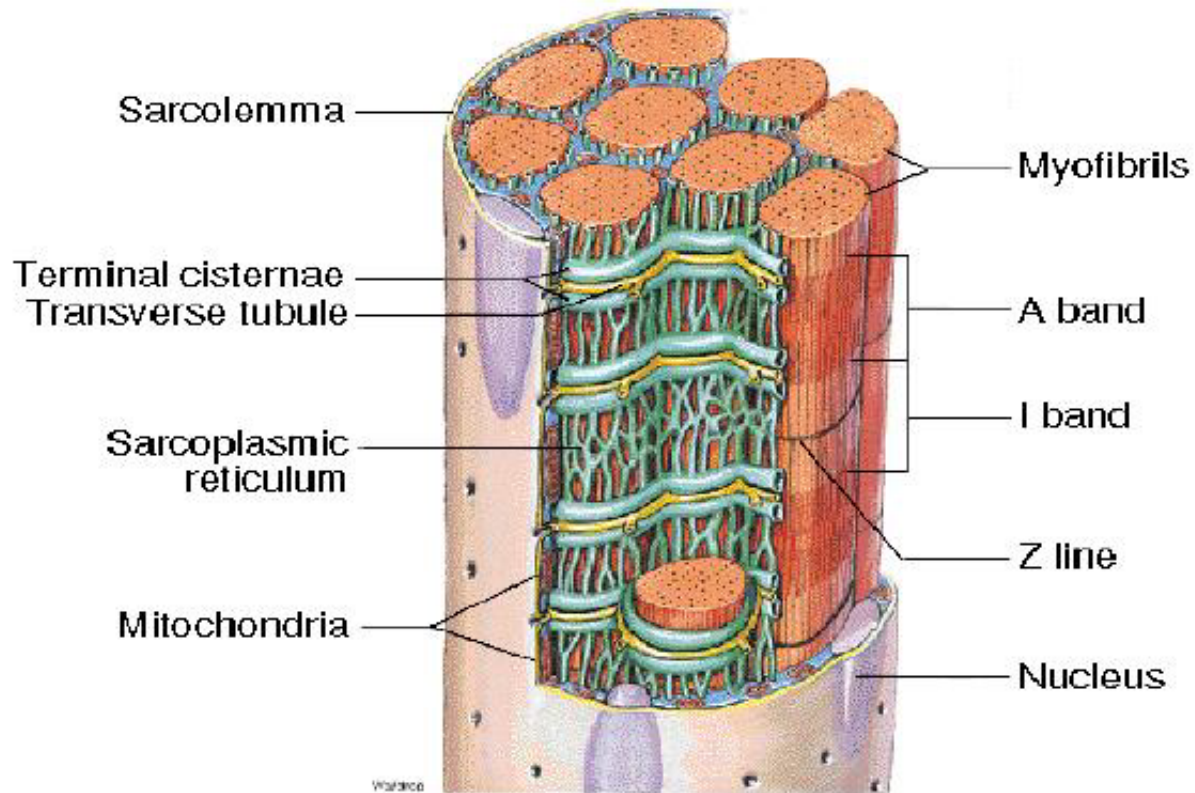
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Valencia 26 de Junio 2007



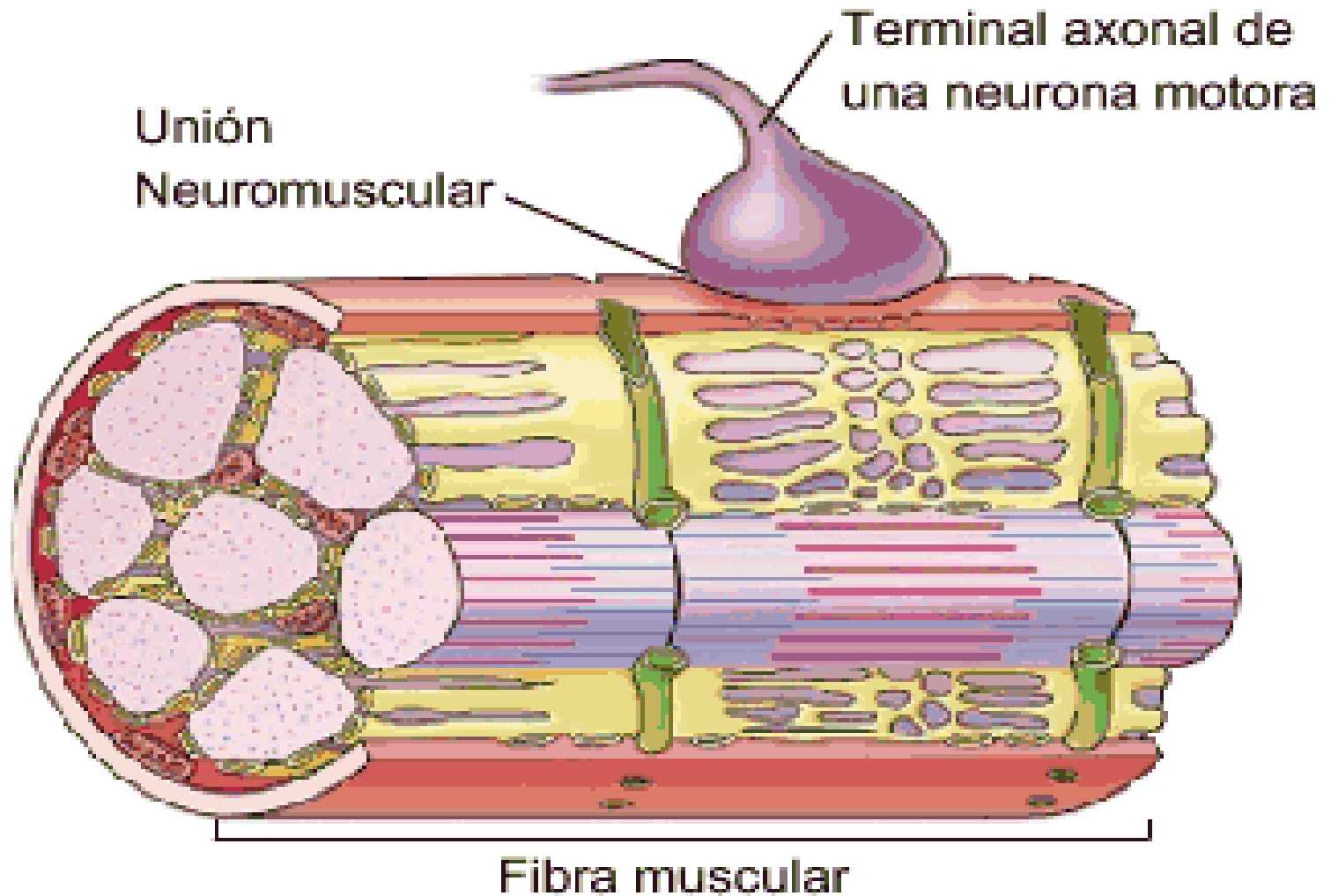
*Enrique Simonet Valencia 1863*

# Sarcoplasmic Reticulum

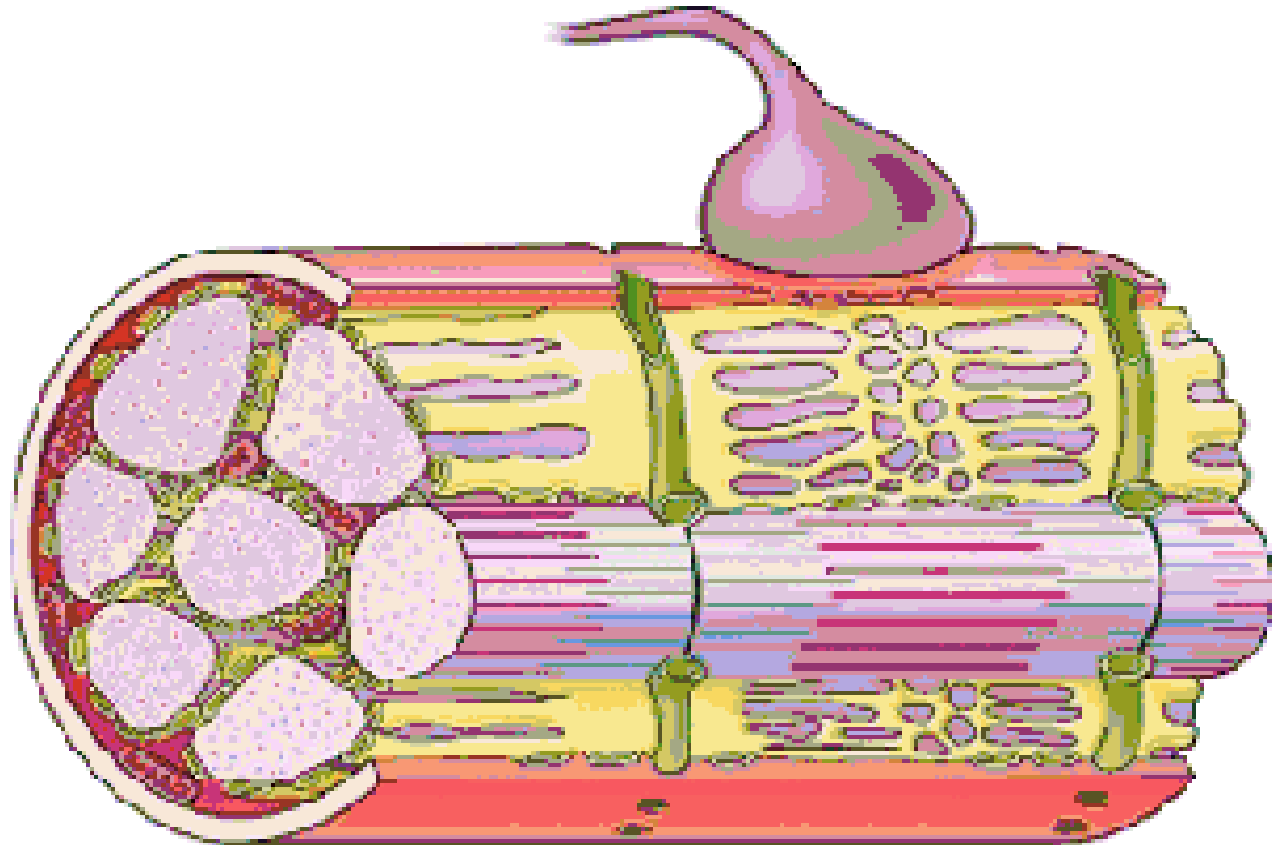
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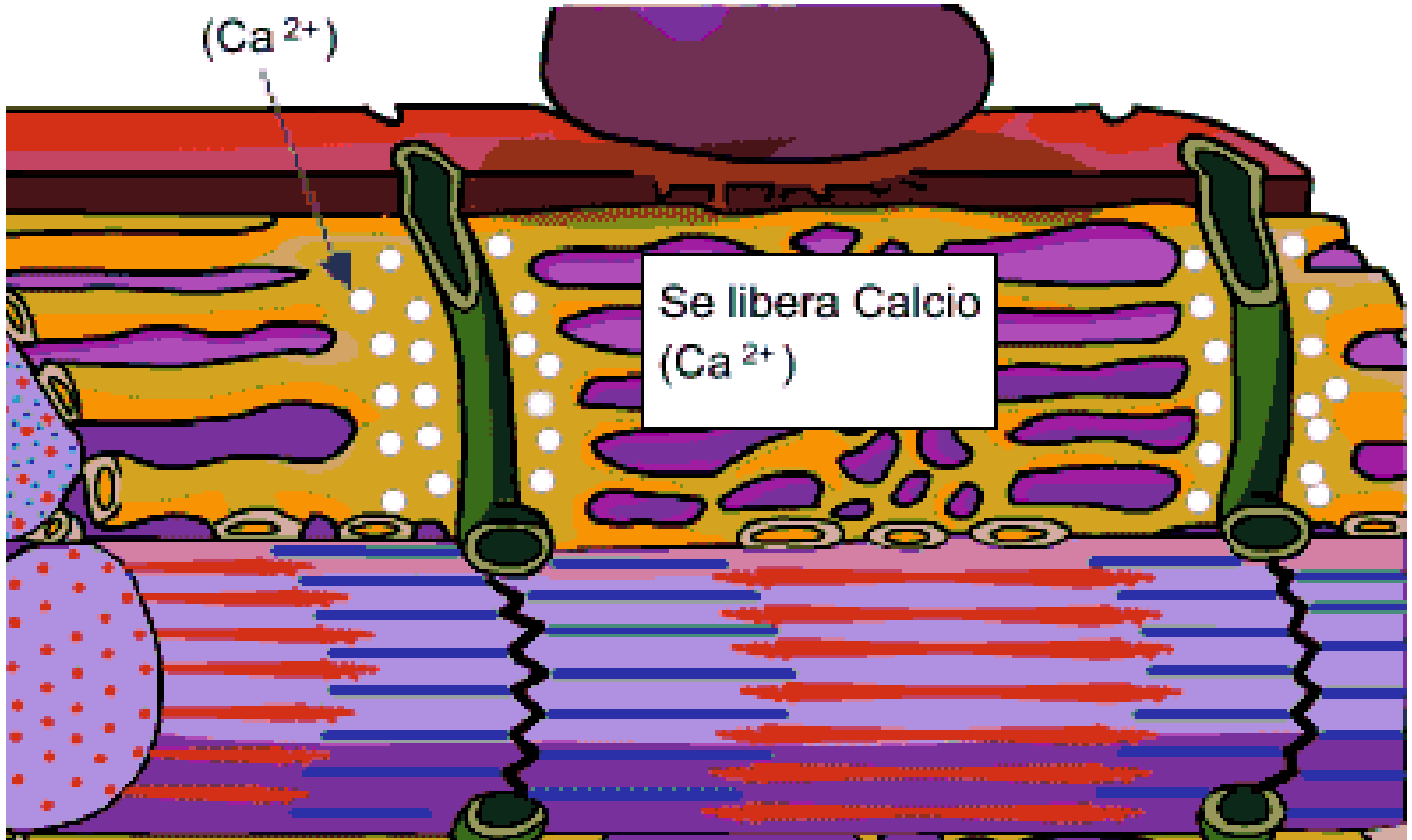
# Mecanismo molecular de la contracción neuromuscular



# Mecanismo molecular de la contracción neuromuscular



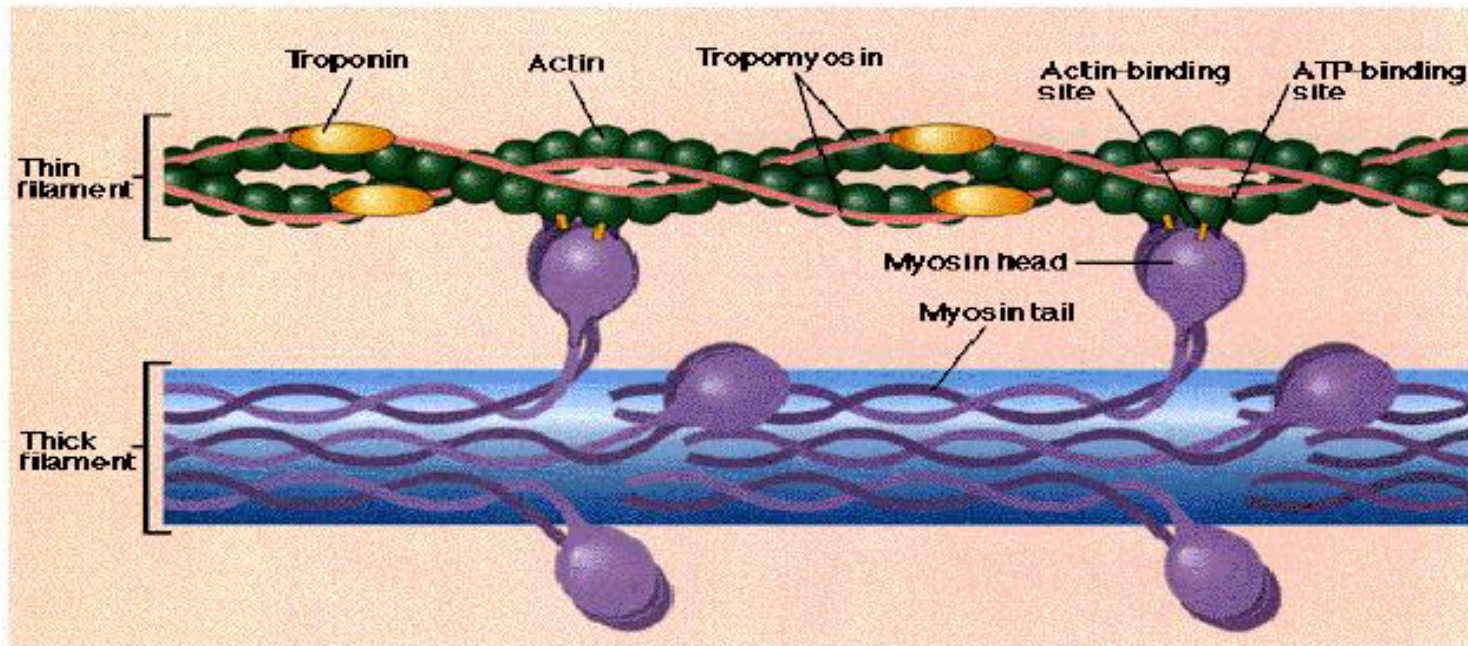
# Mecanismo molecular de la contracción neuromuscular

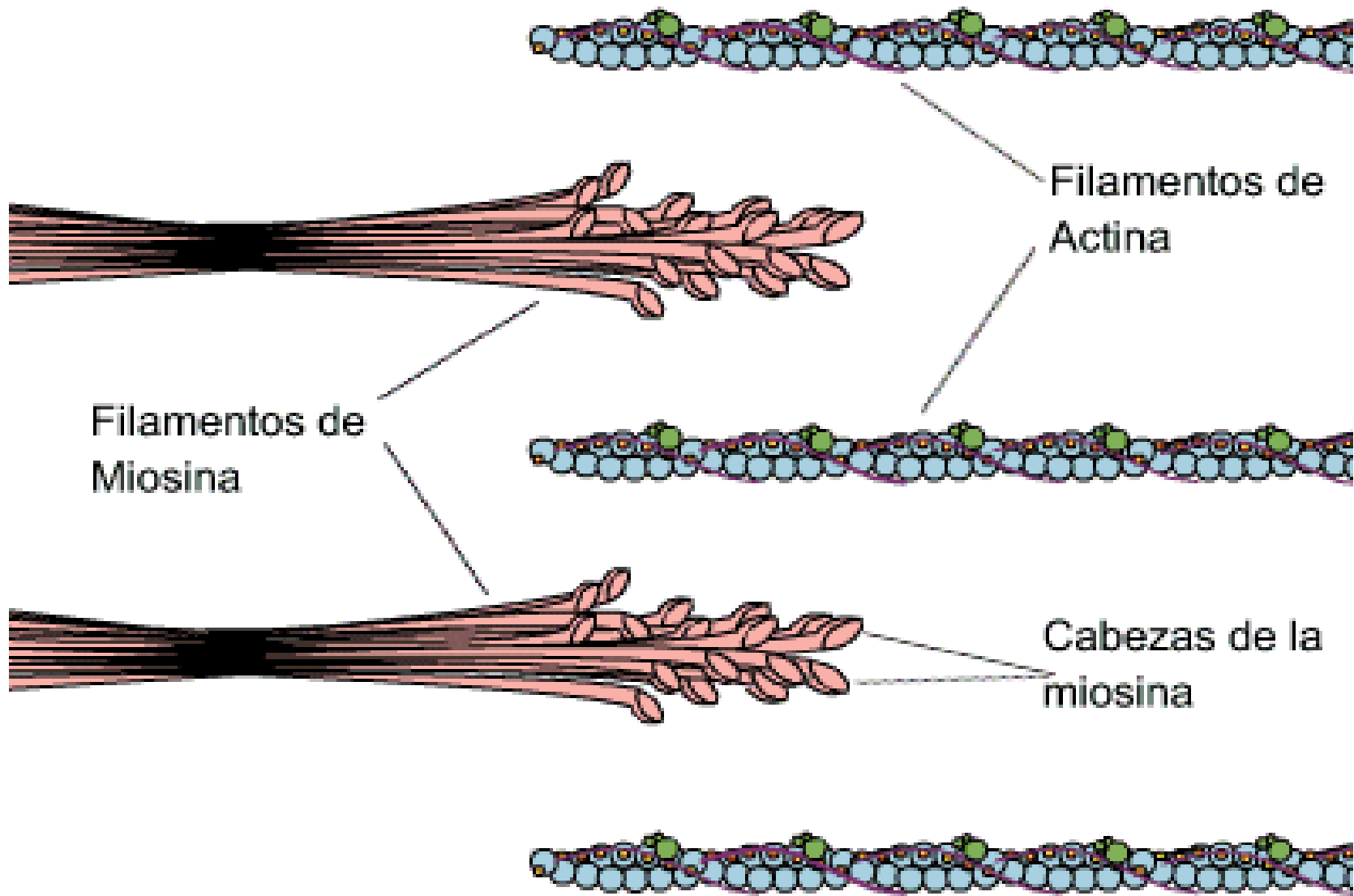


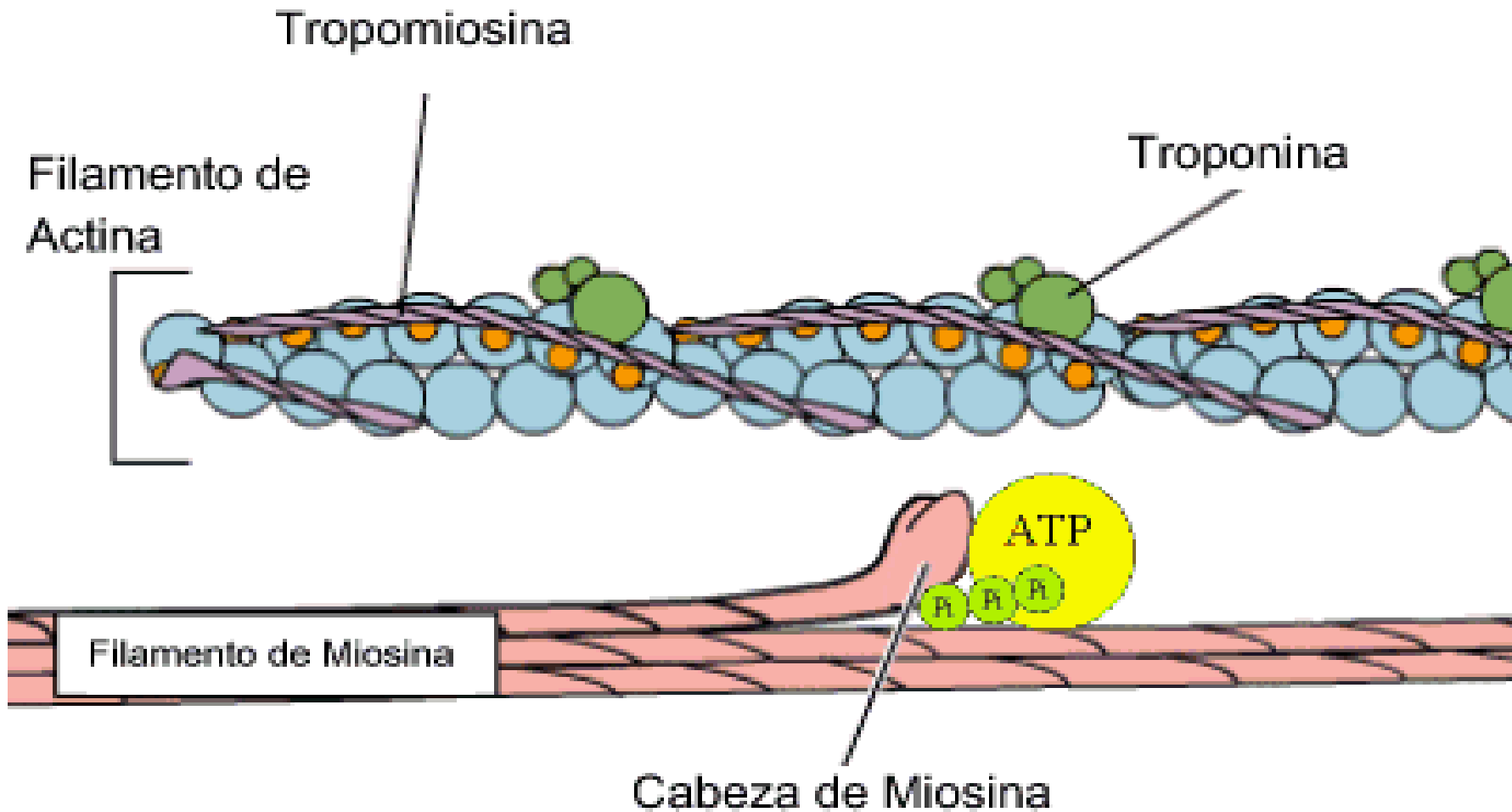


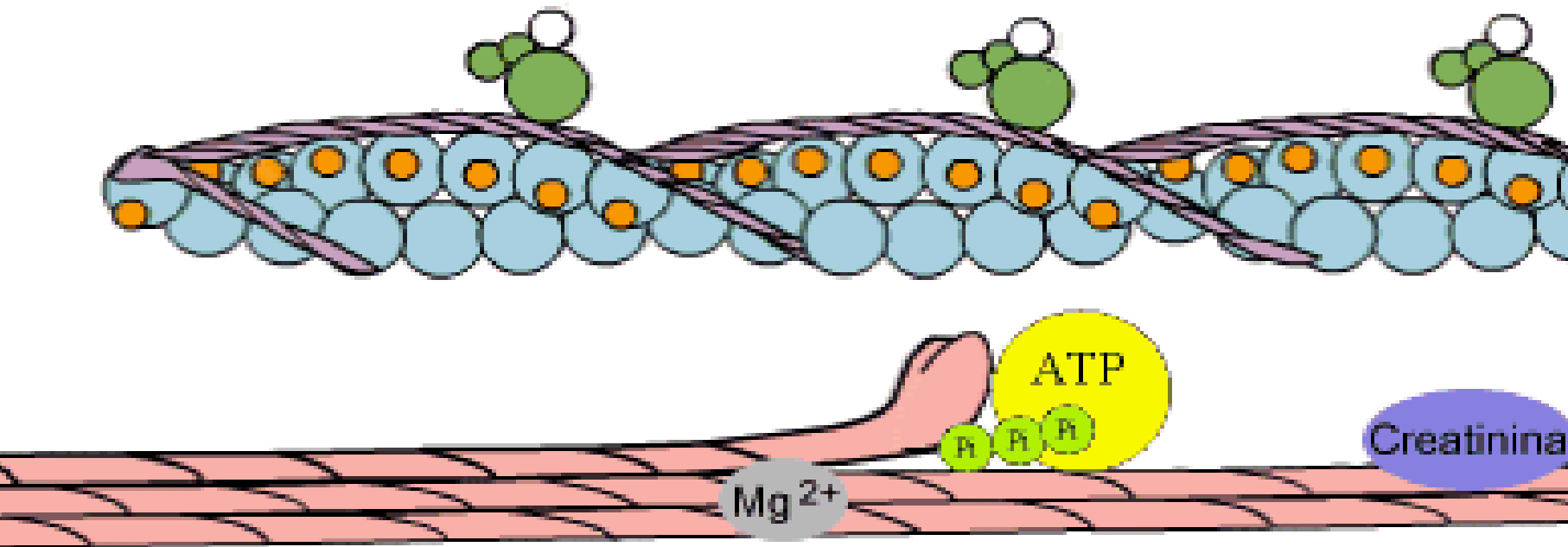
# Myosin & the Thick Filament

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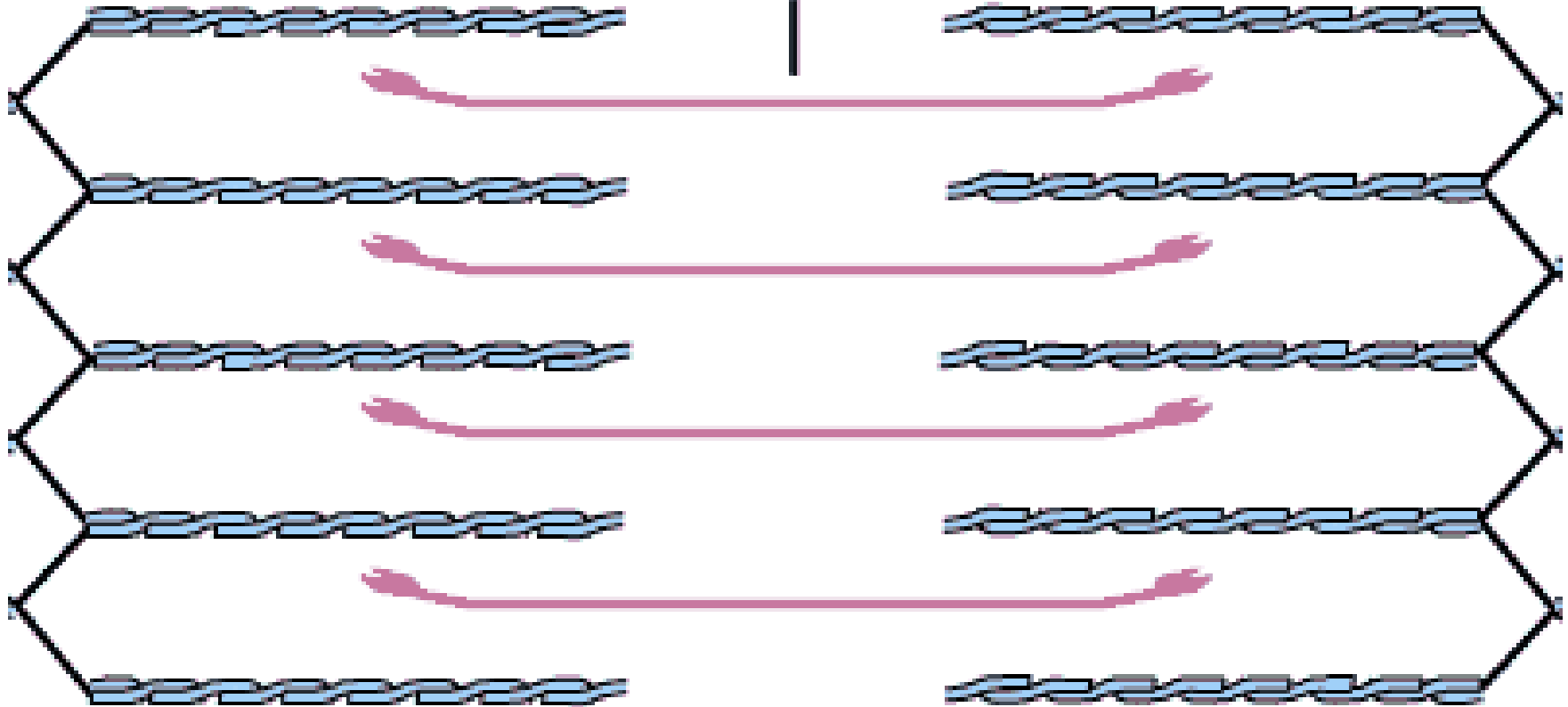


# Contracción - Relajación

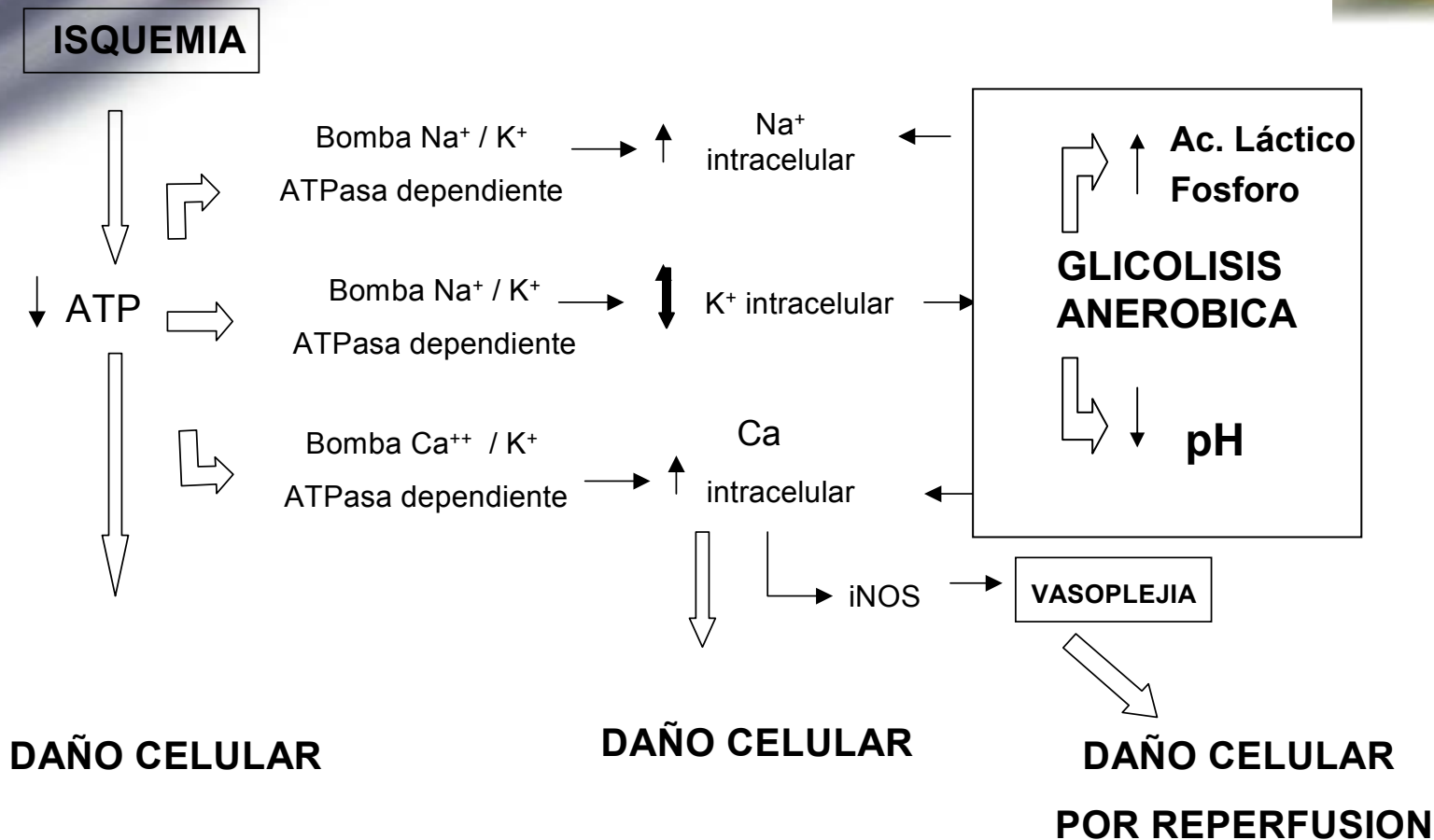
Actina

Miosina

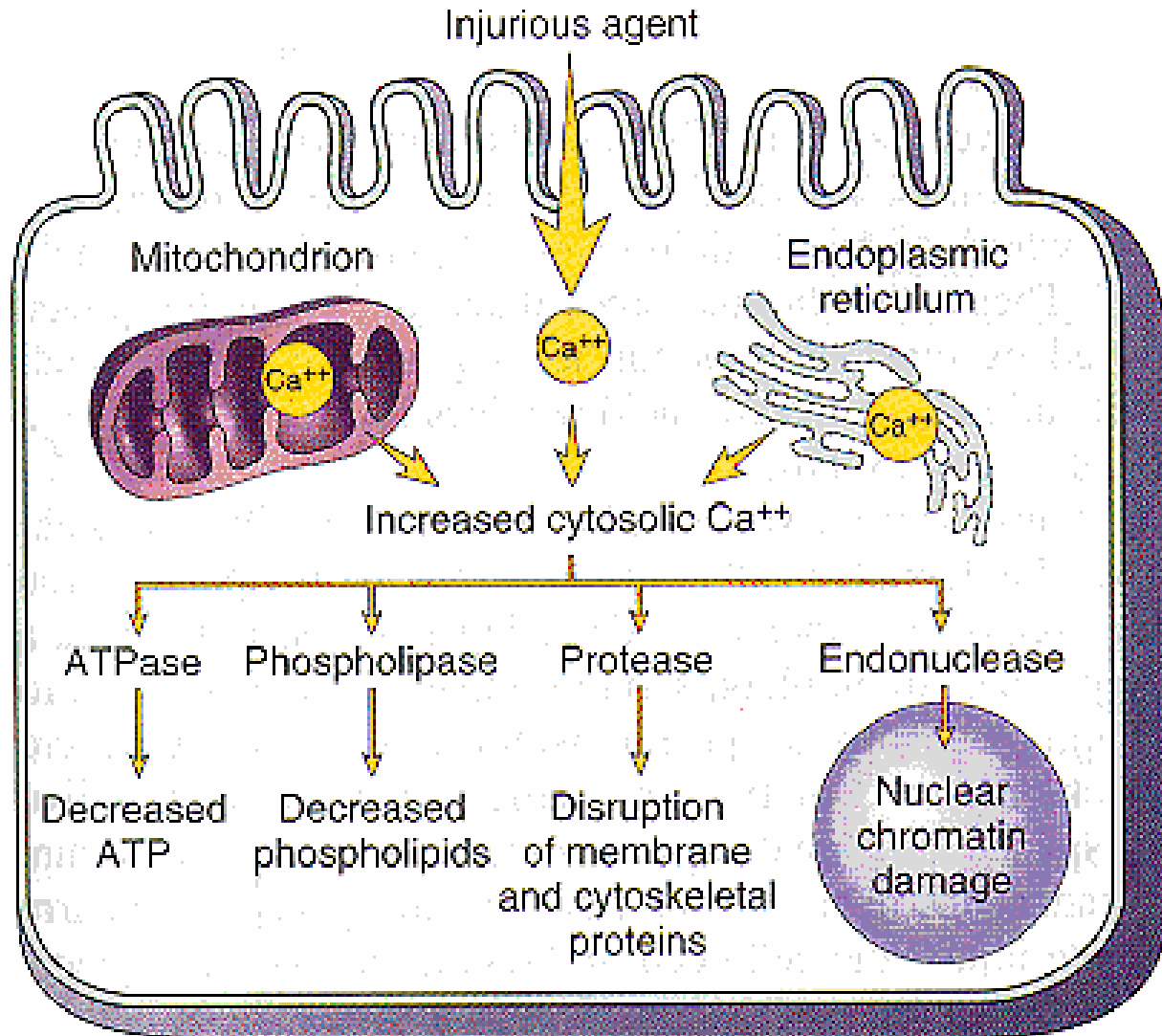
Actina



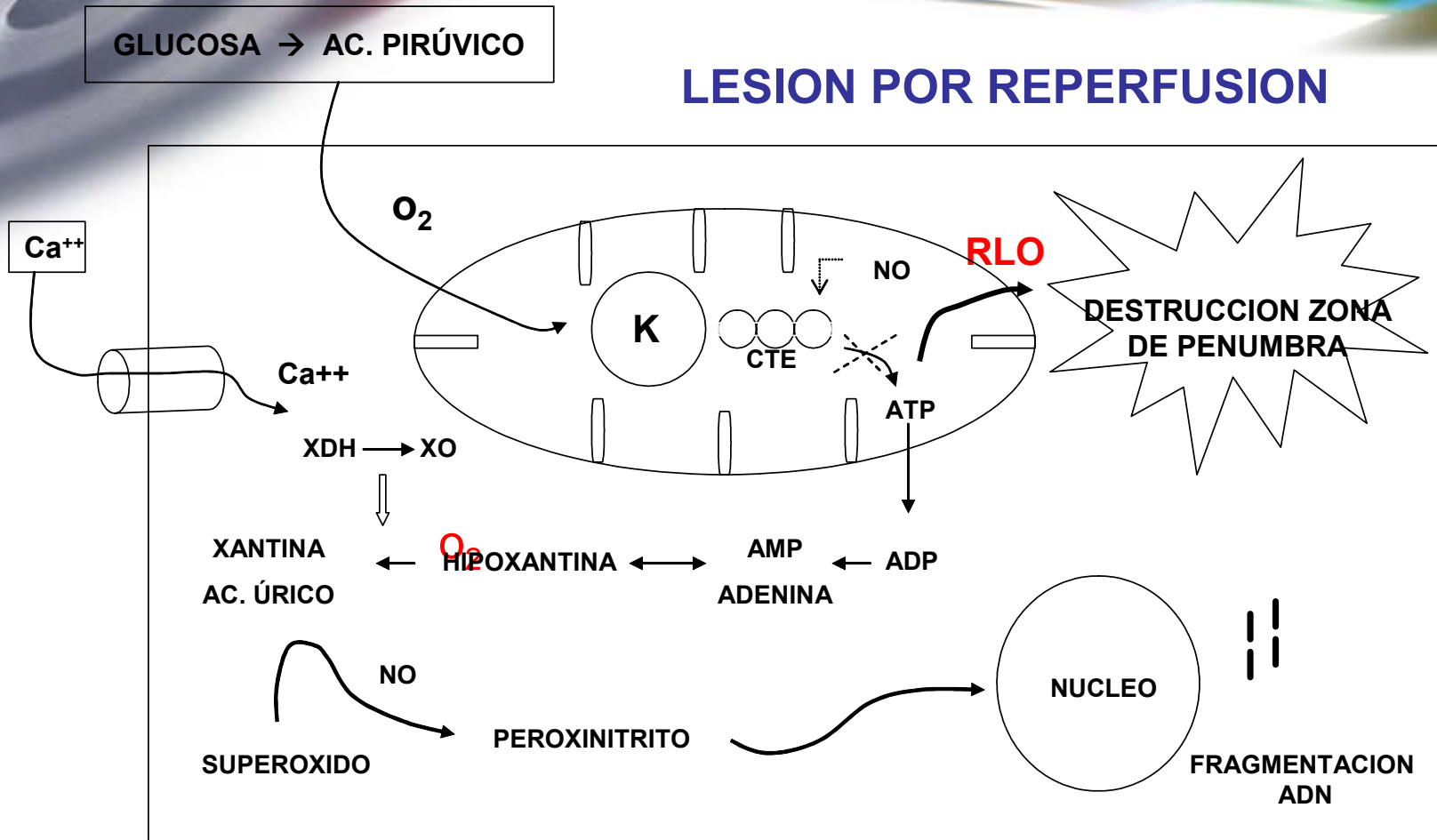
# DAÑO CELULAR POR ISQUEMIA



# Mecanismos que explican los efectos tóxicos de concentraciones anormalmente altas en el $\text{Ca}^{2+}$ citosólico

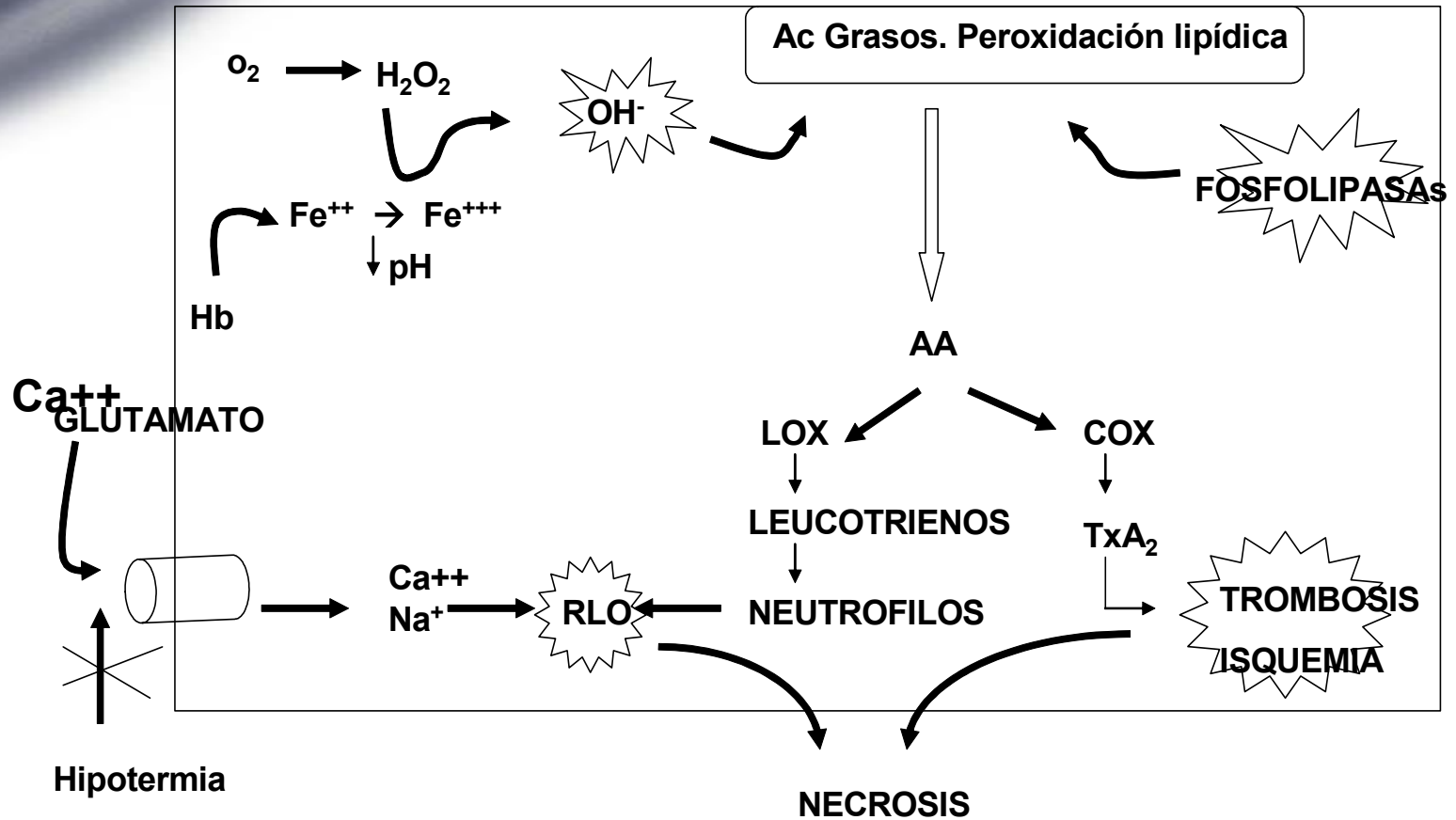


## LESION POR REPERFUSION





### NECROSIS CELULAR





# DIAGNÓSTICO

4

*Ignacio Pinazo  
Carmalench*

*Valencia 1849*



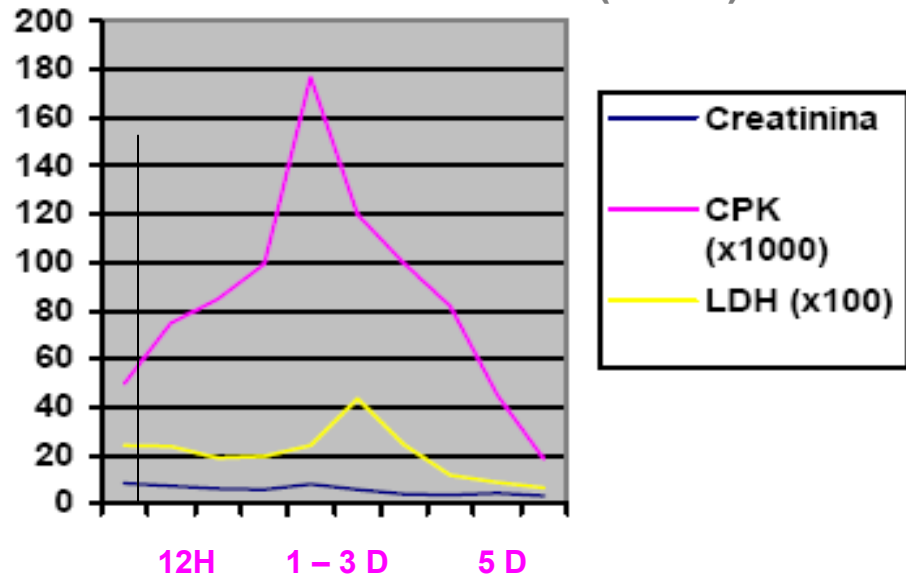
# RABDOMIOLISIS

## DIAGNOSTICO

**CLINICO** Mialgia, debilidad y orina negra

**LABORATORIO** MM CPK 500? ,1000?, 5000?  
( ↑ 5 veces valor normal)  
LDH, ↑

**MIOGLOBINA (< 6 H)**



# **RABDOMIOLISIS**

## **DIAGNOSTICO**



**TEST ORTOTOLUIDINA (+)**  
**(Tira de Orina)**

**DESCARTAR HEMATURIA**

**MIOGLOBINURIA** > 1,5 mg/dL mioglobina plasmática  
100 mg/dL → **ORINA NEGRA**

# RABDOMIOLISIS

## DIAGNOSTICO

**LABORATORIO** ANHIDRASA CARBÓNICA III  
ALDOLASA

TROPONINA I, TROPONINA T

Músculo

Esquelético

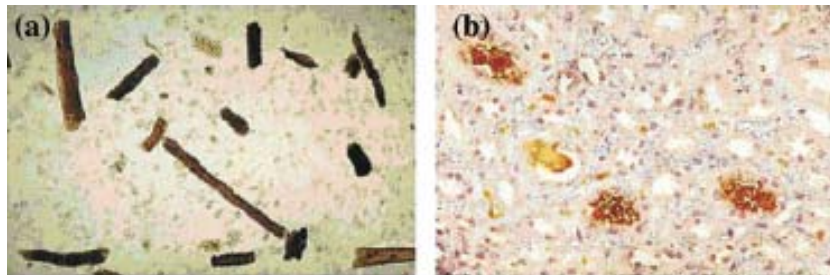
**IONES** : Hiperpotasemia

Hiperfosfatemia

Hipocalcemia → Hipercalcemia

**ORINA** : Cilindros pigmentados marrones

Cristales de ácido úrico





# COMPLICACIONES

3

*José Benlliure  
Gil  
Valencia 1855*





**¡Capitán  
despierte!**

**Como se  
descuide aquí  
se intuban a la  
mínima**



# **RABDOMIOLISIS**

## **COMPLICACIONES**

### **1. FRACASO RENAL**

1. Hipoperfusión y vasoconstricción
2. Obstrucción tubular
3. Necrosis tubular. Peroxidación

### **Factores predictivos de FRA**

**CPK > 5000**

**Sexo masculino**

**S. Aplastamiento**

**IMC > 40**

**FC > 100**

¡Capitán despierte!

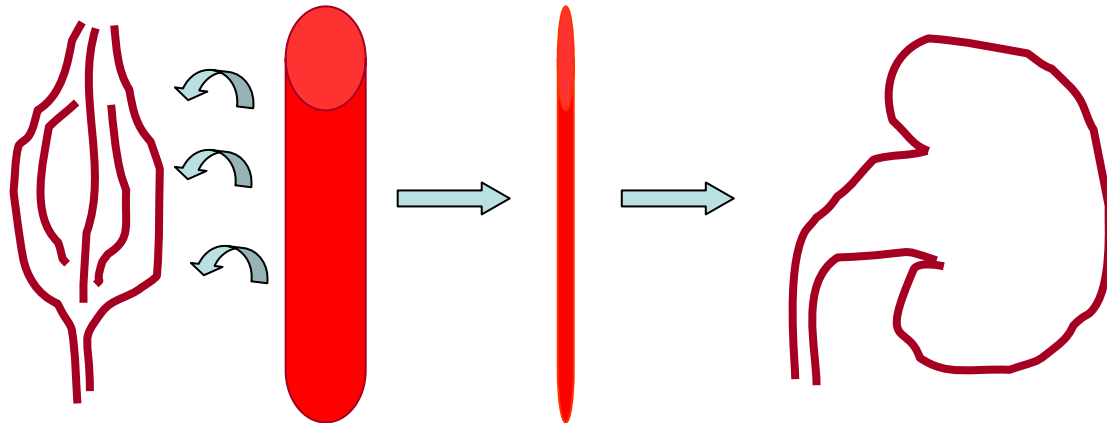
Como se descuide aquí e intuban a la mínima



# RABDOMIOLISIS

## FRACASO RENAL

### 1. Hipoperfusión y vasoconstricción



VASOCONSTRICCIÓN

\*SNS

\*SRAA

NO



Endotelina 1

PAF

FAT

FNT

MIOGLOBINA

CITOQUINAS

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¡Capitán despierte!

Como se escuide, aquí se intuban a la mínima

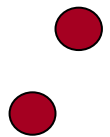


# RABDOMIOLISIS

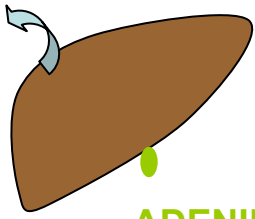
## FRACASO RENAL

### 2. OBSTRUCCIÓN TUBULAR

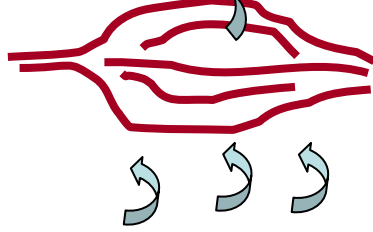
MIOGLOBINA



AC ÚRICO



ADENINA



ORINA ACIDA

TH

TH

¡Capitán despierte!

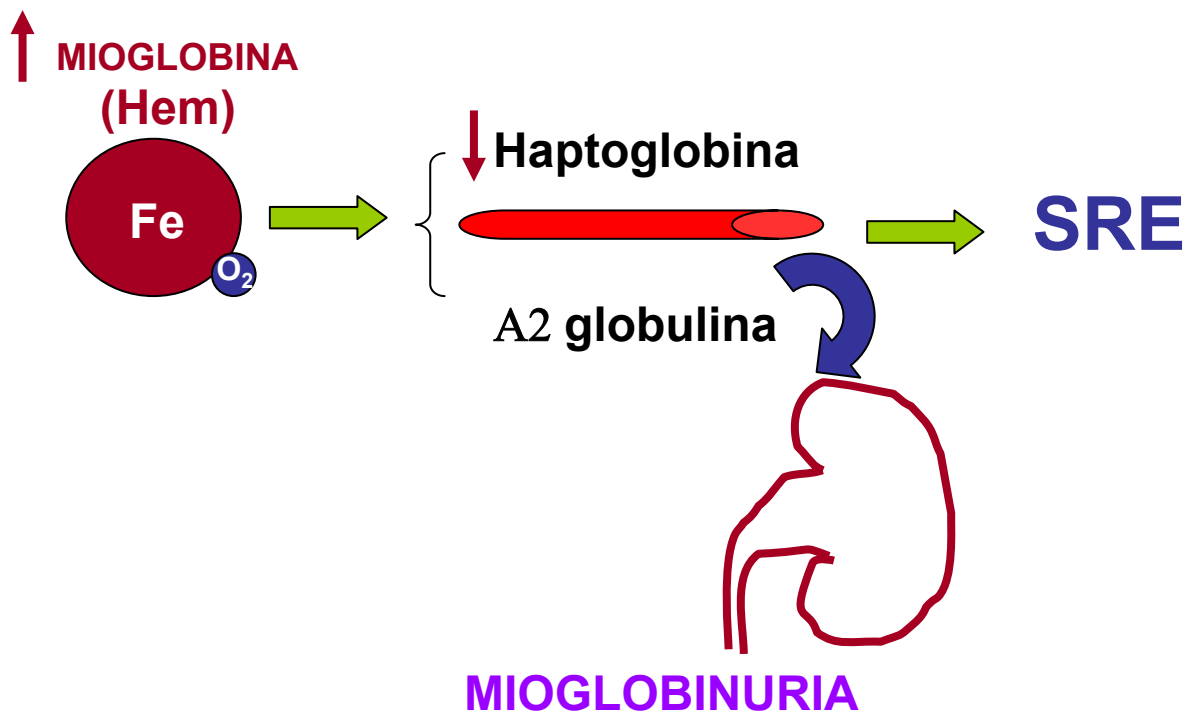
Como se escuide, aquí se intuban a la mínima



# RABDOMIOLISIS

## FRACASO RENAL

### 3. NECROSIS TUBULAR Y PEROXIDACIÓN LIPIDICA



¡Capitán despierte!

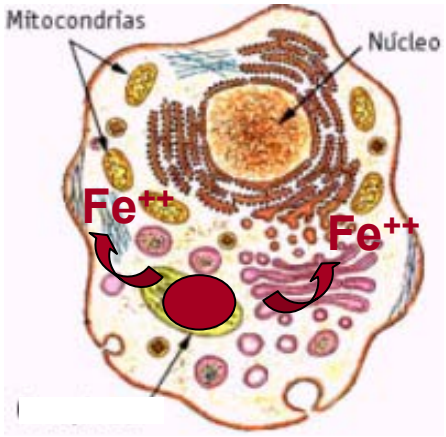
Como se escuide, aquí se intuban a la mínima



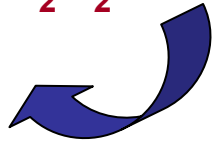
# RABDOMIOLISIS

## FRACASO RENAL

### 3. NECROSIS TUBULAR Y PEROXIDACIÓN LIPIDICA



Reacción de Fenton



PEROXIDACION LIPIDICA

# **RABDOMIOLISIS**

## **COMPLICACIONES**

### **2. HIPERPOTASEMIA**

**FACTOR PRONÓSTICO  
MÁS IMPORTANTE EN LA  
RABDOMIOLISIS**

# Clínica

## HIPERPOTASEMIA

$$E = -60 \cdot \log \frac{[K]_i}{[K]_e} \downarrow \text{ Despolarización}$$

Parestesias

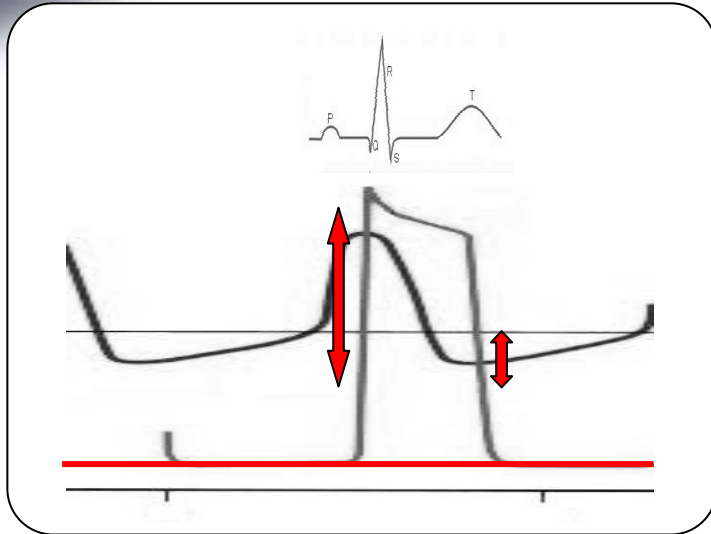
Actividad motriz espontánea

Calambres

Debilidad progresiva (parálisis flaccida)

# Electrocardiografía

## HIPERPOTASEMIA

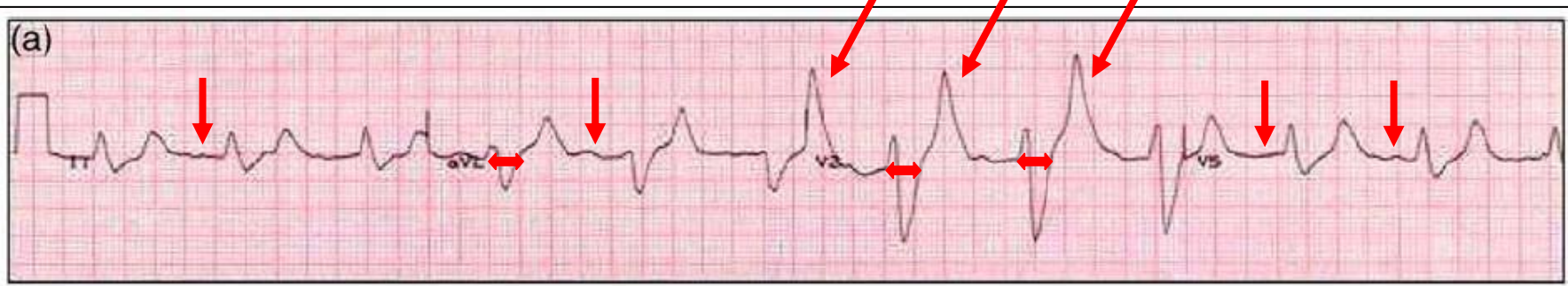


Ondas T estrechas y picudas

Aplanamiento de la onda P

Complejo QRS ancho

Acortamiento del segmento QT



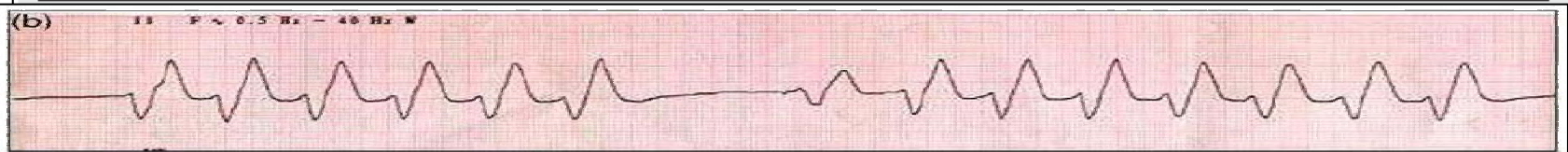


# Electrocardiografía

## HIPERPOTASEMIA

Table 2 ECG changes associated with the severity of hyperkalaemia

Potassium (mmol/l)	MAJOR ECG CHANGES
5.5	Tall, peaked (tent) T waves [T wave larger than R wave in more than 1 lead]
6.5	
7.0	Prolonged PR interval
7.5	Flattened or absent P waves
8.0	
8.5	Widened QRS [greater than 0.12 seconds]
>9.0	Sine wave pattern (S and T waves merging) Bradycardia Ventricular tachycardia
	<b>High risk of Cardiac arrest</b>



# Electrocardiografía

## HIPERPOTASEMIA

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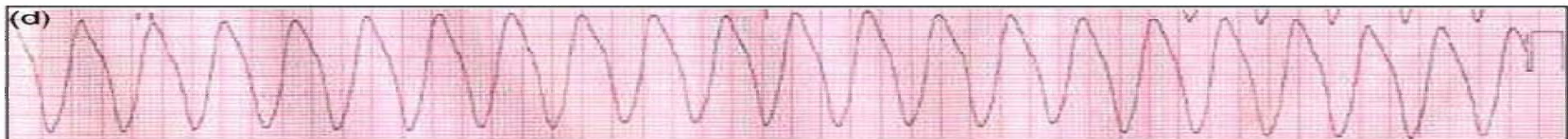


# Electrocardiografía

## HIPERPOTASEMIA

Table 2 ECG changes associated with the severity of hyperkalaemia

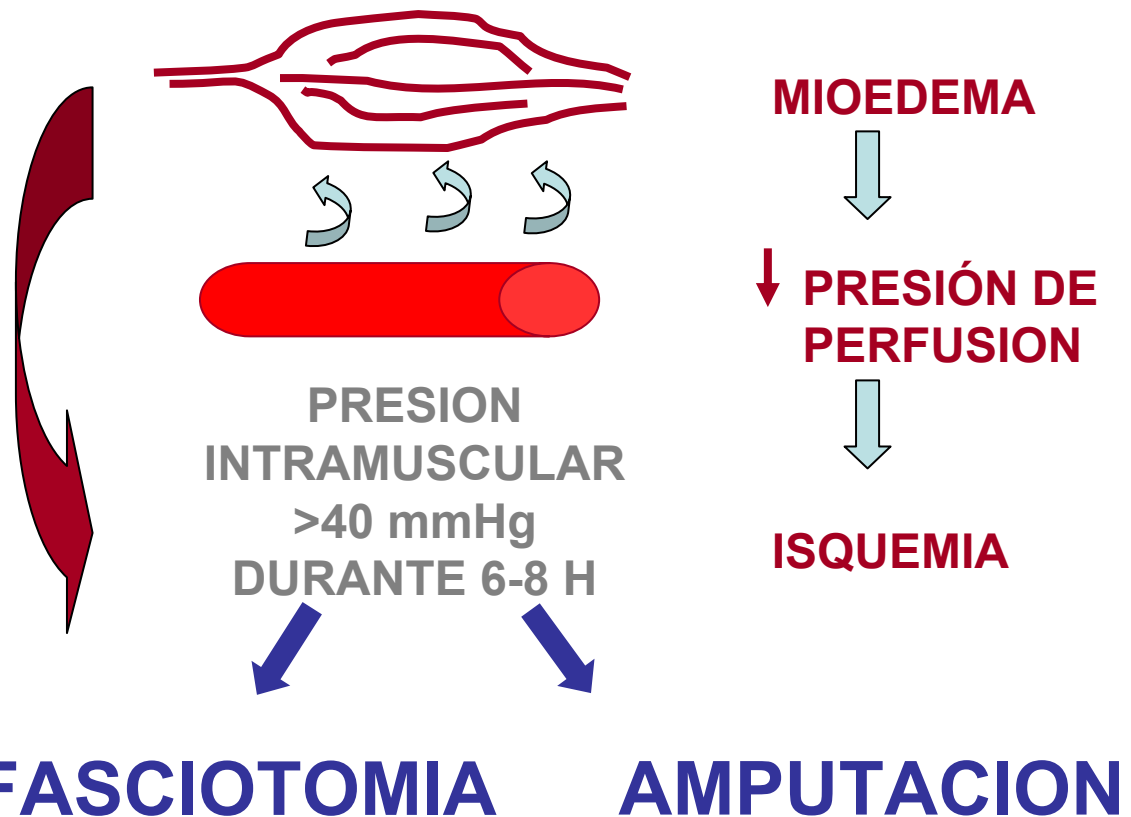
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	<b>High risk of Cardiac arrest</b>



# RABDOMIOLISIS

## COMPLICACIONES

### 3. SINDROME COMPARTIMENTAL





TRATAMIENTO

2

*JOAQUIN  
SOROLLA Y  
BASTIDA*

*Valencia 1863*





Y AÚN DICEN QUE EL PESCADO ES CARO. J. SOROLLA

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# **RABDOMIOLISIS**

## **TRATAMIENTO**

### **1. CORRECCIÓN DE LA VOLEMIA**

1500 cc/h de SSF hasta reposición de volemia

500 cc / h de Glucosado 5% + { 55mmol de Na + 20 mmol bicarbonato  
35 mmol de Cl

*Better Os. Post traumatic acute renal failure: pathogenesis and prophylaxis. Nephrol Dial Transplant. 1992;7:260-264*

*Better Os. The crush syndrom revisired (1940-1990) Nephrol 1990;55:97-103*

*Better Os Stein JH. Early management of shock and prophylaxis of acute renal failure in traumatic rhabdomyolysis: N Eng J Med 1990;322:825-829*





# **RABDOMIOLISIS**

## **TRATAMIENTO**

### **2. FORZAR DIURESIS**

#### **MANITOL**

Evita precipitación renal de mioglobina

Barredor de radicales libres (↓ nefrotoxicidad)

↓ Viscosidad de la sangre

Vasodilatador renal { ↑ Flujo sanguíneo renal

↓ Edema muscular { ↑ Filtrado glomerular

**10 mL / h si diuresis > 20cc/h**

*Vanholder R. Rhabdomyolysis. J Am Soc Nephrol 2000; 11: 1553- 61*

*Eneas J. Arch Inter Med .1979;139:801-805*

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Valencia 26 de Junio 2007



# **RABDOMIOLISIS**

## **TRATAMIENTO**

### **2. FORZAR DIURESIS**

### **FUROSEMIDA**

Evita precipitación renal de mioglobina

Edema muscular

Trasforma FRA anúrico en poliúrico

**Acidifica la orina**

**Favorece hipocalcemia cuando hipovolemia se corrige**

*Corwin H. Factors influencing survival in acute failure renal. Semin Dial 1989;2:220-5*

*Vanholder R. Rhabdomyolysis. J Am Soc Nephrol 2000; 11: 1553- 61*



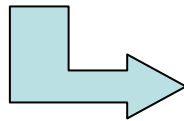
# RABDOMIOLISIS

## TRATAMIENTO

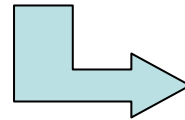
### 3. ALCALINIZAR ORINA

## BICARBONATO

REPOSICIÓN DE VOLEMIA



ACLARAMIENTO RENAL DE  
COMPUESTOS ACIDOS



**ORINA ACIDA**

↓ Ciclo redox de mioglobina

pH = 6

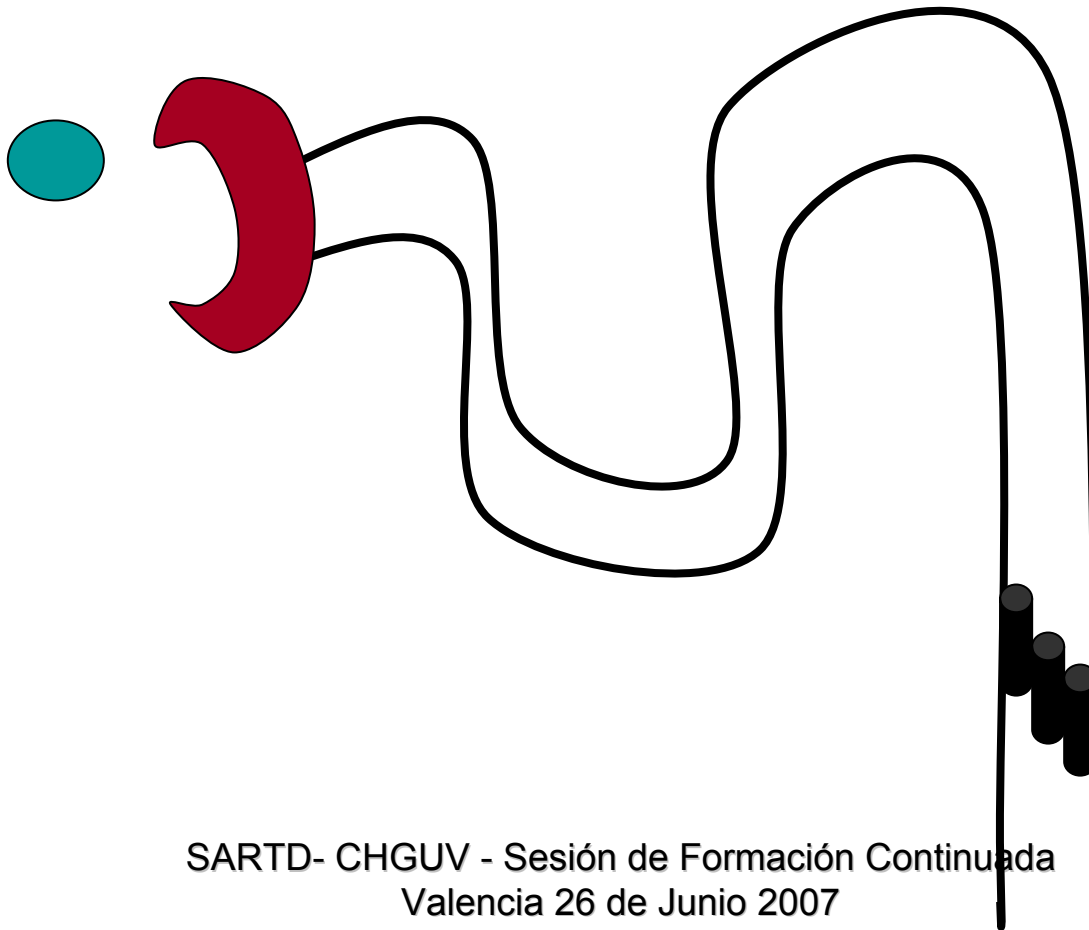
*Ron D. Prevention of acute renal failure in traumatic rhabdomyolysis. Arch Inter Med .1984;144:277-280*

*Warren JD. Rhabdomyolysis: a review. Muscle and Nerve 2002;25:332-347*



# **RABDOMIOLISIS**

## **TRATAMIENTO**



## Interventions in clinical acute renal failure: what are the data?

[Conger](#)

[JD.](#)

Division of Renal Diseases and Hypertension, University of Colorado Health Sciences Center, Denver, USA.

A variety of therapeutic approaches have been used both to prevent acute ischemic and nephrotoxic renal injury and to improve renal function and reduce mortality once acute renal failure (ARF) has developed. Unfortunately, there have been few rigorous assessments of the efficacy of these treatment interventions. The reasons for the lack of abundant critical data regarding treatment effects in ARF are several. First, ARF is a functional disorder. It has a spectrum of etiologies, occurs in a variety of clinical settings and varies in severity. Second, selected endpoints of treatment success vary and co-morbid factors frequently

# RABDOMIOLISIS

## TRATAMIENTO

Prophylaxis of acute renal failure in patients with rhabdomyolysis.

Homsí E, Barreiro MF, Orlando JM, Higa EM. Ren Fail 1997,19: 283-288

Intensive Care Unit, Hospital Municipal Artur Ribeiro de Saboya, São Paulo, Brazil.

Patients that develop rhabdomyolysis of different causes are at high risk of acute renal failure. Efforts to minimize this risk include volume repletion, treatment with mannitol, and urinary alkalization as soon as possible after muscle injury. This is a retrospective analysis (from January 1, 1992, to December 31, 1995) of therapeutic response to prophylactic treatment in patients with rhabdomyolysis admitted to an intensive care unit (ICU). The diagnosis of rhabdomyolysis was based on creatinine kinase (CK) level ( $> 500$  U/L) and the criteria for prophylaxis were: time elapsed between muscle injury to ICU admission  $< 48$  h and serum creatinine  $< 3$  mg/dL. Fifteen patients were treated with the association of saline, mannitol, and sodium bicarbonate (S + M + B

# RABDOMIOLISIS

## TRATAMIENTO

prophylaxis of acute renal failure in patients with rhabdomyolysis.

Tomasi E, Barreiro MF, Orlando JM, Higa EM.

Intensive Care Unit, Hospital Municipal Artur Ribeiro de Saboya, São Paulo, Brazil  
1997.

Retrospectivo 24 pacientes

- CPK > 500
- Creatinina < 3 mg/dl
- Retraso admisión en UVI < 48H



15 Pacientes SSF + Bicarbonato +Manitol

9 Pacientes SSF

**NO DIFERENCIAS**



# RABDOMIOLISIS

## TRATAMIENTO

### Preventing Renal Failure in Patients with Rhabdomyolysis: Do Bicarbonate and Mannitol Make a Difference?

*Carlos V. R. Brown, MD, Peter Rhee, MD, MPH, Linda Chan, PhD, Kelly Evans, MS, Demetrios Demetriades, MD, PhD, and George C. Velmanos, MD, PhD*

*J Trauma.* 2004;56:1191–1196.

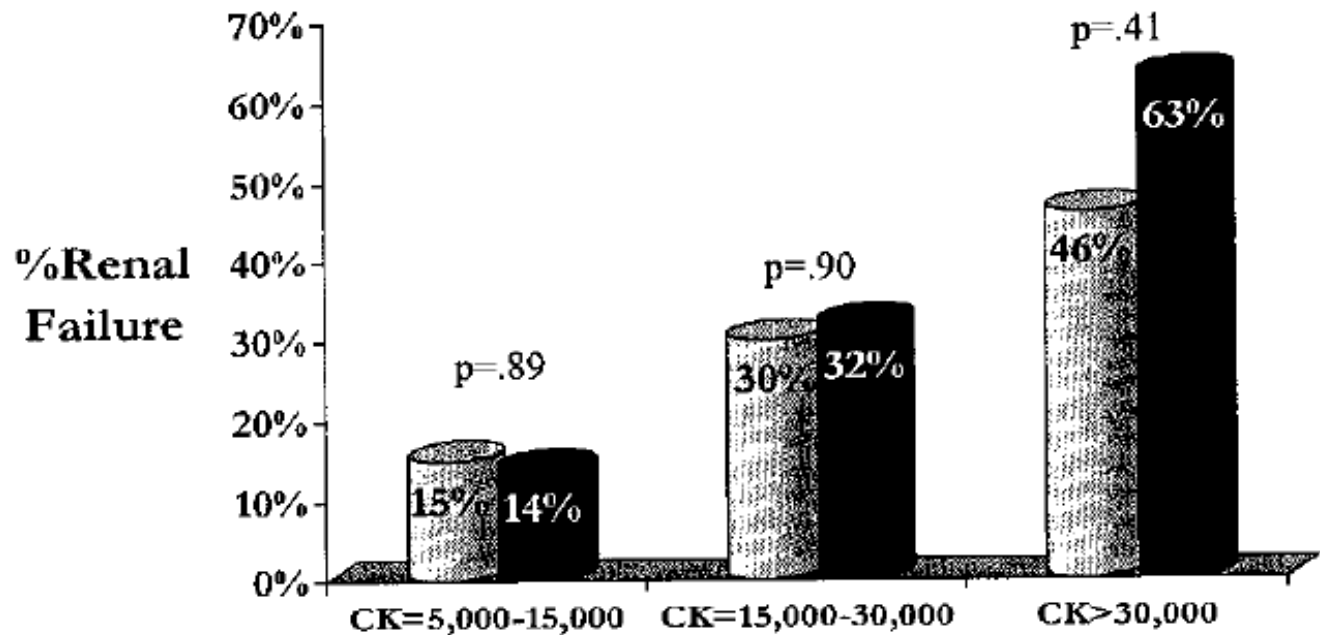
**Conclusion:** Abnormal CK levels are common among critically injured patients, and a CK level greater than 5,000 U/L is associated with RF. BIC/MAN does not prevent RF, dialysis, or mortality in patients with creatine kinase levels greater than 5,000 U/L. The standard of administering BIC/MAN to patients with post-traumatic rhabdomyolysis should be re-evaluated.





# RABDOMIOLISIS

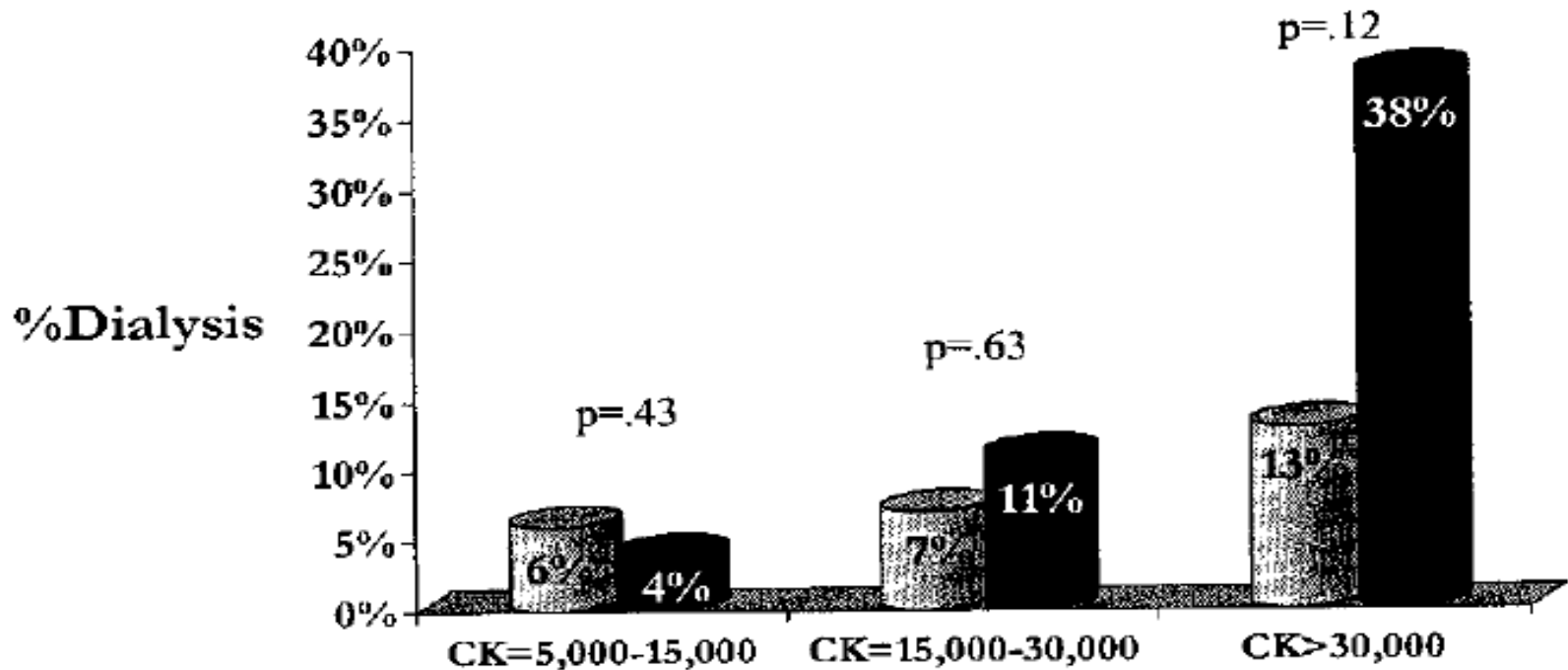
## TRATAMIENTO





# RABDOMIOLISIS

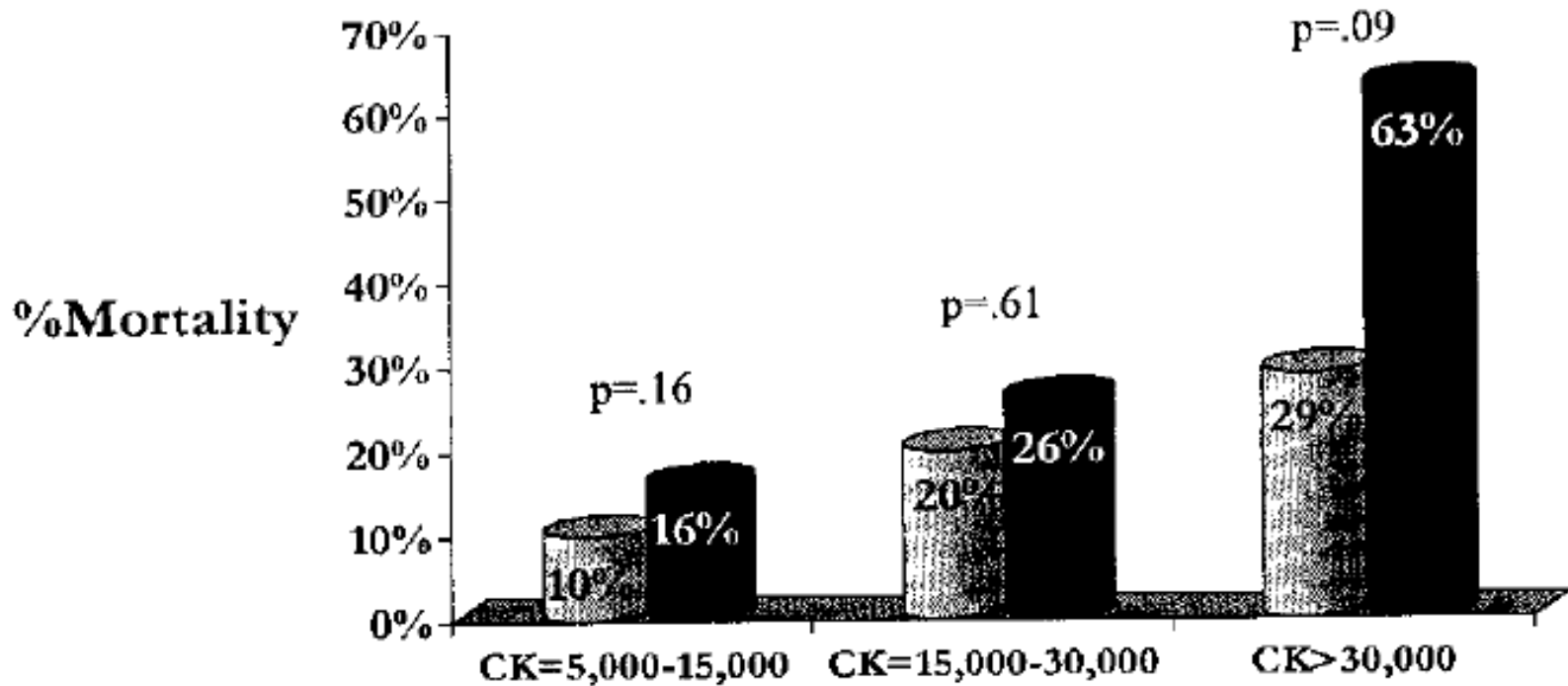
## TRATAMIENTO





# RABDOMIOLISIS

## TRATAMIENTO





# RABDOMIOLISIS

## TRATAMIENTO



## The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

Volume 336:1303-1309

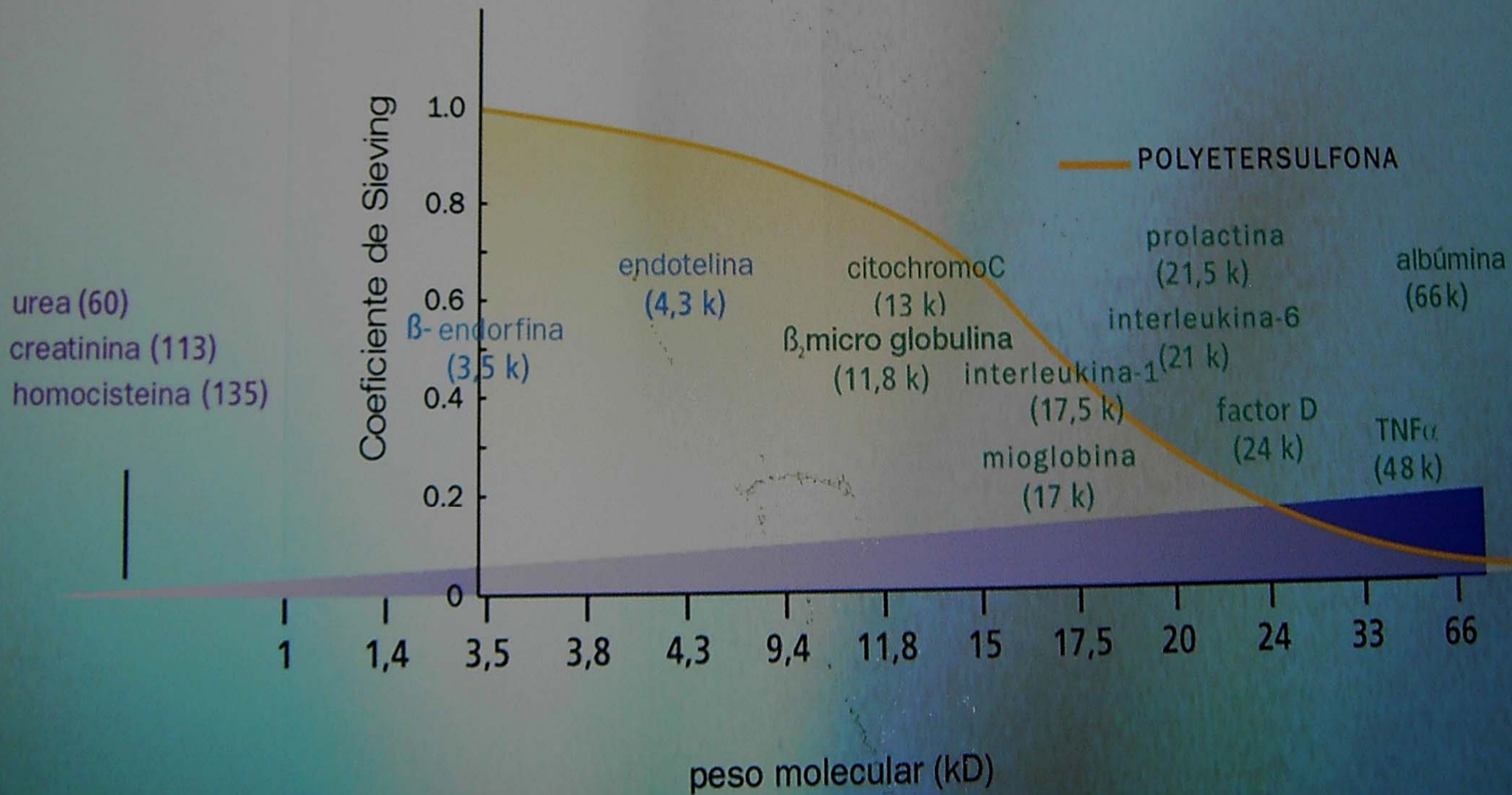
May 1, 1997

Number 18

### Continuous Hemofiltration in the Treatment of Acute Renal Failure

*L.G. Forni, M.B., Ph.D., and P.J. Hilton, M.D.*

BAJO PESO MOLECULAR      PESO MOLECULAR MEDIO      PESO MOLECULAR ALTO





# RABDOMIOLISIS

## TRATAMIENTO

Intensive Care Med (1999) 25: 1169–1172  
© Springer-Verlag 1999

### BRIEF REPORT

S.-L. Amyot  
M. Leblanc  
Y. Thibeault  
D. Geadah  
J. Cardinal

### **Myoglobin clearance and removal during continuous venovenous hemofiltration**

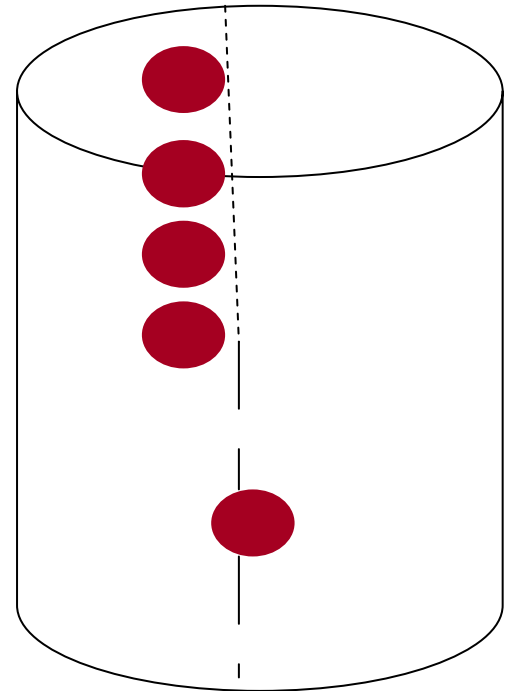
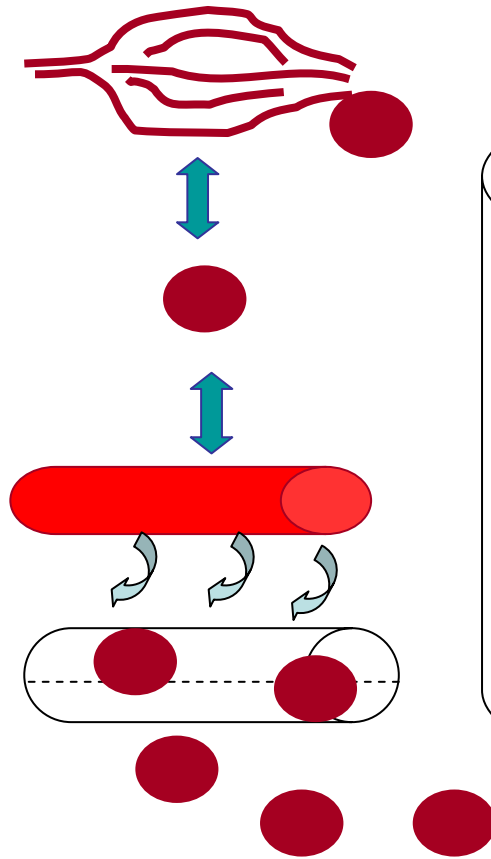
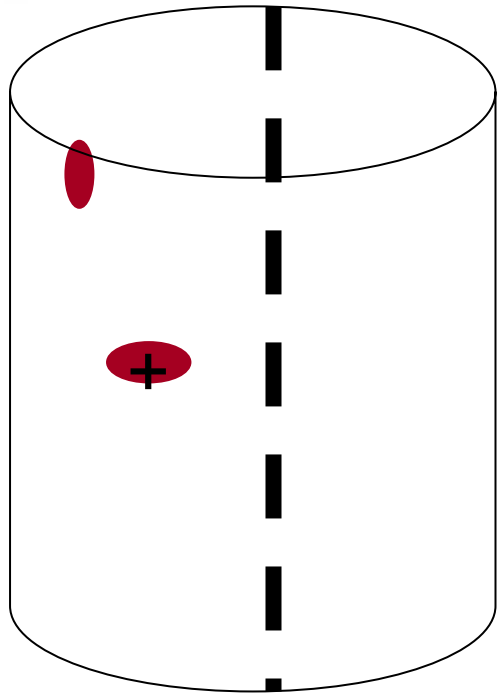
Whereas myoglobin can be removed by CVVH, it remains unknown at this point if such a modality, applied early, can alter or shorten the course of myoglobinuric acute renal failure.

***CAPACIDAD LIMITADA PARA EXTRACCIÓN DE MIOGLOBINA  
ÚTIL EN FRACASO RENAL ESTABLECIDO***



# RABDOMIOLISIS

## TRATAMIENTO





# RABDOMIOLISIS

## TRATAMIENTO

Research

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### **Myoglobin clearance by super high-flux hemofiltration in a case of severe rhabdomyolysis: a case report**

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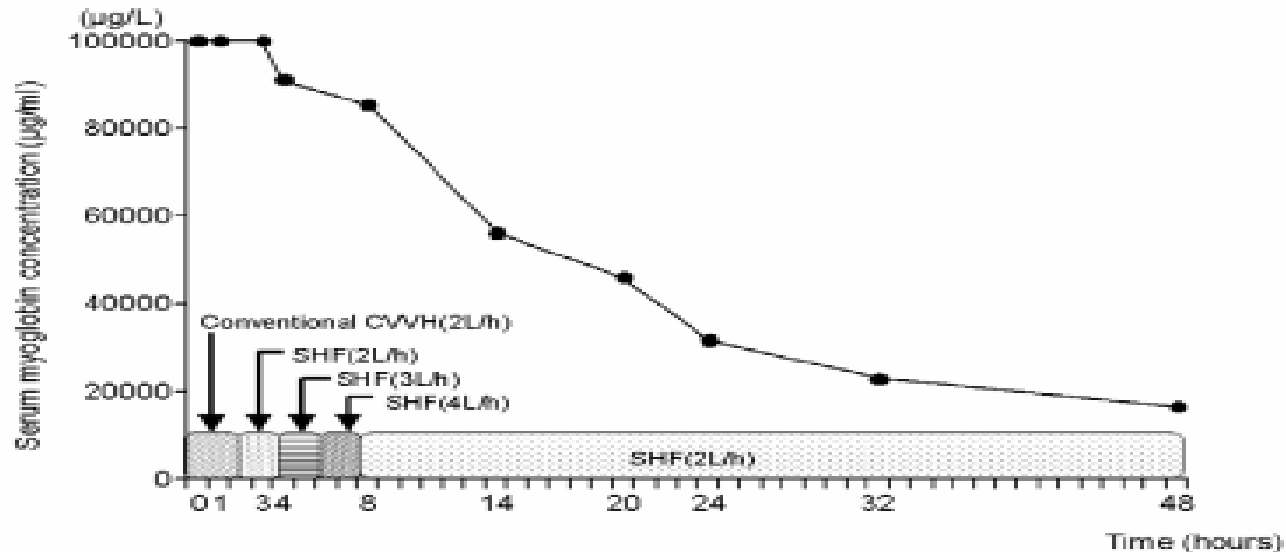
This article is online at: <http://ccforum.com/content/9/2/R90>





# RABDOMIOLISIS

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Progressive reduction of serum myoglobin concentration over a 48-hour period using super high-flux (SHF) continuous veno-venous hemofiltration (CVWH). The serum concentration of myoglobin remained >100,000 µg/l until commencement of SHF CVWH.



# **RABDOMIOLISIS**

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1st ICU day

2nd ICU day

3rd ICU day



Images of ultrafiltration fluid demonstrating progressive reduction in pigmentation over a 3-day period concurrent with treatment using super high-flux continuous veno-venous hemofiltration. ICU, intensive care unit.



# RABDOMIOLISIS

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### Extracorporeal therapies in acute rhabdomyolysis and myoglobin clearance

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#### Abstract

Rhabdomyolysis is a pathogenetic cause of acute kidney injury. In such circumstances, not only should therapeutic strategies to replace the failing kidney be implemented, but measures should also be explored to prevent further damage by circulating myoglobin. Volume expansion and forced diuresis have been used, but when a kidney fails, renal replacement therapies are instituted.

The techniques and devices used for classic dialytic techniques have displayed a limited capacity for the removal of circulating myoglobin. In a recent paper, Naka and colleagues have proposed the use of a super-high-flux membrane in continuous hemofiltration. The removal of myoglobin was greater than in than any previous report. Thus, if the removal of myoglobin is desirable, a combination of continuous hemofiltration and hyperpermeable membranes seems to be the most effective. However, care must be exercised to prevent unwanted albumin losses.



# **RABDOMIOLISIS**

## **NUEVAS TERAPIAS**

### **1. BARREDORES DE RADICALES LIBRES**

Pentoxifilina, Vitamina E, vitamina C, Lazaroides, Zn, Mn, Se

### **2. DANTROLENO ( Inhibe liberación de calcio).**

Hipertermia. Síndrome Neuroleptico Maligno (SNM)

### **3. BROMOCRIPTINA (dopaminérgico). SNM**

### **4. PLASMAFERESIS**

### **5. ANTAGONISTAS DE ENDOTELINA , PAF ...**

# **RABDOMIOLISIS**

- 1. La causa más frecuente de rabdomiolisis en nuestro medio es la isquemia arterial**
- 2. LA CPK proporciona la energía necesaria para la contracción muscular actuando sobre la fosfocreatina**
- 3. Elevaciones de la CPK, junto con un test (+) de ortotoluidina hacen muy sospechoso el diagnóstico**
- 4. La interacción de la proteína de Tamm- Horsfall con la mioglobina es la responsable de las características de la orina en estos pacientes**
- 5. El uso de manitol y la alcalinización urinaria es la base del tratamiento del fracaso renal asociado**
- 6. El uso de técnicas continuas de reemplazo renal es muy útil en el aclaramiento de la mioglobulinemia**
- 7. ¿Cuáles son los “5” mejores pintores valencianos?**

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