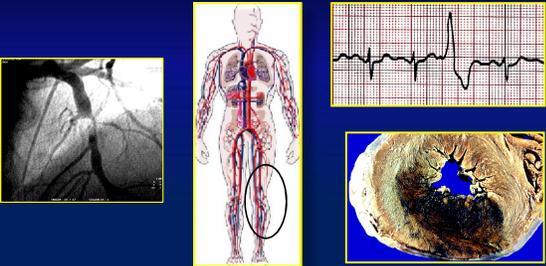


### PRESCRIÇÃO DE EXERCÍCIO FÍSICO E CARDIOPATIAS



Dr. Sérgio Luiz Cahú Rodrigues

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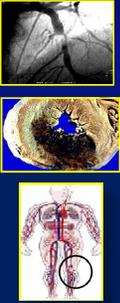
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### TRIAGEM DE RISCO CARDIOVASCULAR PARA A PRÁTICA DE EXERCÍCIO FÍSICO E CARDIOPATIAS

- Doença arterial coronariana
- Doenças do ritmo
- Doença arterial periférica

PRESCREVA UM TREINAMENTO  
PARA UM CARDIOPATA COM DAC



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### TRIAGEM DE RISCO CARDIOVASCULAR PARA A PRÁTICA DE EXERCÍCIO FÍSICO E CARDIOPATIAS



Triagem para participação

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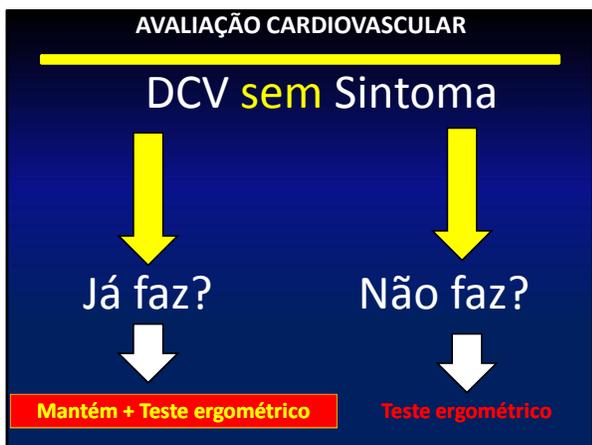
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**RISCO MUITO ALTO**

• SINTOMÁTICOS

MANIFESTAÇÕES (SINTOMAS)

- Frequentes;
- Sem outra explicação de saúde;
- Exercício ou Emoção(estresse)

- Dor/Desconforto/Compressão/Queimação/Aperto no tórax, pescoço, maxila, braços, etc...
- Falta de ar (dispnéia) repouso ou exercício leve
- Síncope(tonturas/desmaios)
- Palpitação ou taquicardia
- Claudicação Intermitente(dor no MI durante o esforço)
- Fadiga incomum com atividades usuais



Sintomas = INSTABILIDADE da doença

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**CONDUTAS**

1ª - INDIVÍDUO ATIVO COM SINTOMAS

- **Interrompe** o exercício físico

Encaminha para o médico

2ª - INDIVÍDUO INATIVO COM SINTOMAS

- **Não comece** o exercício físico

**Sintomas - NÃO faz exercício**

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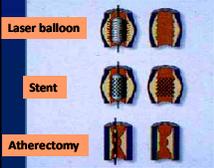
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## RISCO ALTO

- **CARDIOPATAS**

**DOENÇAS CARDÍACAS**

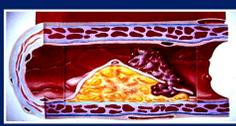
- Doenças conhecidas;
- Cirurgias prévias;
- Medicamentos



**Laser balloon**

**Stent**

**Atherectomy**





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## CONDUTAS

- 1ª - INDIVÍDUO CARDIOPATA ATIVO **COM** TESTE
  - **Prescreve**
- 2ª - INDIVÍDUO CARDIOPATA ATIVO **SEM** TESTE
  - **Não** prescreve, continua o exercício (necessário teste)
- 3ª - INDIVÍDUO CARDIOPATA ATIVO **COM** TESTE
  - **Prescreve**
- 4ª - INDIVÍDUO CARDIOPATA INATIVO **SEM** TESTE
  - **Não** prescreve, não inicia o exercício e pede teste (necessário)

Sem teste – NÃO prescreve  
 Iniciar com supervisão médica

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### TRIAGEM DE RISCO CARDIOVASCULAR PARA A PRÁTICA DE EXERCÍCIO FÍSICO E CARDIOPATAS

Classificação	Características	Condutas
<b>MUITO ALTO</b>	Presença de sintomas	<b>Não</b> fazer exercício Procurar médico
<b>ALTO</b>	Cardiopatas	<b>Avaliação Médica - Atestado</b> <b>Prescrição com Teste Necessário</b>
<b>MODERADO</b>	H ≥ 45 anos M ≥ 55 anos Outros com 2 o } <b>RISCO</b> + FR	Recomenda visita ao médico Teste e Prescrição - depende
<b>BAIXO</b>	H < 45 anos M < 55 anos Com até 1 FR	Prescrição sem restrições

Roque et. al. Rev Pesq Ed Fis; 6:507-514, 2007.

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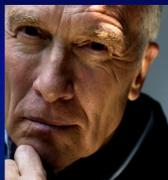
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
CARDIOPATIAS**



Este senhor de 70 anos lhe procurou dizendo que fez uma cirurgia de safena há 6 meses. Seu quadro está controlado e estável. O médico mandou que ele fizesse exercício físico. Porém, antes de começar, ele quer saber, quais são os procedimentos que você irá realizar.

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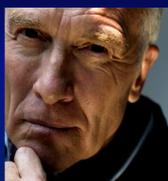
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
CARDIOPATIAS**



Este mesmo senhor quer saber quais são as formas que você pode prescrever o exercício físico para ele. O que você responderia?

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
CARDIOPATIAS**

**DIRETA E INDIRETA**

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
CARDIOPATIAS**



Quais são as formas de prescrição direta?

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
CARDIOPATIAS**



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
CARDIOPATIAS**



Quais são as formas de prescrição indireta?

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E CARDIOPATIAS**

1. Aproximação  $1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n} \sim \ln n$

2. Fórmula de Stirling  $n! \sim \sqrt{2\pi n} n^n e^{-n}$

3. Da fórmula de Wallis:  $\frac{\pi}{2} = \lim_{n \rightarrow \infty} \frac{2 \cdot 4 \cdot 6 \dots 2n}{1 \cdot 3 \cdot 5 \dots (2n-1) \sqrt{2n+1}}$

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E CARDIOPATIAS**



Este senhor de 70 anos lhe procurou dizendo que fez uma cirurgia de safena há 6 meses? Já sabemos que seu quadro está controlado e estável. O médico mandou que ele fizesse exercício. Porém, antes de começar, ele lhe entrega um teste Ergométrico e um Ecocardiograma. E agora ele quer saber quais são os procedimentos que você irá utilizar para realizar a prescrição do exercício físico aeróbio?

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E CARDIOPATIAS**



Lembra???

Olha ele aí!

Agora, ele lhe entrega um teste Ergométrico e um Ecocardiograma, e quer saber quais os procedimentos que você irá utilizar para realizar a prescrição do treinamento do força?

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
CARDIOPATIAS**

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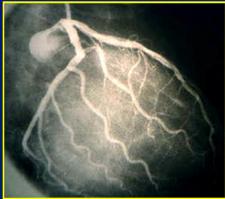
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
CARDIOPATIAS**

- **Doenças das artérias coronárias**  
(Doença isquêmica do coração)



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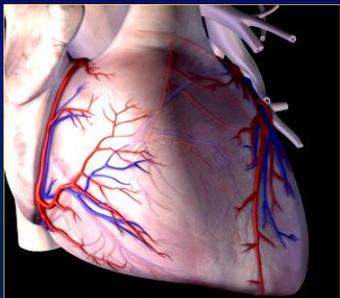
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**Estrutura da artéria coronária**

Alguém pode descrever a estrutura e a função das artérias coronárias?



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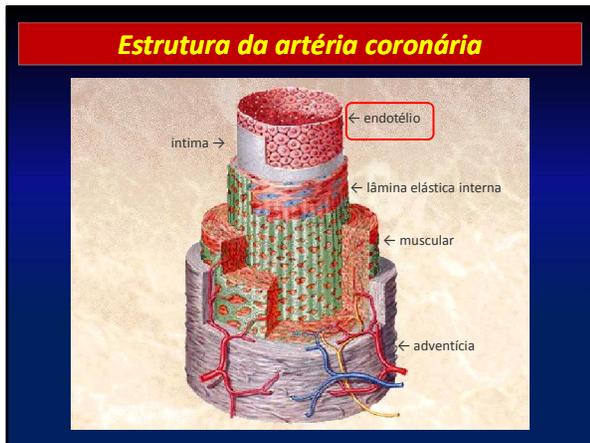
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### Funções do endotélio

- Regulação da permeabilidade vascular;
- Proliferação das células do músculo liso vascular;
- Controle da expressão de moléculas de adesão;
- Inibição da agregação plaquetária;
- **Controle do tônus vascular.**

Aird, 2005

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## ATEROSCLEROSE

### MARCADORES DE INFLAMAÇÃO

- 1. CITOQUINAS:**
  1. CITOQUINAS PROINFLAMATÓRIAS PRIMÁRIAS (IL-1, TNF- $\alpha$ )
  2. CITOQUINAS PROINFLAMATÓRIAS SECUNDÁRIAS (IL-6)
  3. CITOQUINAS QUIMIOATRACTORAS (IL-8, MCP-1)
- 2. MOLÉCULAS DE ADESÃO:**
  1. SELECTINAS (P-SELECTINA, E-SELECTINA, L-SELECTINA)
  2. MOLÉCULAS DE ADESÃO CELULAR E VASCULAR (ICAM-1 e 2, VCAM-1)
- 3. PROTEÍNAS DA FASE AGUDA:**
  1. PRODUZIDAS EM CONCENTRAÇÃO MUITO ALTA (PCR)
  2. PRODUZIDAS EM BAIXA CONCENTRAÇÃO (FIBRINOGENIO)

MCP-1: proteína 1 atrativa de monócitos; ICAM 1 e 2: moléculas de adesão intercelular; VCAM: moléculas de adesão de célula vascular

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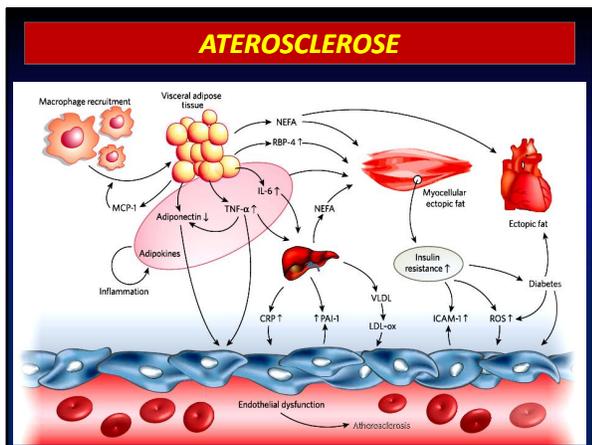
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## ATEROSCLEROSE

### TEORIA CELULAR DA ATROSKLEROSE

FATORES LESIVOS (LÍPIDES, HEMODINÂMICOS, REAÇÕES IMUNES, ETC)

↓

LESÃO ENDOTELIAL FUNCIONAL

↓

INFILTRAÇÃO E ATIVAÇÃO DE MACRÓFAGOS

↓

SECREÇÃO DE FATORES DE CRESCIMENTO

↓

MULTIPLICAÇÃO DE CÉLULAS MUSCULARES LISAS

↓

CRESCIMENTO DA PLACA

↓

LESÃO SECUNDÁRIA

↓

ADESÃO E ATIVAÇÃO DE PLAQUETAS

↓

CRESCIMENTO ULTERIOR DA PLACA

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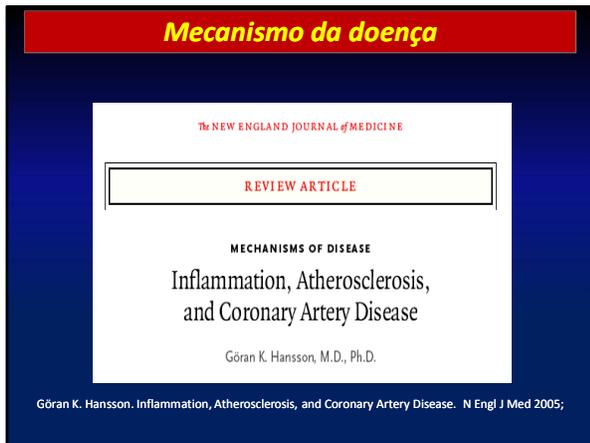
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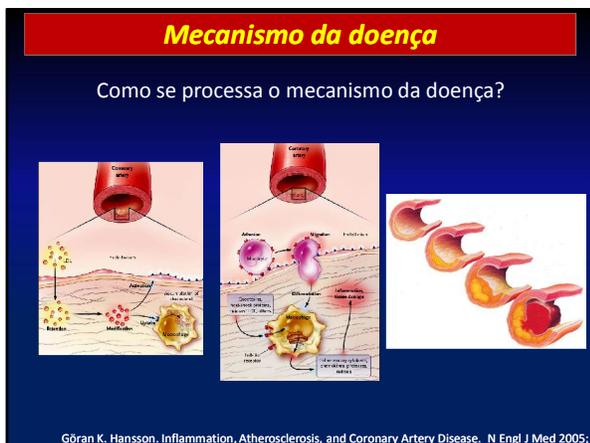
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### Formação da placa de ateroma

**Formação da placa**

- Exposição aos fatores de risco
- lesão endotelial funcional

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### Formação da placa de ateroma

**Formação da placa**

- migração das LDL para o sub-endotélio
- oxidação das LDL
- infiltração e ativação de macrófagos
- formação das células espumosas

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### Formação da placa de ateroma

**Formação da placa**

- secreção dos fatores de crescimento
- multiplicação das células musculares lisas
- síntese de colágeno
- crescimento da placa

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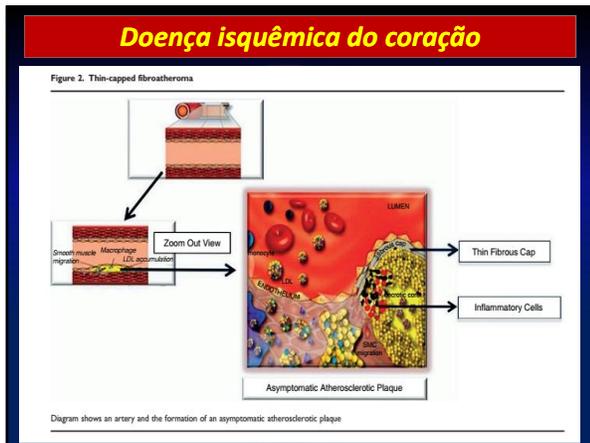
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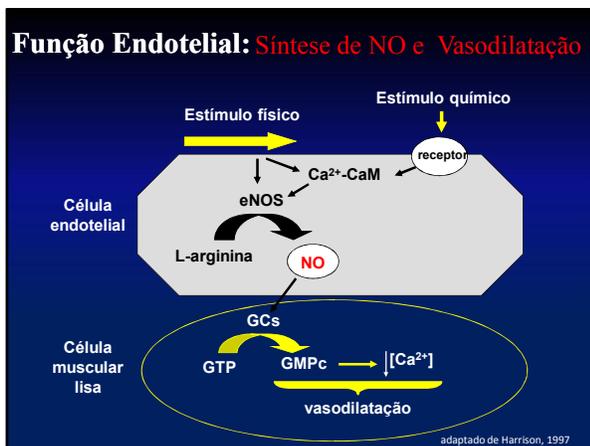
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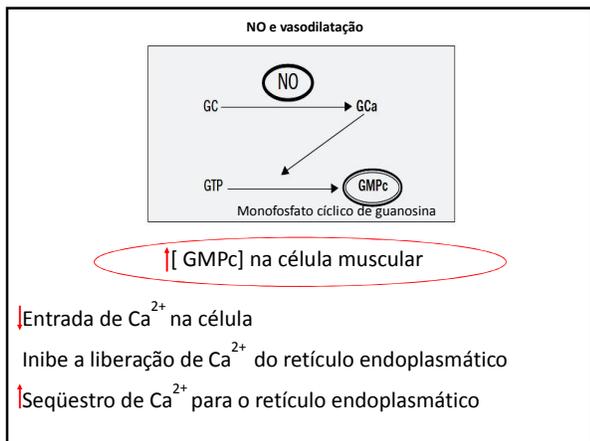
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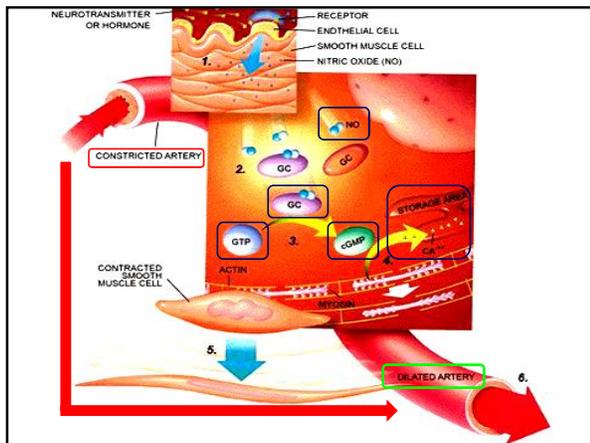
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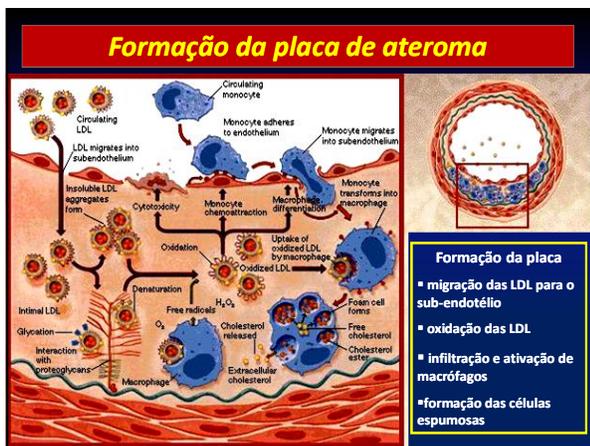
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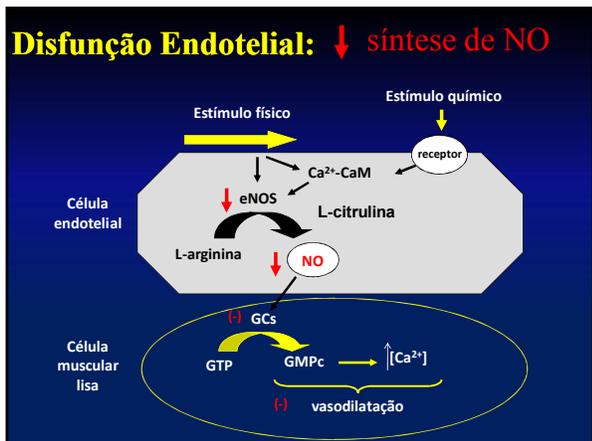
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**Substâncias secretadas pelo endotélio**  
**SUBSTÂNCIAS VASODILATADORAS**

**ÓXIDO NÍTRICO (ON)** - inibição da agregação e adesão plaquetária, da ativação leucocitária e da proliferação muscular lisa;

**PROSTACICLINA (PGI<sub>2</sub>)** - também inibe a agregação plaquetária, diminui a quantidade de colesterol que penetra nos macrófagos e células musculares lisas e previne a liberação de fatores de crescimento que provocam o espessamento da parede vascular

Mombouli e Vanhoutte, 1999

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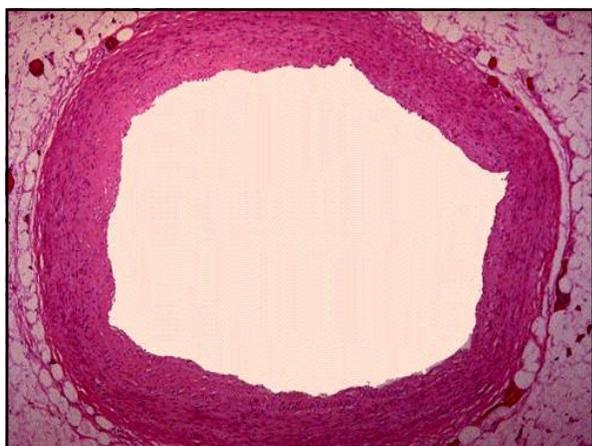
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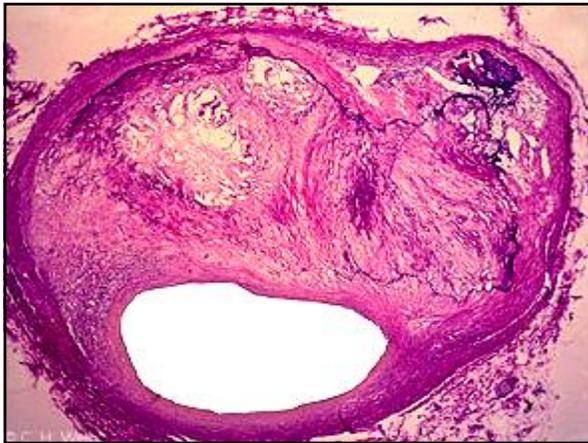
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**Doença isquêmica do coração**

**ISQUEMIA**



Obstrução  
Placa de Ateroma

**NORMAL**  
Necessidade de Sangue  
DEMANDA ENERGÉTICA = Oferta de Sangue  
FLUXO CORONARIANO

**ISQUEMIA**  
Necessidade de Sangue  
DEMANDA ENERGÉTICA > Oferta de Sangue  
FLUXO CORONARIANO

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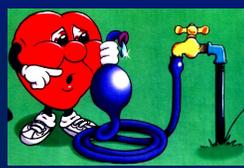
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**Substâncias secretadas pelo endotélio**

**SUBSTÂNCIAS VASOCONSTRITORAS:**

ENDOTELINA I  
PROSTAGLANDINA (PGH2)  
TROMBOXANO (TXA2)  
ANGIOTENSINA II



Mombouli e Vanhoutte, 1999

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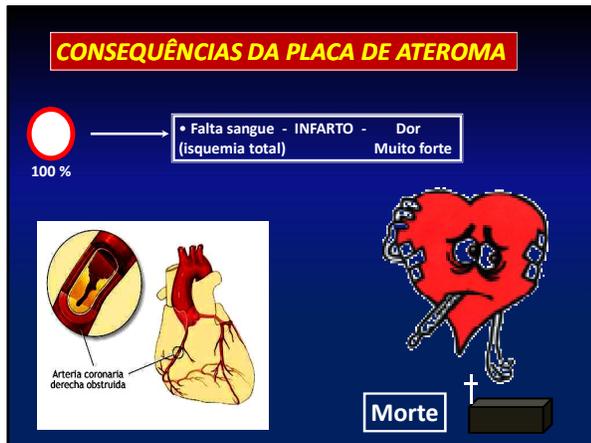
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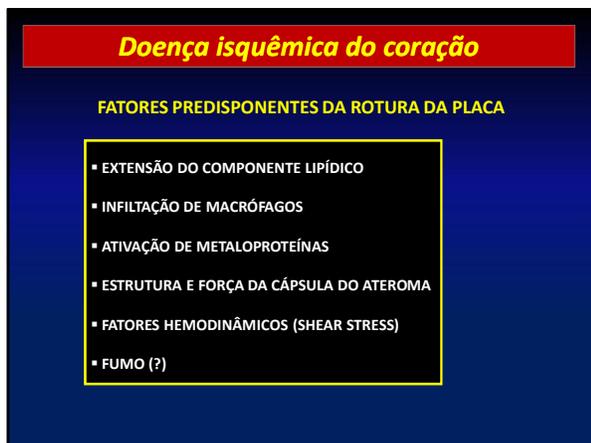
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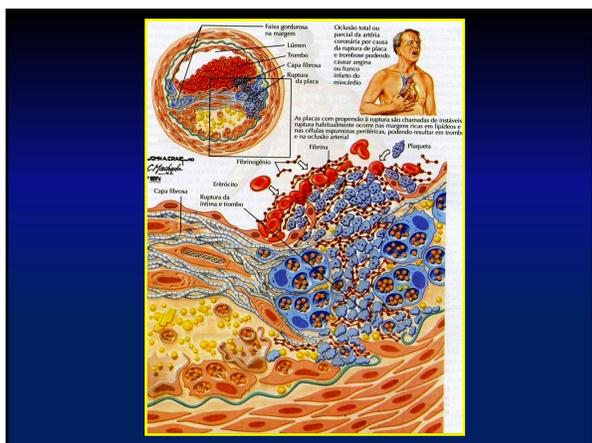
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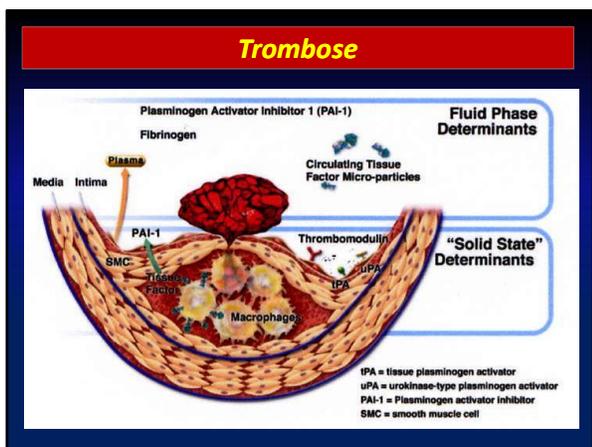
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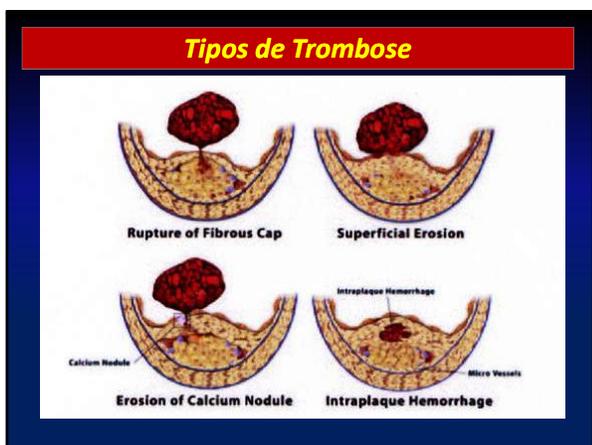
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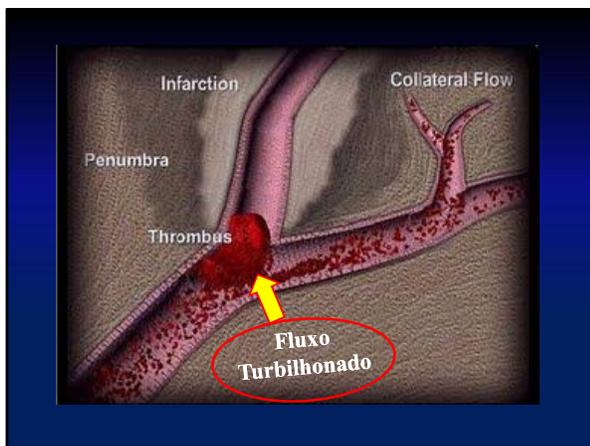
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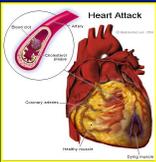
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### Doença isquêmica do coração

- É a obstrução repentina da artéria coronária, com alterações bioquímicas, histológicas e funcionais.
- Desvio do metabolismo aeróbio para o metabolismo anaeróbio:
- Aumento na produção de Lactato
- Diminuição nos fosfatos de alta energia (ATP e CP)
- Aumento do fosfato inorgânico (Pi)
- Aumento do cálcio e sódio intracelular
- Aumento do potássio extracelular
- Edema nas mitocôndrias
- Rupturas da membrana citoplasmática
- Necrose celular
- Perda da contratilidade (Negrão, 2005)




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### Doença isquêmica do coração (DIC)

#### O que é a DIC

Processo de obstrução da luz das artérias coronárias por aterosclerose, caracterizada por depósito de placa de gordura (ateroma) no endotélio das coronárias, associado a processo inflamatório local, que pode levar a uma obstrução do vaso e interrupção total (necrose) ou parcial (isquemia) do fluxo sanguíneo ao músculo do ventrículo esquerdo.

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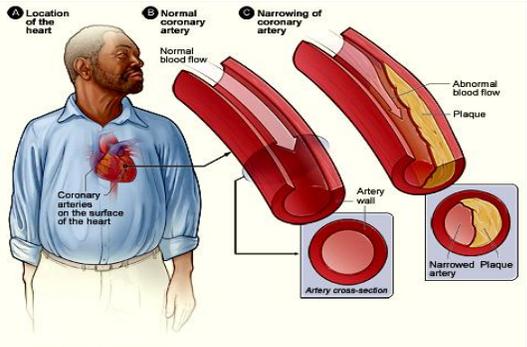
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### Doença isquêmica do coração (DIC)




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**Doença isquêmica do coração**

**FATORES DE RISCO**

- **FATORES PRIMÁRIOS**
  - Hereditariedade
  - Hipertensão
  - Fumo
  - Colesterol elevado
  - HDL- C baixo
  - LDL- C elevado
  - **SEDENTARISMO**
- **FATORES SECUNDÁRIOS**
  - Obesidade
  - Diabetes
  - Estresse

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**Doença isquêmica do coração**

**FATORES DE RISCO**

Não Modificáveis                      Modificáveis

<ul style="list-style-type: none"><li>• <b>IDADE</b></li><li>• <b>SEXO</b></li><li>• <b>HEREDITARIEDADE</b></li></ul>	<ul style="list-style-type: none"><li>• <b>ALTERAÇÕES LIPÍDICAS</b></li><li>• <b>DIABETES</b></li><li>• <b>OBESIDADE</b></li><li>• <b>SEDENTARISMO</b></li><li>• <b>FUMO</b></li><li>• <b>HIPERTENSÃO</b></li><li>• <b>ESTRESSE</b></li></ul>
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**Doença isquêmica do coração**

**FATORES DE RISCO**

 <p>Colesterol</p>	 <p>Triglicérides</p>	 <p>Hipertensão</p>	 <p>Obesidade</p>
 <p>Estresse</p>	 <p>Diabetes</p>	 <p>Fumo</p>	 <p>Sedentarismo</p>

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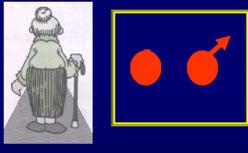
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## Doença isquêmica do coração

### FATORES DE RISCO

RISCO CARDÍACO  
FATORES NÃO CONTROLÁVEIS



**Sexo e Idade**  
Homens > 45 anos  
Mulheres > 55 anos



**Hereditariedade**  
(pai, mãe ou irmãos com DAC  
- se mulher antes de 65 anos  
- se homem antes de 55 anos)

(ACSM, 2011)

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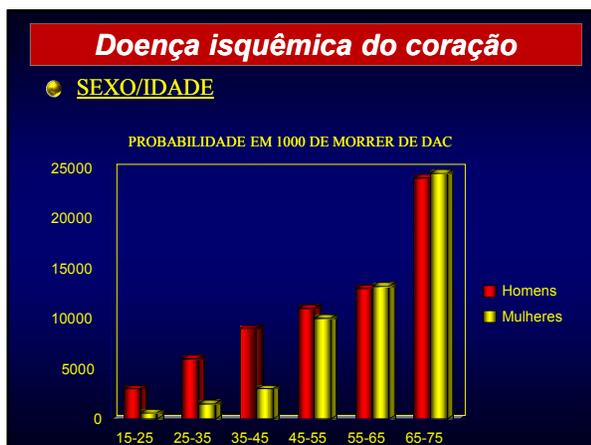
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## Doença isquêmica do coração

### FATORES DE RISCO

#### HEREDITARIEDADE



Estudo de Framingham observou elevação de 30% no risco cardiovascular, em função da "herança genética".

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- ### Doença isquêmica do coração
- #### FORMAS CLÍNICAS
- ANGINA
  - INFARTO
  - INSUFICIÊNCIA CARDÍACA
  - MORTE SÚBITA DE ORIGEM CARDÍACA

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### Doença isquêmica do coração

#### ANGINA (Isquemia)

**DEFINIÇÃO:** FLUXO CORONARIO É INSUFICIENTE PARA SUPRIR AS NECESSIDADES DE O<sub>2</sub> E NUTRIENTES DO MIOCÁRDIO, DEVIDO A REDUÇÃO DO LÚMEN DAS ARTÉRIAS.

**PORTANTO, HÁ SUPRIMENTO INADEQUADO AO MUSCULO CARDÍACO**

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### Doença isquêmica do coração

ISQUEMIA



Obstrução  
Placa de Ateroma

**NORMAL**

Necessidade de Sangue DEMANDA ENERGÉTICA	=	Oferta de Sangue FLUXO CORONARIANO
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**ISQUEMIA**

Necessidade de Sangue DEMANDA ENERGÉTICA	>	Oferta de Sangue FLUXO CORONARIANO
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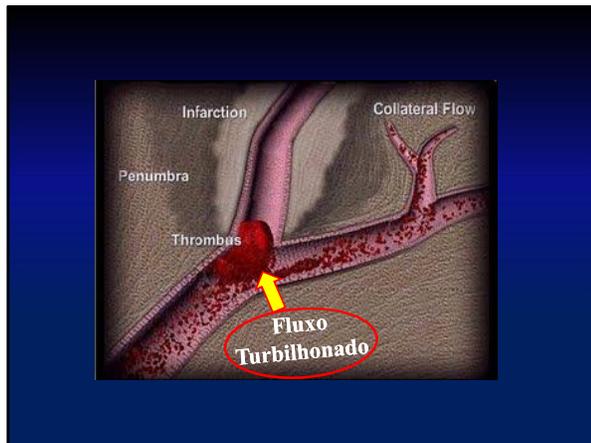
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### Doença isquêmica do coração



V4  
**REPOUSO**



V5

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**Doença isquêmica do coração**

**ALTERAÇÕES ISQUÊMICAS INDUZIDAS PELO EXERCÍCIO**

REPOUSO      EXERCÍCIO

V4

V5

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**Doença isquêmica do coração**

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**Doença isquêmica do coração**

**Obstrução Coronariana (ATEROSCLEROSE/ PONTE MIOCÁRDICA/ ESPASMO) ou; Isquemia Coronariana Não Obstrutiva (ESTENOSE AÓRTICA/ SOBRECARGA VE/ PRÉ EXCITAÇÃO VENTRICULAR/ PROLAPSO VALVAR MITRAL)**

**Síntomas:**  
 Angina  
 Baixa tolerância ao esforço  
 Dispnéia desproporcional ao esforço  
 Incompetência cronotrópica  
 Déficit inotrópico  
 Fadiga de membros inferiores

**Alterações eletrocardiográficas:**  
 Alterações repolarização - infradesnivelamento do segmento ST  
 - supradesnivelamento do segmento ST

**Arritmias complexas**  
 Bloqueios de ramo esforço induzidos

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**Doença isquêmica do coração**

**SINTOMAS –** frequentes;  
sem outra explicação de saúde;  
se em emoção ou exercício

- Dor, desconforto no peito, pescoço, braços, etc;
- Falta de ar (dispnéia)
- Desmaios
- Palpitação ou taquicardia
- Cansaço - Fadiga incomum com atividades usuais
- Falta de ar noturna ou quando fica em pé
- Inchaço de tornozelo
- Claudicação intermitente – mancar

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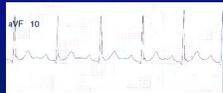
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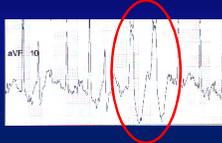
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**Doença isquêmica do coração**

**RITMO CARDÍACO (ECG)**



**ECG NORMAL**



**ECG ARRITMIA**

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**Doença isquêmica do coração**

**RITMO CARDÍACO (ECG)**

- ELEVADA INCIDÊNCIA DE ARRITMIA, AUMENTA COM IDADE, ATÉ 50% DOS TE EM INDIVÍDUOS SEM ANORMALIDADES CV;
- ESV ISOLADAS SÃO AS MAIS FREQUENTES INDUZIDAS OU SUPRIMIDAS PELO EXERCÍCIO PRESENTES DESDE O REPOUSO OU APENAS NA RECUPERAÇÃO TANTO EM INDIVÍDUOS NORMAIS QUANTO EM PACIENTES COM DAC;
- ANORMAIS SE > 10 POR MINUTO, NO ESFORÇO OU RECUPERAÇÃO
- RELAÇÃO COM DAC QUANDO EM BAIXA INTENSIDADE DE ESFORÇO OU ALTERAÇÃO DE ECG ASSOCIADA;
- PAREADAS OU ISOLADAS FREQUENTES (> 10% DE QUALQUER SEQUÊNCIA DE ECG DO TESTE) RELAÇÃO COM MAIOR RISCO DE MORTE CV

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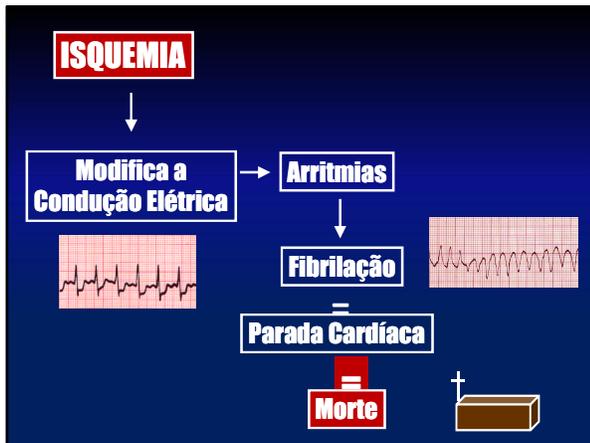
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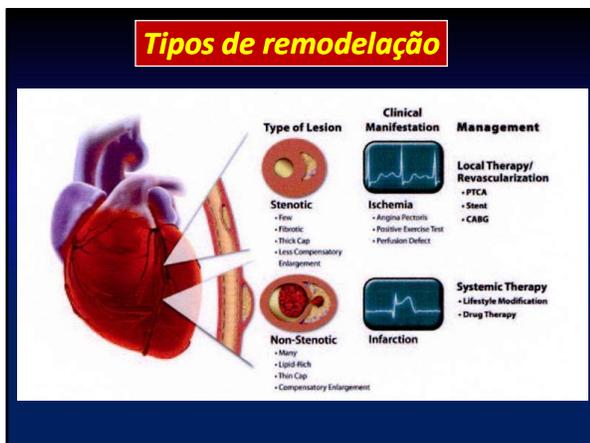
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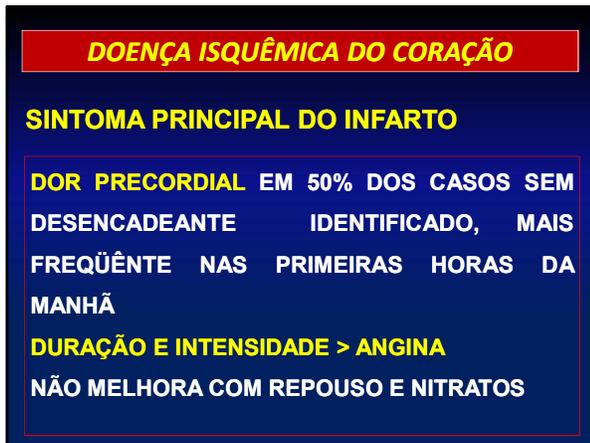
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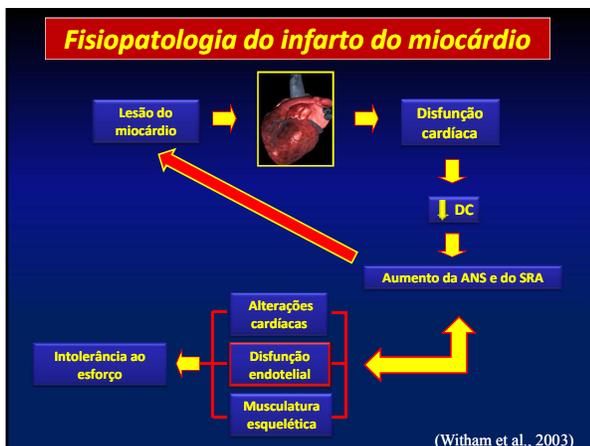
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**DOENÇA ISQUÊMICA DO CORAÇÃO**

**QUAIS AS POSSÍVEIS INTERVENÇÕES PARA PREVENIR OU COMBATER A DOENÇA ?**

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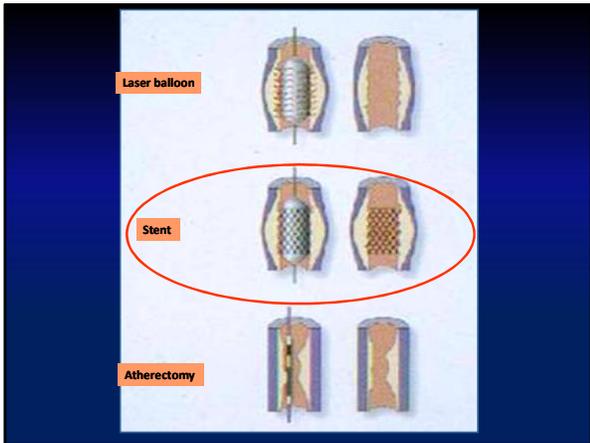
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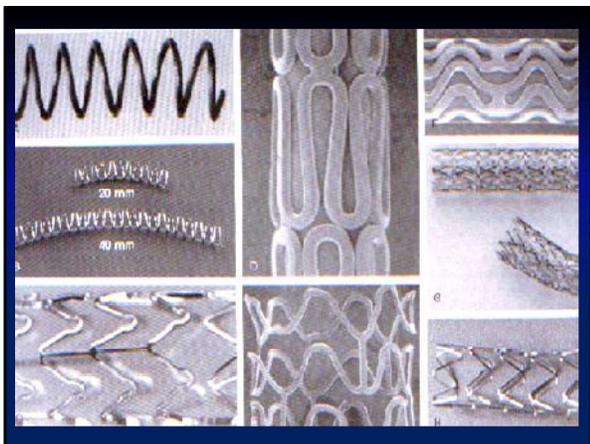
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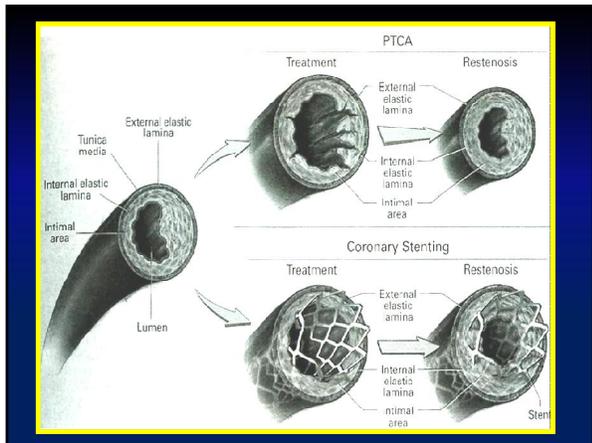
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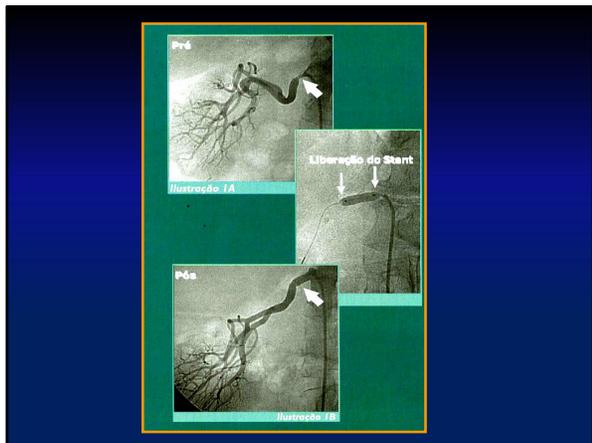
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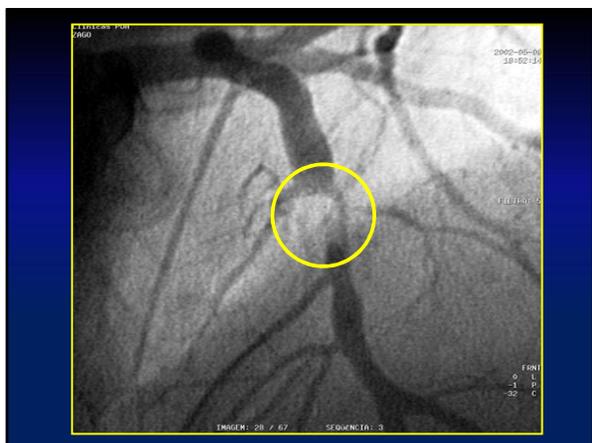
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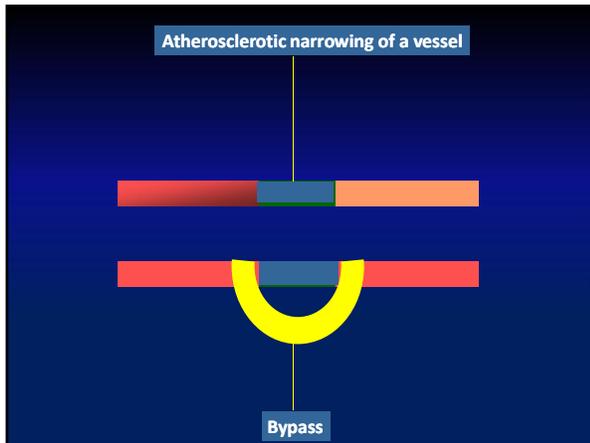
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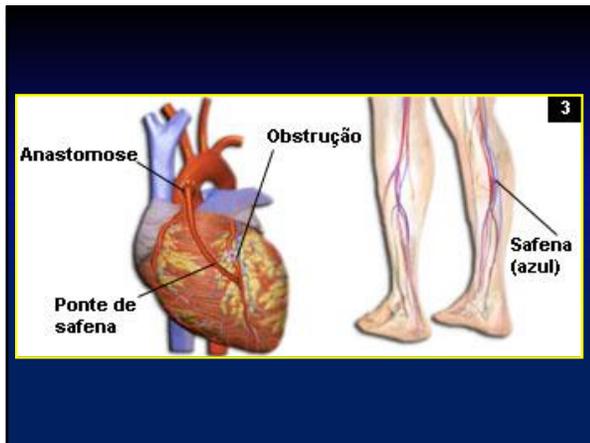
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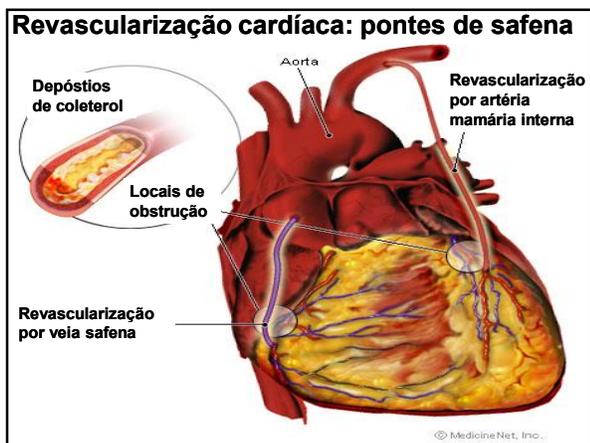
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**QUAL O IMPACTO DA DIC NA APTIDÃO FUNCIONAL?**

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Exercise Performance, Physical Activity, and Health-Related Quality of Life in Participants With Stable Angina**

Andrew W. Gardner, PhD<sup>1,2,3</sup>, Polly S. Montgomery, MS<sup>1,2,3</sup>, Raphael M. Ritti-Dias, PhD<sup>4</sup>, and Udho Thadani, MD, FACC<sup>5,6</sup>

Angiology  
62(6) 461-466  
© The Author(s) 2011  
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sagepub.com/journalsPermissions.nav  
DOI: 10.1177/0003319111399897  
http://ang.sagepub.com  
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**ANGINA VS. CAPACIDADE FUNCIONAL**

**Table 2. Exercise Performance and Self-Reported Health of Participants With Stable Angina and Controls\***

Variables	Control Group (n = 441)	Stable Angina Group (n = 115)	Unadjusted P	Adjusted P <sup>b</sup>
6-Min walk distance (m)	485 (100)	449 (96)	.003	.037
WIQ distance score (%)	76 (34)	57 (38)	<.001	<.001
WIQ speed score (%)	65 (32)	48 (32)	<.001	<.001
WIQ stair-climbing score (%)	67 (35)	48 (36)	<.001	<.001
SPPB score (points)	10.5 (1.2)	10.1 (1.2)	.004	.017
SPPB chair (points)	2.7 (1.1)	2.2 (1.1)	<.001	.002
SPPB stand (points)	3.8 (0.5)	3.8 (0.6)	.714	.890
SPPB walk (points)	4.0 (0.2)	3.9 (0.3)	.040	.109

**MENOR CAPACIDADE FUNCIONAL**

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**ANGINA VS. AT. FÍSICAS DIÁRIAS**

**Table 3. Physical Activity Measures of Participants With Stable Angina and Controls<sup>a</sup>**

Variables	Control Group (n = 441)	Stable Angina Group (n = 115)	Unadjusted P	Adjusted P <sup>b</sup>
Total LTPA (kcal/day)	212 (226)	144 (157)	.003	.016
Low intensity LTPA (kcal/day)	64 (112)	42 (76)	.050	.082
Moderate intensity LTPA (kcal/day)	127 (164)	93 (120)	.040	.124
High intensity LTPA (kcal/day)	18 (47)	8 (15)	.023	.121
Mean intensity LTPA (kcal/min)	4.8 (1.0)	4.7 (1.0)	.637	.963
Mean duration LTPA (min/day)	47 (52)	34 (34)	.014	.046
Physical Activity Scale (units)	2.3 (1.5)	1.7 (1.2)	<.001	<.001

**MENOR NÍVEL DE ATIVIDADE FÍSICA**

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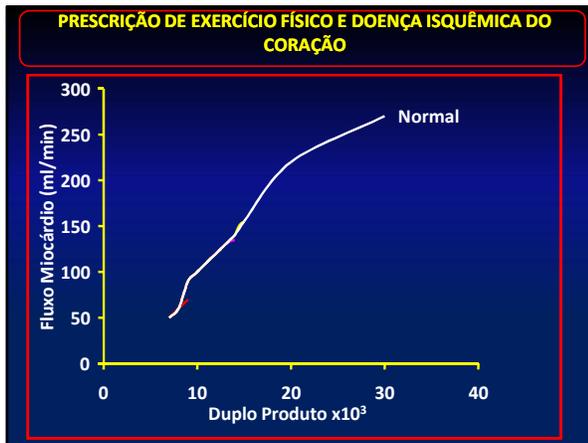
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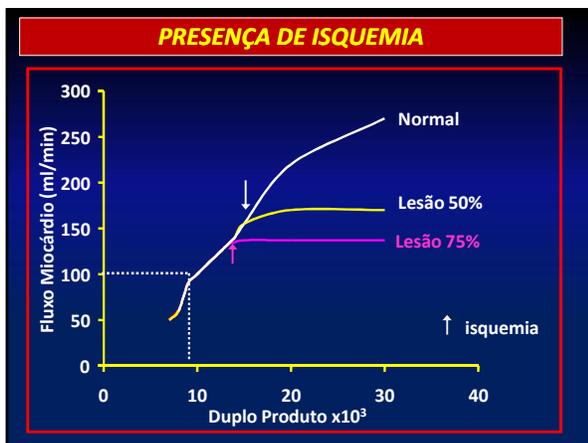
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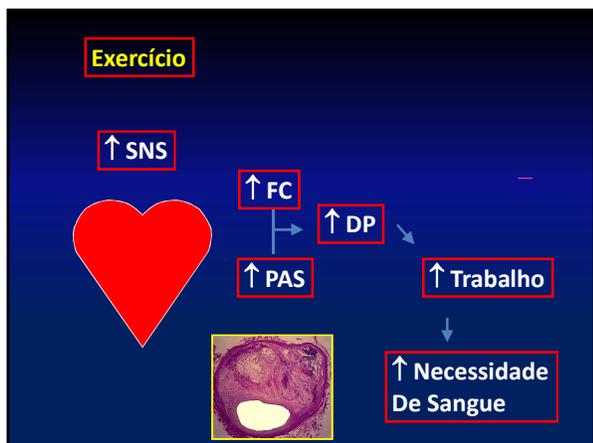
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**Doença isquêmica do coração**

**Sintomas:**

- Angina
- Baixa tolerância ao esforço
- Dispnéia desproporcional ao esforço
- Incompetência cronotrópica
- Déficit inotrópico
- Fadiga de membros inferiores

**Alterações eletrocardiográficas;**

- Alterações de repolarização
- infradesnivelamento do segmento ST
- supradesnivelamento do segmento ST
- Arritmias complexas

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**Doença isquêmica do coração**

**Sintomas**

- ✓ Angina (Dor no peito)
- ✓ Dor no braço
- ✓ Aperto na garganta
- ✓ Mal estar
- ✓ Cansaço fácil
- ✓ Falta de ar
- ✓ Tontura
- ✓ Desmaio

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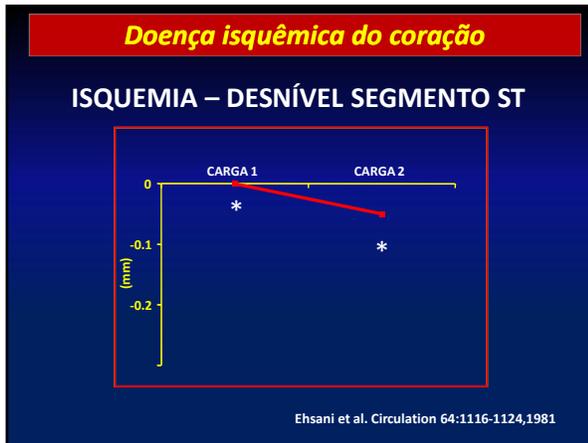
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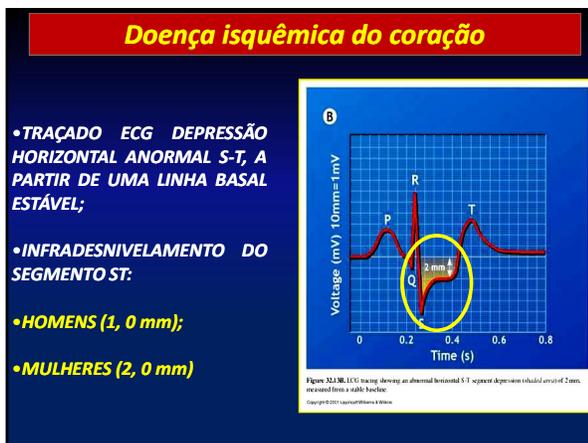
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO (DIC)**

*Onde devemos nos basear?*

RESTAURANT

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO (DIC)**

*Diretrizes...*

AMERICAN COLLEGE OF SPORTS MEDICINE  
FOUNDED 1954

AMERICAN COLLEGE of SPORTS MEDICINE

American Heart Association  
life is why™

SOCIEDADE BRASILEIRA DE CARDIOLOGIA  
SBC  
MCMXLIII

AMERICAN COLLEGE of CARDIOLOGY

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Arquivos Brasileiros de Cardiologia**

O treinamento contínuo pode ser aplicado segundo o tempo de realização, em exercício, de curta (até 10min) média (de 10 a 30min) e longa (acima de 30min), duração

Departamento de Ergometria e Reabilitação Cardiovascular da Sociedade Brasileira de Cardiologia

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**AHA Scientific Statement**

**Resistance Exercise in Individuals With and Without Cardiovascular Disease: 2007 Update**

A Scientific Statement From the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism

Mark A. Williams, PhD, Co-Chair; William L. Haskell, PhD, FAHA, Co-Chair; Philip A. Ades, MD; Ezra A. Amsterdam, MD; Vera Bittner, MD; Barry A. Franklin, PhD; Meg Gulanick, RN, PhD; Susan T. Laing, MD; Kerry J. Stewart, EdD

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

	Aeróbio	Resistido
<b>Dinâmica Cardiovascular</b>		
FC repouso	↓↓	0
VS repouso e máximo	↑↑	0
DC repouso	0	0
DC máximo	↑↑	0
PAS repouso	↓0	0
PAD repouso	↓0	0
<b>Performance</b>		
VO <sub>2</sub> max	↑↑↑	↑0
Tempo de endurance	↑↑↑	↑↑
DP submáximo	↓↓	↓0
<b>Taxa Metabólica Basal</b>		
QV relativa à saúde	↑0	↑0

Adaptado de Williams et al. Circulation 2007, 116:572-84.

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**



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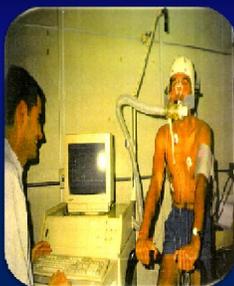
**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**

*Intensidade*

**• TESTE ERGOESPIROMÉTRICO**

- ✓ Entre o primeiro e segundo limiar do Teste Ergoespirométrico;

(INCOR, 2005)



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**

*Intensidade*

**• TESTE ERGOMÉTRICO:**

- ✓ 50 A 70% DA FC DE RESERVA

Teste Ergométrico



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### Exercise recommendation and catecholamines in patients with coronary artery disease.

Tegthur U, Meyer H, Machold H, Busse MW. Z. *Cardiol.* 2002 Nov;91(11):927-36.

Exercise training for patients with coronary artery disease (CAD) is recommended in a wide range between 40-85% of maximum functional capacity (MFC) or 55-90% of maximum heart rate (HR). During exercise, high levels of catecholamines and metabolic acidosis could induce arrhythmia and ischemia. But catecholamines have never been determined in CAD during constant load exercise in the upper range of recommended intensities. In 11 CAD patients (age 58±7.8 years, BMI 26.1±4.0 kg x m<sup>-2</sup>, NYHA I n=7, II n=4) we tested the maximum functional capacity (MFC), norepinephrine (NE), epinephrine (E) and blood lactate ([Lac<sup>-</sup>]) in a symptom-limited incremental ergometer test. Related to the exercise recommendation, the kinetics of NE, E and [Lac<sup>-</sup>] were determined in two 30 min constant load tests in randomized order: one was performed at the anaerobic lactate threshold (CTAT), a second was performed 10% above the individual threshold intensity (CT+10%). In the incremental tests maximum workload and VO<sub>2</sub> were 141±54 W and 1766±532 ml x min<sup>-1</sup>, respectively (85±22% of normal, [Lac<sup>-</sup>] 5.7±1.9 mmol x l<sup>-1</sup>, HR 138±29 b x min<sup>-1</sup>, NE 11.7±6.1, E 3.6±1.4 nmol x l<sup>-1</sup>). In CTAT the anaerobic threshold (63±7% of MFC) represented the mean range of recommended exercise intensity for CAD (40-85%) and could be validated as steady-state intensity because catecholamines and [Lac<sup>-</sup>] concentrations remained constant after the initial increase (workload 88±35 W, [Lac<sup>-</sup>] 3.3±1.4 mmol x l<sup>-1</sup>, HR 117±23 b x min<sup>-1</sup>, NE 8.3±3.5, E 0.8±0.7 nmol x l<sup>-1</sup>). In all patients CT+10% (71±7% of MFC) led to a continuous rise in [Lac<sup>-</sup>], to a NE overload and to earlier exhaustion, although the intensities were in the recommended training range (workload 100±35 W, [Lac<sup>-</sup>] 5.8±1.9 mmol x l<sup>-1</sup>, HR 129±29 b x min<sup>-1</sup>, NE 13.9±6.9, E 1.5±1.7 nmol x l<sup>-1</sup>); p<0.01 against CTAT for all except E).

**Conclusions** In the upper range of recommended training intensity for CAD patients, norepinephrine and lactate were higher during endurance exercise than at MFC in incremental tests. Endurance exercise with intensities >70% of MFC could overload the cardiac patient and increase the risk of arrhythmia and ischemia. Therefore, endurance exercise should be performed below 70% of MFC or below 85% of maximum HR, respectively, whereas higher intensities should apply to interval

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Hypothetical Model (Skinner, 1980) LA PCR

	Fase 01 AERÓBIO LEVE	Fase 02 AERÓBIO MODERADO	Fase 03 AERÓBIO INTENSO	ANÁLISE DO SUPRA MÁXIMA 100%
Metabolismo Predominante	Aeróbico	Anaeróbica Compensada	Anaeróbica Descompensada	
Substrato Energético Predominante	Predominância LIPÍDICA e Glicose	Predominância LIPÍDICA e Glicose LACTATO BICARBONATO DE SÓDIO	Predominância GLICOLÍTICA e Lipídio LACTATO	
Tipo de Fibra Muscular	I, II a, II X	I, II a, II X	I, II a, II X	
% da FCR	40	50	70	
% do vo2 máx	40	60	70	
QR	± 0.7	± 1.0		

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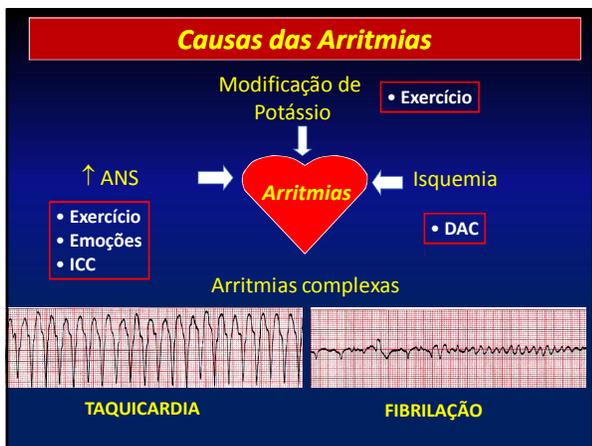
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**INFARTO AGUDO DO MIOCÁRDIO**

Tempo	Risco de IAM
Durante	6
P1h	6
P2h	1
P3h	1
P4h	1
P5h	1

• Risco aumentado em cardiopatas

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**EVOLUÇÃO PARA O INFARTO**

- ❖ Trombose – lesão secundária
- ❖ Embolismo
- ❖ Vasoespasmo
- ❖ Obstrução crônica lenta

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**INFARTO AGUDO DO MIOCÁRDIO**

**Exercício:**  
 ↑ velocidade de fluxo  
 Modificações metabólicas

Facilita lesão secundária  
 Facilita formação de trombos  
 Facilita formação de êmbolos

**Dependente da Intensidade**

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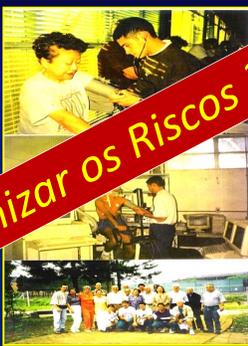
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Minimizar os Riscos ????**



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**TRIAGEM DE RISCO CARDIOVASCULAR PARA A PRÁTICA DE  
EXERCÍCIO FÍSICO E CARDIOPATAS**



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**

**• TESTE ERGOESPIROMÉTRICO:**

1. Resposta Cronotrópica;
2. Resposta Inotrópica;
3. Eletrocardiográfica;
4.  $VO_2$  Máximo DIRETO;
5. Limiares Ventilatórios.



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**

• **TESTE DE ESFORÇO:** Avaliação da resposta cardiovascular, respiratória e metabólica ao exercício progressivo.

• **TESTE ERGOMÉTRICO:**

- 1. Resposta Cronotrópica;
- 2. Resposta Inotrópica;
- 3. Eletrocardiográfica;
- 4. VO<sub>2</sub> Máximo INDIRETO.

Teste Ergométrico



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**

**LAUDO MÉDICO AUTORIZANDO A  
LIBERAÇÃO PARA A REALIZAÇÃO  
EXERCÍCIO FÍSICO**



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## PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO (DIC)



Lembra que este senhor de 70 anos lhe procurou dizendo que fez uma cirurgia de safena há 6 meses? Já sabemos que seu quadro está controlado e estável. O médico mandou que ele fizesse exercício. Porém, antes de começar, ele lhe entrega um teste Ergométrico. A partir desse exame, ele quer saber quais são os procedimentos que você irá utilizar para realizar a prescrição do exercício físico aeróbio ?

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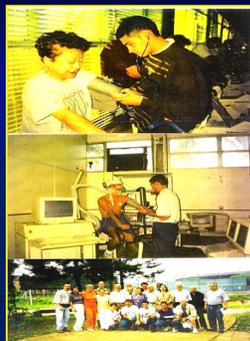
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## PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO

<b>ESCOLA DE EDUCAÇÃO FÍSICA</b> UNIVERSIDADE DE SÃO PAULO Av. Prof. Mello Moraes, 66 - Cidade Universitária - tel. 011-3183		
<b>ECG DE REPOUSO e TESTE ERGOMÉTRICO</b>		
Paciente: DiCondiçãoamento Físico <span style="float: right;">Exame n. F. 682 Data: 23/08/95</span>		
<b>Dados Pessoais</b>		
Idade: 67 anos Peso: 67 Kg	Sexo: Masculino Estatura: 1,67 m	Indivíduo: Ativo
<b>Condições para o Teste</b>		
Hora: 07:28 Temperatura: 21 °C Mecanismo: Não	Exercício: Estreia Protocolo: Balke modificado Derivação: MV5, D2M e V2M	FC Máxima: 158 BPM FC Submáxima: 134 BPM
<b>Finalidade</b> Avaliação funcional cardiorrespiratória.		
<b>Dados Clínicos</b> ICo crônica (Revascularização Miocárdica 17.10.90) DM tipo II Dislipidemia Assintomático do ponto de vista cardiovascular.		
<b>Medicamentos em Uso</b> Norvasc 5mg meio cp/dia Diazem 1cp/dia Propral 1cp/dia.		
<b>Responsável</b>		




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<b>ESCOLA DE EDUCAÇÃO FÍSICA</b> UNIVERSIDADE DE SÃO PAULO Av. Prof. Mello Moraes, 66 - Cidade Universitária - tel. 011-3183		
<b>ECG DE REPOUSO e TESTE ERGOMÉTRICO</b>		
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Idade: 67 anos Peso: 67 Kg	Sexo: Masculino Estatura: 1,67 m	Indivíduo: Ativo
<b>Condições para o Teste</b>		
Hora: 07:28 Temperatura: 21 °C Mecanismo: Não	Exercício: Estreia Protocolo: Balke modificado Derivação: MV5, D2M e V2M	FC Máxima: 158 BPM FC Submáxima: 134 BPM
<b>Finalidade</b> Avaliação funcional cardiorrespiratória.		
<b>Dados Clínicos</b> ICo crônica (Revascularização Miocárdica 17.10.90) DM tipo II Dislipidemia Assintomático do ponto de vista cardiovascular.		
<b>Medicamentos em Uso</b> Norvasc 5mg meio cp/dia Diazem 1cp/dia Propral 1cp/dia.		
<b>Responsável</b>		

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

$FCT = (FCMÁX. - FCREPOUSO) \times \% \text{ Desejado} + FC \text{ REPOUSO}$

PAS=

PAD=

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

$FCT = (FCMÁX. - FCREPOUSO) \times (\% \text{ DESEJADO}) + FC \text{ REPOUSO}$

FCT= (151 - 6

FCT= (151 - 6

**PAS MÁXIMA**

**PAD MÁXIMA**




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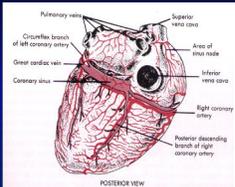
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**Doença isquêmica do coração**




**OBSTRUÇÃO**



**PLACA DE ATEROMA**

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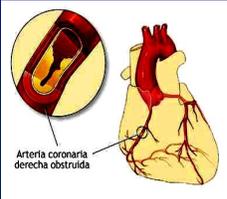
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### CONSEQUÊNCIAS DA PLACA DE ATEROMA



80 %

• Falta sangue - INFARTO - Dor Muito forte  
(isquemia quase total)



Arteria coronária derecha obstruída



Morte

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TEBAPEX2000  
12.00

**ESCOLA DE EDUCAÇÃO FÍSICA**  
UNIVERSIDADE DE SÃO PAULO  
Av. Prof. Mello Moraes, 86 - Cidade Universitária - tel.: 519.3183

**ECG DE REPOUSO e TESTE ERGOMÉTRICO**

Paciente: \_\_\_\_\_  
Indicação: D/Condicionamento Físico Exame n. F 682  
Data: 23/08/95

**Dados Pessoais**

Idade: 62 anos Peso: 87 Kg	Sexo: Masculino Estatura: 1,87 m	Instituição: Ativo
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**Condições para o Teste**

Hora: 07:30 Temperatura: 21 °C Marechazo: Não	Ergômetro: Esteira Protocolo: balca modificado Derivações: MV5, D2M e V2M	FC Máxima: 158 BPM FC Submáxima: 134 BPM
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**Finalidade**  
Avaliação funcional cardiocirculatória.

**Dados Clínicos**  
ICo crônica (Revascularização Miocárdica 17.10.90)  
DM tipo II  
Dislipidemia  
Assintomático do ponto de vista cardiovascular.

**Medicamentos em Uso**  
Norvasc 5mg meio cp/dia.  
Dantrol 1cp/dia.  
Proepa 1cp/dia.

Responsável: \_\_\_\_\_

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ESCOLA DE EDUCAÇÃO FÍSICA TEB - APEX2000 11

EXAME N. F 682 PACIENTE: \_\_\_\_\_ 23/08/95

ANÁLISE DO TESTE

**Parâmetros Clínicos** \_\_\_\_\_

INTERROMPIDO DEVIDO ÀS ALTERAÇÕES ELETROCARDIOGRÁFICAS, COM FREQUÊNCIA CARDÍACA SUBMÁXIMA ATINGIDA ATINGIDA. QUEDA DA PA SISTÓLICA INTRA-ESFORÇO. COMPORTAMENTO NORMAL DA PA DIAS - TÓLICA. ASSINTOMÁTICO DO PONTO DE VISTA CARDIOVASCULAR.

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**Parâmetros Eletrocardiográficos**

**ECG de Repouso:**  
SEM ANORMALIDADES.

**Durante Esforço:**  
ATINGIU 96% DA FREQUÊNCIA CARDÍACA MÁXIMA PRECONIZADA PARA A IDADE.  
INFRADENIVELAMENTO DO SEG.ST. DE MORFOLOGIA HORIZONTAL EM MV5 E D2M,  
COM PONTO Y EM ATÉ -6,0mm.  
EXTRASSISTOLES VENTRICULARES ISOLADAS RARAS NO PICO DO ESFORÇO (MONI -  
TOR).

**Recuperação:**  
INFRADENIVELAMENTO DO SEG.ST. DE MORFOLOGIA DESCENDENTE EM MV5 E D2M,  
COM PONTO Y EM ATÉ -3,0mm.

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**Conclusões e Comentários**

TESTE POSITIVO.

VIDE PARÂMETROS CLÍNICOS E ELETROCARDIOGRÁFICOS.

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ESCOLA DE EDUCAÇÃO FÍSICA TEB - APEX2000 11  
EXAME N.º 682 PACIENTE: 23/08/95

**ANÁLISE DO TESTE**

**Parâmetros Clínicos**

INTERROMPIDO DEVIDO ÀS ALTERAÇÕES ELETROCARDIOGRÁFICAS, COM FREQUÊNCIA  
CARDÍACA SUBMÁXIMA ATINGIDA ATINGIDA.  
QUEDA DA PA SISTÓLICA INTRA-ESFORÇO. COMPORTAMENTO NORMAL DA PA DIAS -  
TÓLICA.  
ASSINTOMÁTICO DO PONTO DE VISTA CARDIOVASCULAR.

**Parâmetros Eletrocardiográficos**

**ECG de Repouso:**  
SEM ANORMALIDADES.

**Durante Esforço:**  
ATINGIU 96% DA FREQUÊNCIA CARDÍACA MÁXIMA PRECONIZADA PARA A IDADE.  
INFRADENIVELAMENTO DO SEG.ST. DE MORFOLOGIA HORIZONTAL EM MV5 E D2M,  
COM PONTO Y EM ATÉ -6,0mm.  
EXTRASSISTOLES VENTRICULARES ISOLADAS RARAS NO PICO DO ESFORÇO (MONI -  
TOR).

**Recuperação:**  
INFRADENIVELAMENTO DO SEG.ST. DE MORFOLOGIA DESCENDENTE EM MV5 E D2M,  
COM PONTO Y EM ATÉ -3,0mm.

**Conclusões e Comentários**

TESTE POSITIVO.

VIDE PARÂMETROS CLÍNICOS E ELETROCARDIOGRÁFICOS.

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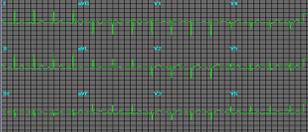
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**TESTE ERGOMÉTRICO**

**INTERPRETAÇÕES  
DO  
TESTE ERGOMÉTRICO**




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**TESTE ERGOMÉTRICO**

**VAMOS INTERPRETAR O TESTE QUANTO:**

DURAÇÃO DO TESTE

COERÊNCIA DA RESPOSTA (EFICIENTE OU MÁXIMO)

RESPOSTA DA PAS

RESPOSTA DA PAD

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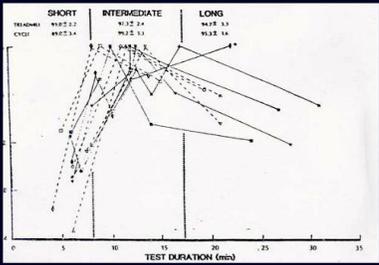
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**DURAÇÃO DO TESTE**



	1	2	3	4	5
Tempo	26±2	15±1	11±1	11±1	7±1
VO <sub>2</sub> max	3,8±0,3	3,9±0,4	3,9±0,4	3,9±0,4	3,7±0,4

**DURAÇÃO IDEAL - 10 ± 2 min**

Buchfuhrer et al. JAP 55:1558-64,1983

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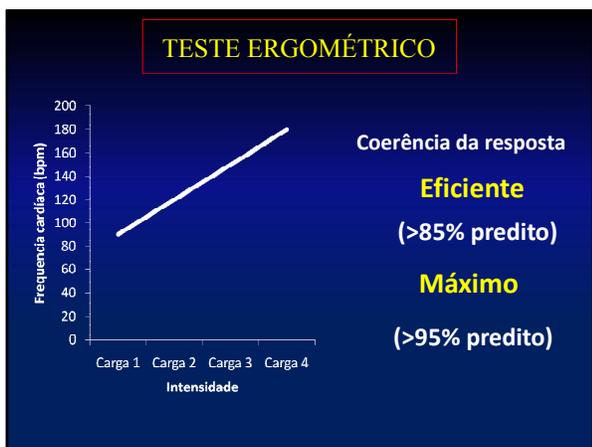
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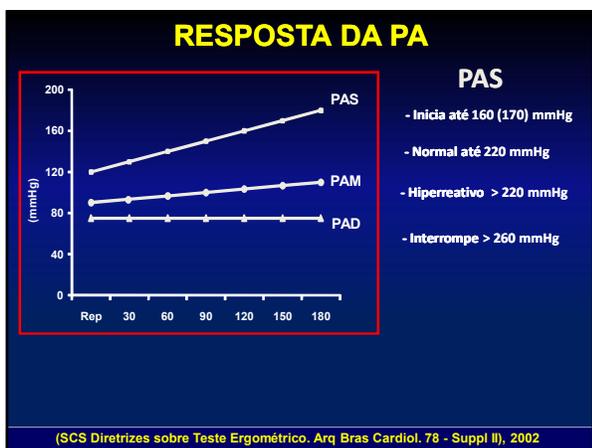
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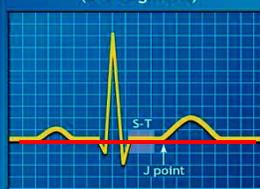
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(SCS Diretrizes sobre Teste Ergométrico. Arq Bras Cardiol. 78 - Suppl II, 2002)



### PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO

#### Ventricular repolarization (S-T segment)



Earlier phase repolarization that extends from the end of the QRS to the start of the T-wave. The J (junction) point represents the S-T segment joins the start of the T-wave.

Figure 16.2 The different phases of the normal ECG from atrial depolarization to ventricular repolarization. (Source: © McGraw-Hill Education)

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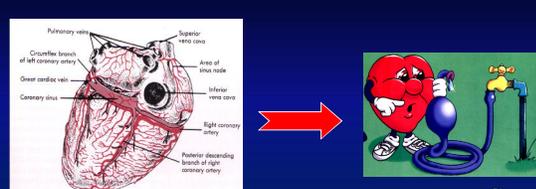
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### Doença isquêmica do coração



**OBSTRUÇÃO**



**PLACA DE ATEROMA**

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### Influence of Anthropological Stimuli on Atherogenesis

**Characteristics of Plaque Development**

1. EC Injury and Activation <small>(mechanical trauma, shear stress, infection, ROS)</small>	2. LDL Oxidation <small>(scavenger receptors, oxLDL/aLDL)</small>	3. Mφ Infiltration <small>(cytokines, growth factors, ROS)</small>	4. SMC Proliferation and Migration <small>(ECM components, cytokines, growth factors)</small>	5. Thrombosis <small>(platelets, lymphocytes)</small>
↑ Energy Intake ↑ Sat/Trans Fat ↑ Smoking ↓ Physical Activity	↑ Energy Intake ↑ ω-6/ω-3 ratio ↑ Sat/Trans Fat ↓ Vitamins ↑ Salt ↑ Smoking ↓ Physical Activity	↑ Energy Intake ↑ ω-6/ω-3 ratio ↑ Sat/Trans Fat ↓ Vitamins ↑ Salt ↑ Smoking ↓ Physical Activity	↑ Energy Intake ↑ ω-6/ω-3 ratio ↑ Sat/Trans Fat ↓ Vitamins ↑ Smoking	↑ Energy Intake ↑ ω-6/ω-3 ratio ↑ Sat/Trans Fat ↓ Vitamins ↑ Smoking ↓ Physical Activity

**Historical Trend and Potential Molecular Targets of Anthropological Stimuli**

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**Doença isquêmica do coração**

- **TRAÇADO ECG DEPRESSÃO HORIZONTAL ANORMAL S-T, A PARTIR DE UMA LINHA BASAL ESTÁVEL;**
- **INFRADESNIVELAMENTO DO SEGMENTO ST:**
- **HOMENS (1, 0 mm);**
- **MULHERES (2, 0 mm)**

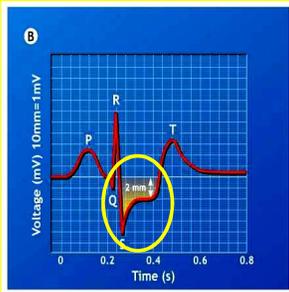


Figure 33.2 ML ECG tracing showing an abnormal horizontal S-T segment depression (shaded area) of 2 mm, occurred from a stable baseline.

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

- **TRAÇADO ECG DEPRESSÃO HORIZONTAL ANORMAL S-T, A PARTIR DE UMA LINHA BASAL ESTÁVEL;**
- **INFRADESNIVELAMENTO DO SEGMENTO ST:**
- **HOMENS (1, 0 mm);**
- **MULHERES (2, 0 mm)**

Teste Positivo

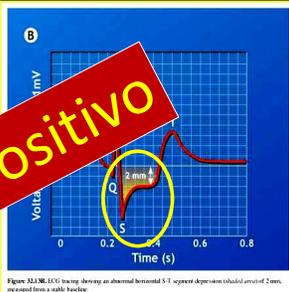


Figure 33.2 ML ECG tracing showing an abnormal horizontal S-T segment depression (shaded area) of 2 mm, occurred from a stable baseline.

**OBSERVAR FREQUÊNCIA CARDÍACA DE POSITIVAÇÃO**

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**ALTERAÇÕES ISQUÊMICAS INDUZIDAS PELO EXERCÍCIO**



**REPOUSO**



**V5**

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**CARDIOPATA COM TESTE POSITIVO**

**Limiar de Isquemia**

**FC – em que ocorre a isquemia**

Acima desse nível → Aumenta Risco Cardiovascular

**NÃO ULTRAPASSAR O LIMIAR**

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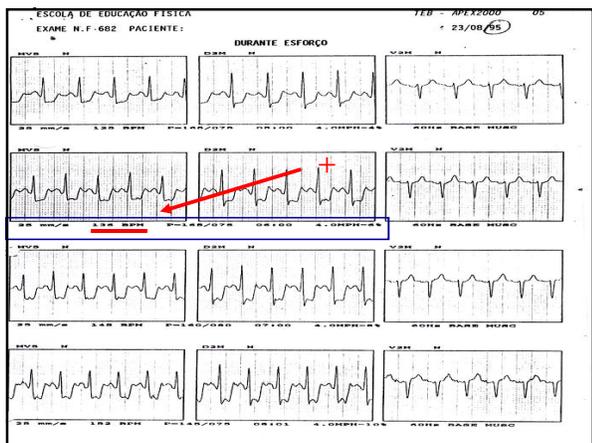
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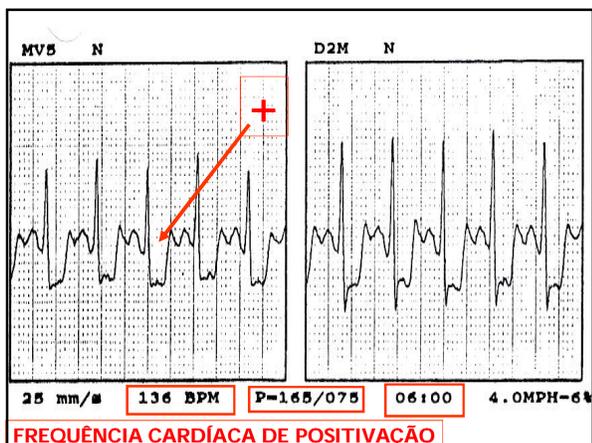
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### FC DE TREINO - KARVONEN

$$FC_{treino} = (FC_{max} - FC_{rep}) \times \% + FC_{rep}$$

FC de POSITIVAÇÃO

Medir após 5 min de repouso

50 a 70% para sedentários, obesos, hipertensos, cardiopatas  
60 a 80% para condicionados

TESTE POSITIVO – LIMITE SUPERIOR - NO MÍNIMO 10 BATIMENTOS ABAIXO DA POSITIVAÇÃO

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### PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO

$$FCT = (FC_{MÁX.} - FC_{REPOUSO}) \times (\% \text{ DESEJADO}) + FC_{REPOUSO}$$

FCT = (125 - 63) x 0.5 + 63 = 94 BPM = 50% DA FCR

FCT = (125 - 63) x 0.7 + 63 = 106 BPM = 70% DA FCR

PAS MÁXIMA = 165  
PAD MÁXIMA = 75

**ou até 180/105 mmHg**

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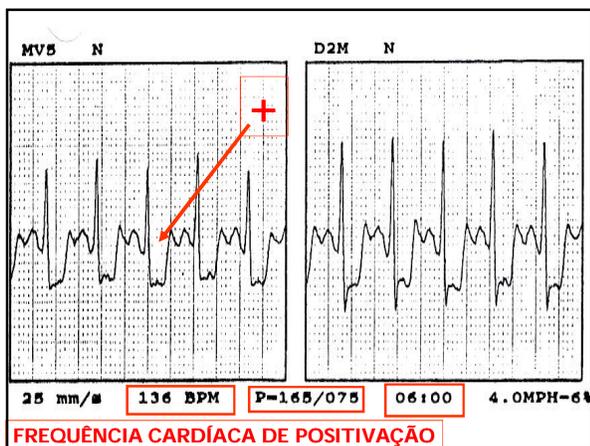
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Circulation**  
Journal of the American Heart Association

**American Heart Association**

Exercise Standards for Testing and Training: A Statement for Healthcare Professionals From the American Heart Association  
 Gerald F. Fletcher, Gary J. Balady, Ezra A. Amsterdam, Bernard Chaitman, Robert Eckel, Jerome Fleg, Victor F. Froelicher, Arthur S. Leon, Helena L. Peña, Roxanne Rodriguez, Denise A. Simons-Morton, Mark A. Williams and Terry Bazzare

Circulation. 2001;104:1694-1740  
 doi: 10.1161/hc3901.095960  
 Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231  
 Copyright © 2001 American Heart Association, Inc. All rights reserved.  
 Print ISSN: 0009-7322, Online ISSN: 1524-4539

methodology (40% to 60% of  $\dot{V}O_2$  max), but with the designated heart rate and work rate below the identified threshold of ischemia (ie, angina and/or  $\geq 1$  mm ischemic ST segment depression on the exercise test). In general, the heart rate prescription should be a minimum of 10 beats/min below the heart rate at which the abnormality occurs.

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

REVIEW ARTICLE

Springer 2012 | 41 (7) 587-605  
 0112-1642/12/0007-0587/\$49.95/0  
 Article © 2012 Springer International Publishing AG. All rights reserved.

**High-Intensity Interval Training in Cardiac Rehabilitation**

Thibaut Guiraud,<sup>1,2,3</sup> Anil Nigam,<sup>1</sup> Vincent Gremeaux,<sup>1,4,5</sup> Philippe Meyer,<sup>1,6</sup> Martin Juneau<sup>1,7</sup> and Laurent Bosquet<sup>7,8</sup>

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**

**COMO PROCEDER NUMA SESSÃO DE  
TREINAMENTO AERÓBIO**



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO  
CORAÇÃO**

**Partes da Aula**

- **Aquecimento – Preparo Geral**  
5 a 10 minutos – gradual  
Grandes grupos musculares
- **Aeróbia – Melhora Cardiovascular**  
30 a 50 minutos  
Individualizado
- **Localizada – Condição Muscular**  
Resistência Muscular Localizada
- **Alongamento e Relaxamento – Flexibilidade**  
Rotinas de Alongamentos

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**1º PA e FC e BORG**

**ALONGAMENTO OU AQUECIMENTO: 05 MIN.**

**2º PA e FC**

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**RESISTÊNCIA CARDIORRESPIRATÓRIA: 20 A 30MINUTOS (ALTERNANDO COM A INTENSIDADE)**

**PA e FC a cada 5 ou 10 minutos**

**MEDIR 5 MINUTOS APÓS A SESSÃO DO EXERCÍCIO AERÓBIO**

*Medir em todas as sessões nos 3 primeiros meses*

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**RECUPERAÇÃO PASSIVA: 10 MIN**

**5º PA e FC de recuperação e BORG**

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Mecanismos de controle**

- **Variáveis** - FC na faixa de treino  
PA na faixa de treino ou até 180/105 mmHg  
Cansaço subjetivo até CANSATIVO (12 a 16)

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**PA E FC**

1. **ALONGAMENTOS: 05 MIN.**

**PA E FC**

2. **RESISTÊNCIA CARDIORRESPIRATÓRIA: 20 A 30MINUTOS (ALTERNANDO COM A INTENSIDADE)**  
**PA E FC A CADA 5 OU 10 MINUTOS**  
**PA E FC APÓS 5 MINUTOS DO EXERCÍCIO**

3. **EXERCÍCIOS LOCALIZADOS : 15 MINUTOS OU; SESSÃO DE TREINAMENTO DE FORÇA**  
**CONTROLE COM A TABELA DE BORG ( 11 A 14 )**

4. **RECUPERAÇÃO PASSIVA: 10 MIN**

**PA E FC DE RECUPERAÇÃO E BORG**

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**VOLUME:**

**ALONGAMENTOS: 05 MIN.**

**RESISTÊNCIA CARDIORRESPIRATÓRIA: 20 A 30MINUTOS (ALTERNANDO COM A INTENSIDADE)**

**EXERCÍCIOS LOCALIZADOS : 15 MINUTOS OU;**

**SESSÃO DE TREINAMENTO DE FORÇA**

**RECUPERAÇÃO ATIVA: 05 MIN.**

**RECUPERAÇÃO PASSIVA: 05 MIN.**

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**



**PERIODIZAÇÃO**

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA  
ISQUÊMICA DO CORAÇÃO**

MESOCICLO DE (3 meses) ou 12 MICROCICLO  
4 MICROCICLO (por mês) - ( De 03 sessões semanais)

**CAPACIDADE RESPIRATÓRIA:**  
OBJETIVO: AUMENTO DA CAPACIDADE FUNCIONAL  
(CAMINHADA, CORRIDA OU BICICLETA)

**CAPACIDADE NEUROMOTORA:**  
TREINAMENTO DE FORÇA OU GINÁSTICA LOCALIZADA:

**PERIODIZAÇÃO**

Iº OBJETIVO: EQUILÍBRIO, RITMO E COORDENAÇÃO ( 15 DIAS)

IIº OBJETIVO: RML E FORÇA DE TRONCO (15 DIAS)

IIIº OBJETIVO: RML E FORÇA DE MEMBROS INFERIORES (15 DIAS)

IVº OBJETIVO: RML E FORÇA DE MEMBROS SUPERIORES (15 DIAS)

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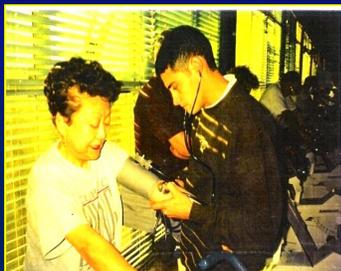
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO  
E DOENÇA ISQUÊMICA DO CORAÇÃO**

**MUDANÇA DE CARGA (AERÓBIO)**



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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**MUDANÇA DE CARGA (AERÓBIO)**

FREQUÊNCIA CARDÍACA: BRADICARDIA CRÔNICA:

PRESSÃO SANGÜINEA ATÉ: 180 SISTÓLICA  
105 DE DIASTÓLICA **NÃO AUMENTA;**

ESCALA DE BORG: 12 PARA CIMA **NÃO AUMENTA;**  
12 MANTÉM;  
ABAIXO DE 12 AUMENTA

**SÓ ALTERA A CARGA QUANDO HOUVER MUDANÇA NAS TRÊS VARIÁVEIS**

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**REAVALIAÇÕES**

- Início
- Três meses de programa
- Seis meses de Programa
- Um ano de programa
- A partir daí:  
Saudáveis – a cada ano  
Cardiopatas – a cada seis meses

(INCOR – HCFMUSP)

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**FASES DO TREINAMENTO**

meses	VO <sub>2</sub> max (ml.kg <sup>-1</sup> .min <sup>-1</sup> )
0	20
3	35
6	45
9	45
12	45

3% por semana no primeiro mês  
2% por semana no segundo mês  
1% por semana depois disso

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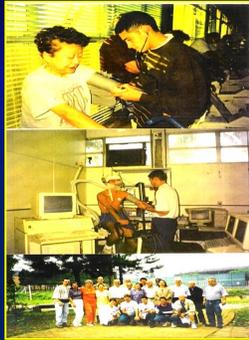
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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**



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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**MODIFICAÇÕES**

- Estruturais
- Funcionais em Repouso
- Funcionais em Exercício



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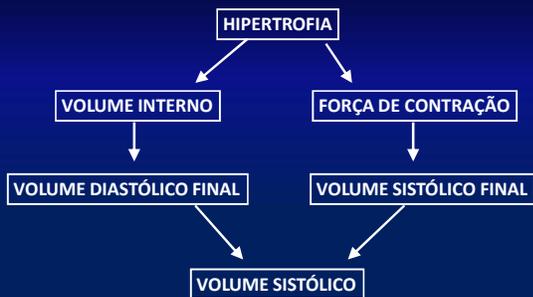
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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**



**EFEITO FUNCIONAL**

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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

O Treinamento físico aeróbio promove que tipo de estímulo?




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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

O Treinamento físico aeróbio promove que tipo de estímulo?




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**Hipertrofia do Ventrículo Esquerdo**



GROSSMAN W. ET AL., (AM J MED 68: 876-884, 1980)  
ROBBIN R. L. ET AL., (PROG CARDIOVASC DIS 27: 371-386, 1988)

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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Regressão da Placa**

Dieta baixa gordura + exercício

- Controle - ↑ 0,13 mm
- Intervenção - → placa
- Intervenção com mais 9204kJ/semana - ↓ placa

Hambrecht et al. JACC 1993; 22:468-77

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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Regressão da Placa**

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- Controle - ↑ 0,13 mm
- **Intervenção** - → placa
- Intervenção com mais 9204kJ/semana - ↓ placa

Hambrecht et al. JACC 1993; 22:468-77

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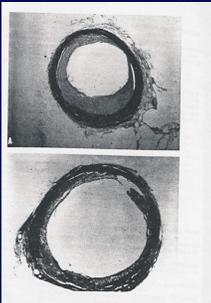
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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**



**Aumento de calibre da coronária**

Kramsch et al. N. Engl. J. Med 305:1483-9, 1981.

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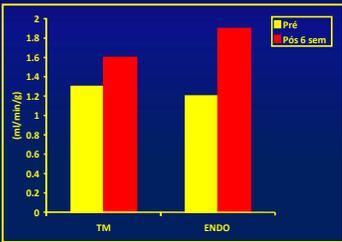
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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Fluxo na Circulação Colateral**



Grupo	Pré	Pós 6 sem
TM	~1.3	~1.6
ENDO	~1.2	~1.8

Heaton et al. Circulation 57:575-81, 1978.

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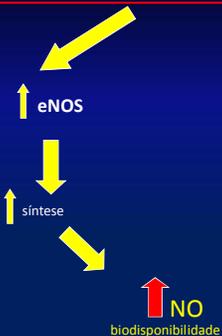
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**EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**



(Kojda e Hambrecht, 2005)

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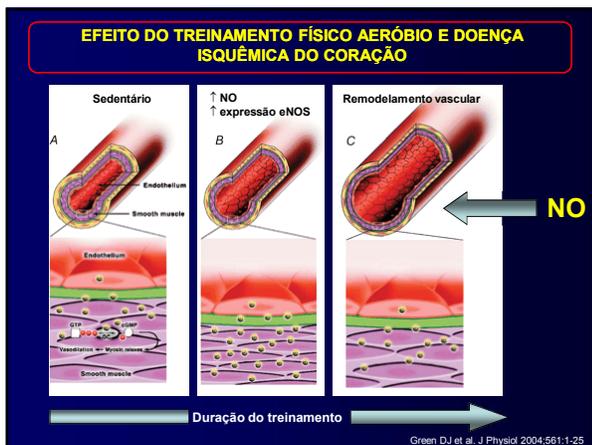
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### EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO

#### Crescimento dos Vasos

- **Horas/dias**
  - Expressão de fatores de crescimento
- **Dias/semanas**
  - Crescimento capilares
- **Semanas/meses**
  - Crescimento de vasos condutores e arteríolas

Fatores envolvidos:  
 Óxido nítrico  
 Células pró-genitoras endoteliais

Linke et al. Progress in Cardio Dis 2006; 48:270-84

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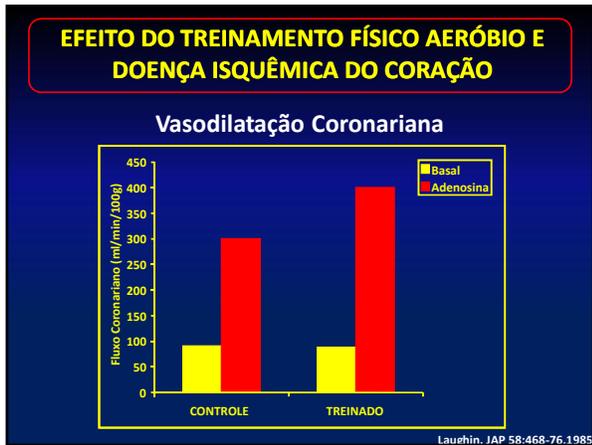
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- ### EFEITO DO TREINAMENTO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO
- #### Treinamento Aeróbio e Circulação Coronariana
- ❖ Regressão da Aterosclerose
  - ❖ Formação de colaterais
  - ❖ Formação de novos vasos
  - ❖ Melhora da função endotelial
- ↑ Fluxo sanguíneo
- ↑ Oferta de sangue
- Linke et al. Progress in Cardio Dis 2006; 48:270-84

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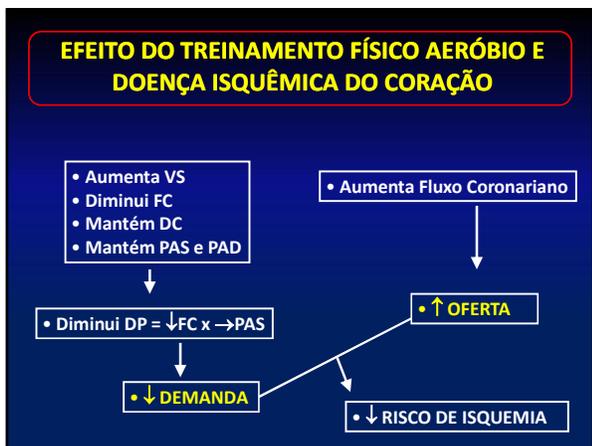
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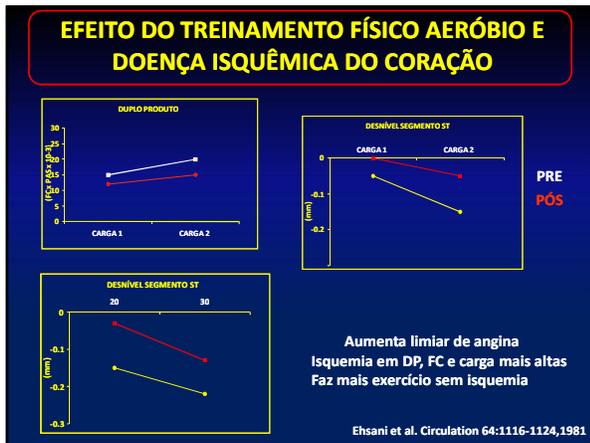
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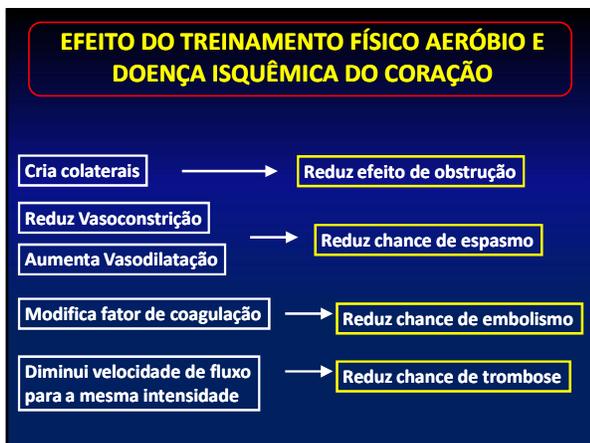
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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO

#### CRITÉRIOS DE EXCLUSÃO:

##### AS CONTRA – INDICAÇÕES:

1. ANGINA ESTÁVEL;
2. ARRITMIAS DESCONTROLADAS;
3. CARDIOMIOPATIA HIPERTRÓFICA COM OBSTRUÇÃO;
4. HISTÓRIA RECENTE DE ICC;
5. DOENÇA VALVAR GRAVE;
6. HIPERTENSÃO DESCONTROLADA (PAS ≥ 160mmHg)  
(PAD ≥ 105mmHg)
7. FUNÇÃO DO VE NORMAL OU MUITO PERTO (FVE > 40%)

(ACSM, 2011)

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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO

#### PRÉ – REQUISITOS PARA PARTICIPAÇÃO

1. FUNÇÃO VENTRICULAR ESQUERDA MODERADA A BOA;
2. CAPACIDADE DE REALIZAR EXERCÍCIO SUPERIOR A 5 MET;
3. SEM SINTOMAS ANGINOSOS OU DEPRESSÃO ISQUÊMICA ST.

O (ACSM, 2008), RECOMENDA QUE ANTES DE COMEÇAR O TF OS PACIENTES CARDÍACOS PODERÃO SER BENEFICIADOS SE PARTICIPAREM PRIMEIRO DE UM ESQUEMA DE EXERCÍCIOS AERÓBIOS POR DUAS SEMANAS OU MAIS;

DEVIDO OCORRER ADAPTAÇÕES CARDIORESPIRATÓRIAS E MUSCULO ESQUELÉTICAS NECESSÁRIAS PARA PROGREDIR PARA UM EXERCÍCIO MAIS INTENSO.

(ACSM, 2011)

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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO



AMERICAN COLLEGE  
of SPORTS MEDICINE

POSITION STAND

Exercise for Patients with  
Coronary Artery Disease

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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO

Resistance exercises generally are performed with a circuit training approach, up to 10–12 exercises using 10–12 repetitions of resistances that can be performed comfortably (22). Cross-training may also help to reduce musculoskeletal problems and increase compliance.

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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO

<b>INTENSIDADE</b>	<b>40 A 50% DE 1RM</b>
<b>SÉRIES</b>	<b>1 A 3 SÉRIES</b>
<b>REPETIÇÕES</b>	<b>8 A 15</b>
<b>EXERCÍCIOS</b>	<b>8 A 10</b>
<b>RECUPERAÇÃO</b>	<b>30 A 60 SEG</b>
<b>FREQUÊNCIA</b>	<b>3 A 5 SEMANA</b>
<b>FORMA</b>	<b>CIRCUITO OU MAQUINAS</b>



**PRESCRIÇÃO DO EXERCÍCIO PARA PACIENTES CARDÍACOS**  
**AMERICAN COLLEGE OF SPORTS MEDICINE (ACSM, 2011)**

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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO

#### ALGUMAS RECOMENDAÇÕES

- PODE SE UTILIZAR FAIXAS ELÁSTICAS, PESOS LEVES (0,45 A 2,3KG) DE MANEIRA PROGRESSIVA;
- O TF DE BAIXO NÍVEL (USO DE CINTAS ELÁSTICAS E DE PESOS MUITO LEVES NAS MÃOS) DEVE SER INICIADO 2 A 3 SEMANAS APÓS UM INFARTO DO MIOCÁRDIO (FASE II);
- EM GERAL 4 A 6 SEMANAS APÓS O EVENTO PODERÃO SER INICIADOS OS HALTERES REGULARES E OU AS MÁQUINAS COM PESOS
- (FASE II E FASE III) - MÁQUINAS

(ACSM, 2011)

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**PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Prescrição:**

- **Série** – 1
- **Exercícios** – 8 a 10
  - Envolver grandes grupos da parte superior e inferior
  - Alternar exercício para superiores e inferiores
- **Intensidade** – por volta de 50% de 1RM
  - 30 a 40% de 1RM para membros superiores
  - 50 a 60% de 1RM para membros inferiores
- **Repetições** – 10 a 15 até FADIGA MODERADA
  - Cansaço 11 a 14 (meio leve a um pouco cansativo)
  - Prática: - Fez 15 movimentos com facilidade – aumenta Evidência de apnéia com 10 repetições – diminui
- **Pausas** – longas – 1 a 2 min

Williams, 2007 - AHA

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**PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

*Treinamento resistido deve ser realizado:*

- **Progressão**
  - Quando atinge limite superior confortavelmente
  - aumentar 5% na carga
  - 1 a 2 kg – mmss (2 a 5 lb)
  - 2 a 4 kg – mmii (5 a 10 lb)
- **Execução Adequada**
  - Maneira rítmica com velocidade moderada e controlada
  - Por toda a amplitude de movimento
  - Respiração -       expiração durante a contração  
                          inspiração no relaxamento
  - Evitar apnéia, valsava e isometria
- **Avaliação:** 1RM melhor que 8 ou 10RM
- **Material** – elásticos, pesos pequenos, máquinas

(AHA, 2007)

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**PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

ARTICLE IN PRESS

PROGRESS IN CARDIOVASCULAR DISEASES XX (2014) XXX-XXX

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

**ScienceDirect**

[www.onlinepcd.com](http://www.onlinepcd.com)

**ELSEVIER**

**Exercise Training in Patients with Heart Disease: Review of Beneficial Effects and Clinical Recommendations**

Stephan Gielen<sup>a,\*</sup>, M. Harold Laughlin<sup>b</sup>, Christopher O'Conner<sup>c</sup>, Dirk J. Duncker<sup>d</sup>

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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO

- ✓ Resistance training
- ✓ Exercise training can be started early in-hospital
- ✓ Programs should last 2-4 weeks for in-patient or up to 12 weeks for out-patient settings
- ✓ Upper-body training can begin when the sternal wound is stable

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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO



Progress in Cardiovascular Diseases 53 (2011) 397-403  
www.onlinepcd.com

#### Cardiac Rehabilitation and Exercise Training in Secondary Coronary Heart Disease Prevention

Carl J. Lavie\*, Richard V. Milani

*Department of Cardiovascular Diseases, John Ochsner Heart and Vascular Institute, Ochsner Clinical School-The University of Queensland School of Medicine, New Orleans, LA 70121*

Lavie & Milani, Progress in Cardiovascular Diseases (2011)

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### PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO

Exercise prescription in primary and secondary coronary prevention  
Reproduced from Lavie et al<sup>2</sup>

#### Mode

Resistance training: moderate intensity (should not be straining on last repetitions)

Resistance training: hand weights, elastic bands, weight machines, calisthenics

Lavie & Milani, Progress in Cardiovascular Diseases (2011)

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**PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

<b>INTENSIDADE</b>	<b>50% DE 1RM BORG – 11 A 14 (MEIO LEVE A UM POUCO CANSATIVO)</b>
<b>SÉRIES</b>	<b>1 SÉRIE</b>
<b>REPETIÇÕES</b>	<b>10 A 15 ATÉ FADIGA MODERADA</b>
<b>EXERCÍCIOS</b>	<b>8 A 10</b>
<b>RECUPERAÇÃO</b>	<b>30 A 60 SEG</b>
<b>FREQÜÊNCIA</b>	<b>3 A 5 SEMANA</b>
<b>FORMA</b>	<b>CIRCUITO OU MÁQUINAS</b>

**PRECAUÇÕES: EVITAR VALSALVA OU APNÉIA;  
EVITAR ISOMETRIA;  
REVASCULARIZADOS – EVITAR MOVIMENTO DO TÓRAX 3 MESES  
CHECAR A ESTABILIDADE DO ESTERNO** (FORJAZ, 2006)

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**Weightlifting training in cardiac patients. Considerations. McKelvie RS, McCartney N. Sports Med. 1990 Dec;10(6):355-64.**

Cardiovascular disease is the leading cause of morbidity and mortality in most of the industrialised nations in the world. Many treatment strategies are used for patients with coronary artery disease. One of these strategies is the use of cardiac exercise rehabilitation. The traditional approach to cardiac exercise rehabilitation has been the training of large muscle groups using aerobic activities such as cycling or walking. These types of activities have been demonstrated to improve maximal exercise performance and endurance. However, although aerobic performance is improved it does not address another very important component of exercise rehabilitation—namely muscular strength. Weightlifting training has been demonstrated to improve muscular strength in healthy individuals. Until recently this form of exercise training of patients with cardiac disease has been avoided due to the haemodynamic response observed during isometric (static) exercise. Weightlifting has recently been demonstrated not to be a pure isometric exercise and a different haemodynamic response has been found even in patients with cardiac disease. For this reason studies of weightlifting training have been performed in selected groups of patients with coronary artery disease. The results of these studies in this limited group of patients have demonstrated the activity is safe and beneficial in terms of improving the patient's functional capacity. Weightlifting training may also favourably affect the risk factors for coronary artery disease.

**Based on studies reviewed in this paper, recommendations can be made for the weightlifting training of patients with coronary artery disease. These include restriction to patients who are asymptomatic or only mildly symptomatic; initiation of training only after a period of aerobic training; the use of single limb activities; a maximum intensity no greater than 60% of 1 repetition maximum; patients train at their own rate; initially performed in a medically supervised programme; periodic reassessment of the exercise prescription; and patients should record their heart rate and response to exercise.**

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**PRESCRIÇÃO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

**"...clinically acceptable range at 40% and 60% of 1 RM."**

Haslam DR, McCartney SN, McKelvie RS, MacDougall JD. Direct measurements of arterial blood pressure during formal weightlifting in cardiac patients. J Cardiopulm Rehabil. 1988;8:213-225.

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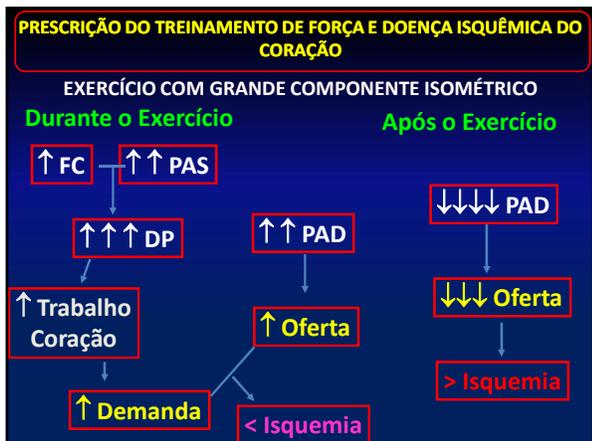
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**EFEITO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

**MENOR RISCO DE ISQUEMIA**

**ISOMÉTRICO**  
Isquemias:  
• Isométrico braço 50% 1 min- nenhuma  
• Isotônico de braço máximo - 7 pacientes

Adaptado de DeBusk et al. Circulation 58: 368-75, 2000

**RESISTIDO**  
40 e 70% 1RM  
- sem isquemia  
- sem arritmias  
-- sem disfunção ventricular

Haslam et al. J. Cardiop. Rehabil. 8:213-25, 1988

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**EFEITO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

- MENOR AUMENTO NO DUPLO PRODUTO
- MENOR CHANCE DE ISQUEMIA
- MAIS SEGURO

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**EFEITO DO TREINAMENTO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

**PICO da PA AO LONGO DA SÉRIE**

Repetição	DAC (mmHg)	Leg-press (mmHg)
R	~180	~100
1	~185	~110
2	~180	~105
3	~185	~110
4	~190	~115
5	~195	~120
6	~200	~125
7	~205	~130
8	~210	~135
9	~215	~140
10	~220	~145

**DAC**  
Leg-press  
80% CVM  
10 rep  
Sem fadiga  
Medicados

FC =  $116 \pm 6$  bpm e PAS =  $215 \pm 7$  mmHg  
DP =  $249 \pm 12$  mmHg.bat.min<sup>-1</sup>.10<sup>2</sup>  
Teste máximo =  $247 \pm 11$  mmHg.bat.min<sup>-1</sup>.10<sup>2</sup>

Haslam et al. J. Cardiop. Rehabil. 8:213-25, 198

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**RESPOSTA AGUDA DO TREINO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO**

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### Physiologic Responses to Weight Lifting in Coronary Artery Disease

Featherstone, J.F. et al., Am J Cardiol 1993;71:257-292)

- 12 homens (34 a 68 anos de idade)
- 7 tinham infarto
- 2 tinham bypass
- 1 tinha infarto e bypass
- 2 angina
- Todos estavam medicados
- Todos já participavam de reabilitação

- Teste máximo em esteira
- Teste até a fadiga máxima em 40%, 60%, 80% e 100% da CVM
- PA e FC medidos

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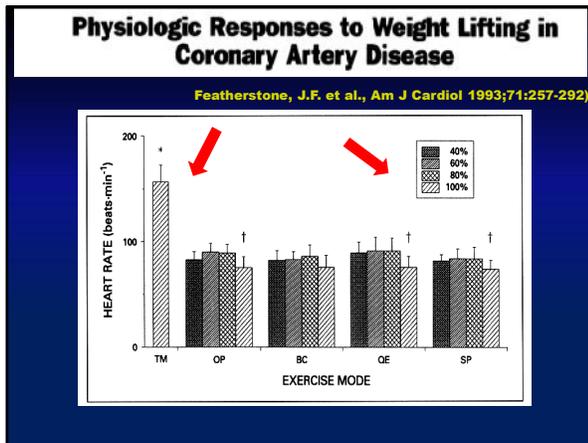
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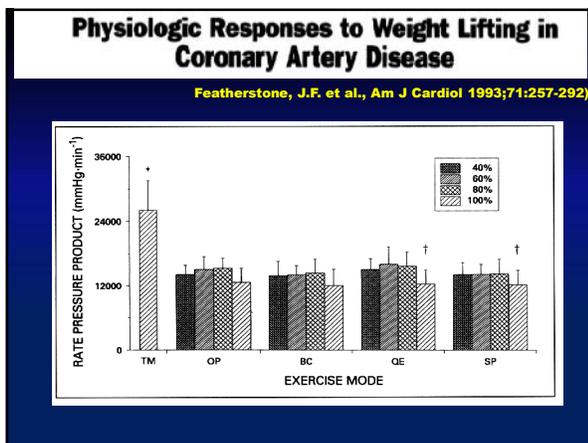
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### Physiologic Responses to Weight Lifting in Coronary Artery Disease

Featherstone, J.F. et al., Am J Cardiol 1993;71:257-292

- O exercício dinâmico de força não promoveu respostas cardiovasculares exacerbadas quando comparado a um teste máximo em cardiopatas
- O exercício de maior intensidade (1 RM) promoveu menor aumento da frequência cardíaca e duplo produto.

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### EFEITO CRÔNICO DO TREINO DE FORÇA E DOENÇA ISQUÊMICA DO CORAÇÃO



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### Resistance Training on Physical Performance in Disabled Older Female Cardiac Patients

Ades, P.A. et al. Med. Sci. Sports Exerc., 35:1265-1270, 2003

#### Treinamento de força :

42 mulheres com DAC (65 a 88 anos)

- 3 x na semana (6 meses)
- 1 série com 10 repetições (aumento para 2 séries)
- 50% de 1 RM e após 2 semanas foi para 80% de 1 RM
- 1) leg extensions (**quadriceps**); 2) leg press (**gluteals, quadriceps**); 3) leg curls (**hamstrings**); 4) shoulder press (**deltoids, triceps**); 5) arm curls (**biceps**); 6) lateral pull-down (**latissimus, biceps**); 7) bench press (**pectorals**); and 8) tricep extension (**triceps**)

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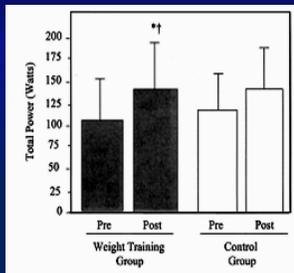
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### Resistance Training on Physical Performance in Disabled Older Female Cardiac Patients

Ades, P.A. et al. *Med. Sci. Sports Exerc.*, 35:1265-1270, 2003



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### PRESCRIÇÃO DE EXERCÍCIO FÍSICO E HIPERTENSÃO ARTERIAL

## HOT TOPIC

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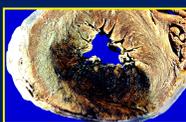
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### PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO

## HIIT



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### PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO

VN Smodlaka: *Interval Training in Rehabilitation Medicine Arch Phys Med Rehabil 54: 428-431, 1973*

Work/Rest=30s/30s

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### PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO

Katharina Meyer, Ph.D.

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### Hierarquia da evidência

World Health Organization | Patient Safety | ePORTUGUÊSe

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

Clin. Cardiol. 13, 851-861 (1990)

**Interval Versus Continuous Exercise Training After Coronary Bypass Surgery: A Comparison of Training-Induced Acute Reactions with Respect to the Effectiveness of the Exercise Methods**

K. MEYER, Ph.D., M. LEHMANN, M.D.,\* G. SÜNDER,† J. KEUL, M.D.,\* H. WEIDEMANN, M.D.  
Theresien-Klinik, Bad Krozingen,\*Medical University Hospital, Freiburg, †University Hospital Freiburg (Biostatistics), Freiburg, Federal Republic of Germany

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**K Meyer et al.: Interval vs Continuous Exercise Training After CABGS: A Comparison of Training Induced Acute Reactions with Respect to the Effectiveness of the Exercise Methods**  
*Clin Cardiol* 13: 851-861, 1990

- Uncomplicated Post (3-4 wk) CABGS Patients
- 60s/60s
- INT
  - 0.27-1.19 W/kg
  - 0.27-1.46 W/kg
  - 0.27-1.66 W/kg
- CONT
  - 0.77 W/kg
  - 0.95 W/kg
  - 1.09 W/kg

People got stronger!!!

Training Method	Power Output (W/kg)	Change
Continuous	~1.2	-
Interval	~1.45	+21%

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

(Am J Cardiol 2005;95:1080-1084)

**Effectiveness of High-Intensity Interval Training for the Rehabilitation of Patients With Coronary Artery Disease**

Darren E.R. Warburton, PhD, Donald C. McKenzie, MD, PhD, Mark J. Haykowsky, PhD, Arlana Taylor, PT, Paula Shoemaker, MSc, Andrew P. Ignaszewski, MD, and Sammy Y. Chan, MD

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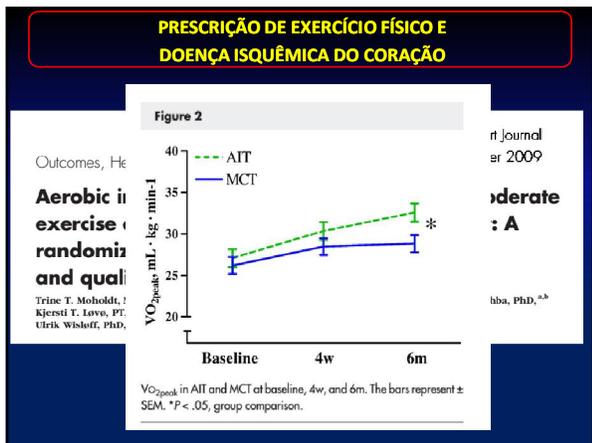
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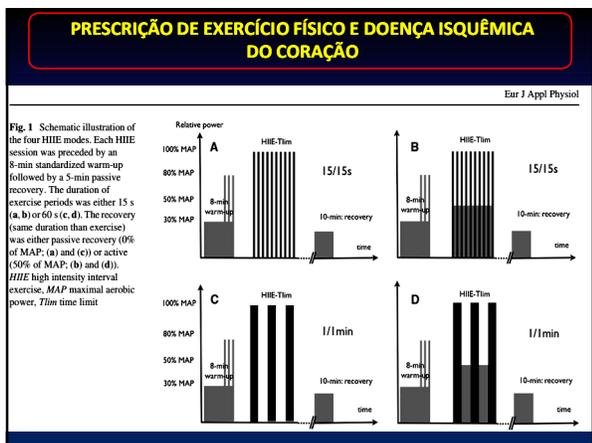


### PRESCRIÇÃO DE EXERCÍCIO FÍSICO E CARDIOPATIAS

**TABLE 1**

Variable	END		HIT	
	Pre	Post	Pre	Post
<b>Resting hemodynamics</b>				
Resting SBP (mm Hg)	124 ± 17	118 ± 19	124 ± 16	121 ± 9
Resting DBP (mm Hg)	75 ± 10	68 ± 10*	81 ± 11	79 ± 10*
Resting HR (bpm)	55 ± 10	52 ± 8*	60 ± 7	57 ± 6*
<b>FMD indices</b>				
Pre-occlusion EDD (mm)	4.30 ± 0.75	4.32 ± 0.75	4.52 ± 0.70	4.52 ± 0.60
Peak RH BF (ml·min <sup>-1</sup> )	295 ± 189	247 ± 115	322 ± 129	346 ± 133
AUC	16,697 ± 12,639	14,021 ± 9,509	13,366 ± 13,197	18,720 ± 11,868
Time to peak RH (s)	62 ± 28	68 ± 25	59 ± 32	66 ± 34
<b>NTG indices</b>				
Pre-NTG EDD (mm)	4.38 ± 0.63	4.39 ± 0.51	4.48 ± 0.54	4.50 ± 0.65
Time to peak NTG (min)	7 ± 2	8 ± 2	7 ± 1	8 ± 2

Data are presented as mean ± SD. NTG measurements, n = 21 (END = 10, HIT = 11). \*P < 0.01 versus pretraining. DBP, diastolic blood pressure; EDD, end-diastolic diameter; BF, blood flow; NTG, nitroglycerin; RH, reactive hyperemia; SBP, systolic blood pressure.



**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

REVIEW ARTICLE Sports Med 2012; 42 (7): 587-605  
0112-1642/12/0007-0587\$49.95/0  
© 2012 Springer International Publishing AG. All rights reserved.

### High-Intensity Interval Training in Cardiac Rehabilitation

Thibaut Guiraud,<sup>1,2,3</sup> Anil Nigam,<sup>1</sup> Vincent Gremeaux,<sup>1,4,5</sup> Philippe Meyer,<sup>1,6</sup> Martin Juneau<sup>1,7</sup> and Laurent Bosquet<sup>7,8</sup>

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

### Efeitos Agudos fisiológicos da recuperação passiva no HIIT na DAC

- ↑ Reoxigenação
- ↑ Restauração mais rápida da PCr
- ↑ Ressíntese de PCr
- ↓ Dispneia
- ↓ Fadiga
- ↓ Índice de percepção de esforço
- Não provoca dano endotelial

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

### Efeitos Crônicos fisiológicos da recuperação passiva no HIIT na DAC

- ↑ Pico de Potência
- ↑ VO<sub>2</sub> pico
- ↑ Função Diastólica
- ↑ Fração de Ejeção
- ↑ Melhora Função Endotelial
- ↑ Qualidade de Vida
- ↓ Sobrecarga Cardíaca
- ↓ Inflamação
- ↓ FC de Recuperação

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

This type of exercise thus appears to be attractive and cost effective. However, one must bear in mind that even if HIIT has become increasingly popular, it has until now been studied only in a small selection of stable cardiac patients, mainly male CAD with high exercise capacity or

Até agora só foi estudada em uma pequena seleção de pacientes cardíacos estáveis, principalmente com DAC do sexo masculino e com alta capacidade de exercício

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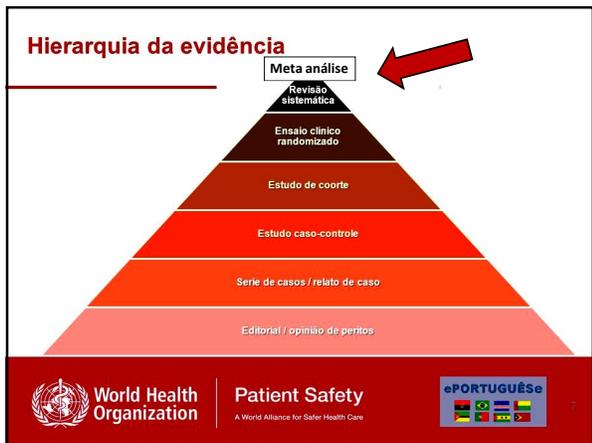
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E CARDIOPATIAS**

**The Role of Exercise Interval Training in Treating Cardiovascular Disease Risk Factors**

Conrad Earnest, PhD Current Cardiovascular Risk Reports 2009, 3:296-301

Intuitively, interval training might best be used after an initial preparatory period of traditional aerobic training. With more complicated conditions, it is equally intuitive that exercise supervision be provided by those who are well skilled in the practice of exercise prescription and are capable of providing adequate oversight for those with complex conditions.

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Conclusions**

When compared to traditional aerobic training, high-intensity INTERVAL appears to be a more effective option than CONTINUOUS for increasing aerobic capacity in patients with stable CAD in the absence of any disclosed heart failure, despite minimal or no effect on other cardiovascular risk factors.

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

Weston KS, et al. *Br J Sports Med* 2014;**48**:1227–1234.

Review

High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis

Kassia S Weston,<sup>1</sup> Ulrik Wisloff,<sup>2</sup> Jeff S Coombes<sup>1</sup>

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

Study	Box 1 Adaptations occurring significantly more with HIIT compared to MICT
Freyssin (2)	▶ ↑VO <sub>2</sub> peak
Fu (2011)	▶ ↓Systolic and diastolic blood pressure
Iellamo (2)	▶ ↑High density lipoproteins
Moholdt (2)	▶ ↓Triglycerides and fasting glucose
Molmen-H	▶ ↓Oxidative stress and inflammation
Roditis (2)	▶ ↓FATP-1 and FAS
Rognmo (2)	▶ ↑Adiponectin, insulin sensitivity and β-cell function
Shjerve (2)	▶ ↑PGC-1α
Tjonna (2)	▶ ↑Maximal rate of Ca <sup>2+</sup> reuptake
Wisloff (2)	▶ ↑Availability of nitric oxide
<b>Total (95%)</b>	▶ ↑Cardiac function
Heteroge	▶ ↑Enjoyment of exercise
Test for c	▶ ↑Quality of life

FATP-1, fatty acid transport protein 1; FAS, fatty acid synthase; HIIT, high-intensity interval training; MICT, moderate-intensity continuous training

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**




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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

Box 2 Suggested contraindications to high-intensity interval training (HIIT)

- ▶ Unstable angina pectoris
- ▶ Uncompensated heart failure
- ▶ Recent myocardial infarction (<4 weeks)
- ▶ Recent coronary artery bypass graft or percutaneous coronary intervention (<12 months)
- ▶ Heart disease that limits exercise (valvular, congenital, ischaemic and hypertrophic cardiomyopathy)
- ▶ Complex ventricular arrhythmias or heart block
- ▶ Severe chronic obstructive pulmonary, cerebrovascular disease or uncontrolled peripheral vascular disease
- ▶ Uncontrolled diabetes mellitus
- ▶ Hypertensive patients with blood pressure >180/110 (or uncontrolled)
- ▶ Severe neuropathy

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Table 2 Protocol recommendations for HIIT**

Frequency	3x/Week
Duration	40 min
Modality	Treadmill/hill, cycle ergometer. Increasing speed or incline
Intensity	Interval=85–95% PHR Rest=passive–70% PHR
Interval times	4x4 min intervals 3x3 min recovery
Warm-up	10 min at 60% PHR
Cool-down	5 min at 50% PHR

HIIT, homeostasis model assessment-insulin resistance; PHR, peak heart rate.

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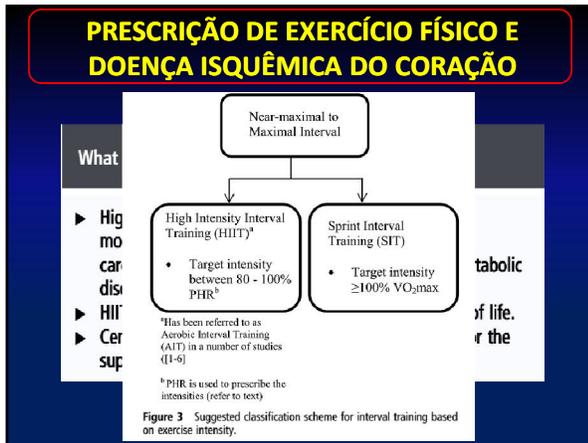
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### PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO

*Uma pergunta....*

*Já se encontra nas diretrizes?*

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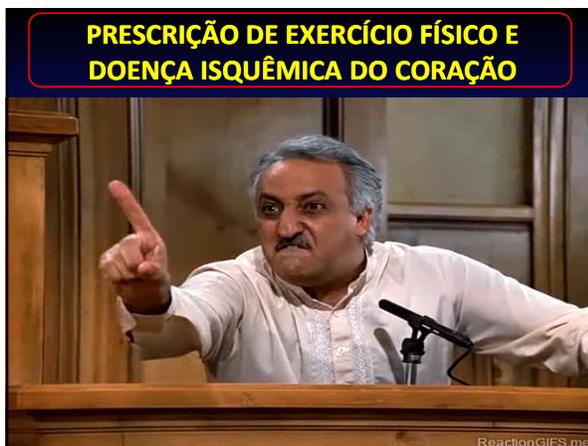
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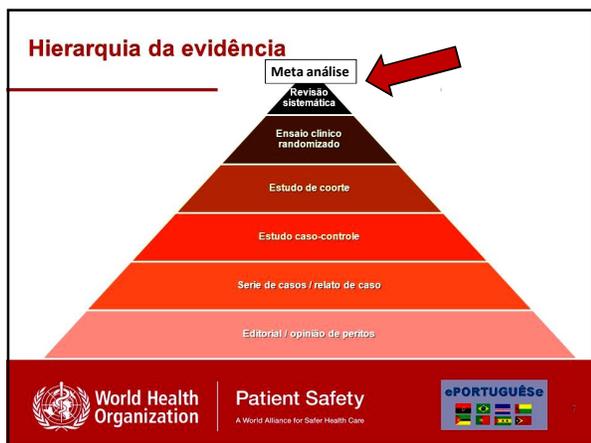
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## PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO

### Subjects

We included 4846 patients (male, 70%; female, 30%) who were referred to an exercise-based cardiac rehabilitation program at 3 different rehabilitation units in Norway between 2004 and 2011. Mean age was 57.8 years. All CHD patients taking part in this survey were enrolled at the rehabilitation units, and the total number of high- and moderate-intensity exercise sessions was registered. The patients were referred to the rehabilitation units by their general practitioner or hospital cardiologist, and their main admission diagnoses included myocardial infarction (7%), angioplasty (40%), coronary surgery (35%), valve surgery (11%), and heart failure (7%).

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## PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO

**Table 1. The Number of Patients, Exercise-Hours, and the Corresponding Number of Cardiovascular Events Associated With Moderate- and High-Intensity Exercise, Respectively**

Center	Patients, n	Total Training, h	Moderate Intensity, h	High Intensity, h
Ålesund	775	25 720 (1)	15 232	10 488 (1)
Feiring	2629	85 208 (2)	63 032 (1)	22 176 (1)
Roros	1442	64 892	51 192	13 700
<b>Total</b>	<b>4846</b>	<b>175 820</b>	<b>129 456</b>	<b>46 364</b>
<b>Event rates</b>				
Cardiac arrest, fatal			1	0
Cardiac arrest, nonfatal			0	2
Myocardial infarction			0	0
<b>Risk of events</b>		<b>1/58 607</b>	<b>1/129 456</b>	<b>1/23 182</b>

The numbers in parentheses indicate the number of events in each center according to intensity.

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**




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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

(Circulation. 2012;126:1436-1440.)

**Exercise Physiology**

**Cardiovascular Risk of High- Versus Moderate-Intensity Aerobic Exercise in Coronary Heart Disease Patients**

Øivind Rognmo, PhD; Trine Moholdt, PhD; Hilde Bakken, BSc; Torstein Hole, MD, PhD; Per Mølsted, MD, PhD; Nils Erling Myhr, BSc; Jostein Grimsmo, MD, PhD; Ulrik Wisløff, PhD

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Table 1. The Number of Patients, Exercise-Hours, and the Corresponding Number of Cardiovascular Events Associated With Moderate- and High-Intensity Exercise, Respective**

Center	Patients, n	Total Training, h	Moderate Intensity, h	High Intensity, h
Ålesund	775	25 720 (1)	15 232	10 488 (1)
Feiring	2629	85 208 (2)	63 032 (1)	22 176 (1)
Roros	1442	64 892	51 192	13 700
Total	4846	175 820	129 456	46 364

**Event rates**

Cardiac arrest, fatal		1	0
Cardiac arrest, nonfatal		0	2
Myocardial infarction		0	0
<b>Risk of events</b>	<b>1/58 607</b>	<b>1/129 456</b>	<b>1/23 182</b>

The numbers in parentheses indicate the number of events in each center according to intensity.

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training interventions are generally low.<sup>16,27,46</sup> However, it has recently been reported that the rates of complications (cardiac arrest) during and immediately post-HIIE training was 1 per 23,182 hours compared to 1 per 129,456 hours of moderate-intensity exercise, suggesting a five times higher rate of cardiac arrest during HIIE compared to that during MICE.<sup>28</sup>

sugerindo uma taxa cinco vezes maior de parada cardíaca durante HIIT em comparação com que durante MICE

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ESTÁGIO	TEMPO	FC (BPM)	PS (mmHg)	PD (mmHg)
PRÉ ESFORÇO	00:00	63	145	75
2 . 0MPH-0%	01:00	83	145	75
3 . 0MPH-0%	02:00	87	145	75
4 . 0MPH-0%	03:00	105	150	75
4 . 0MPH-2%	04:00	115	150	75
4 . 0MPH-4%	05:00	125	165	75
+ 4 . 0MPH-6%	06:00	136	165	75
4 . 0MPH-8%	07:00	145	160	80
4 . 0MPH-10%	08:00	152	145	75
4 . 0MPH-10%	08:00	151	145	75
RECUPERAÇÃO	01:00	132	140	70
RECUPERAÇÃO	02:00	115	145	70
RECUPERAÇÃO	04:00	100	145	70
RECUPERAÇÃO	06:00	96	140	70
RECUPERAÇÃO	08:00	95	130	70
RECUPERAÇÃO	10:00	87	130	70

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**CARDIOPATA COM TESTE POSITIVO**

**Limiar de Isquemia**

**FC – em que ocorre a isquemia**

Acima desse nível → Aumenta Risco Cardiovascular

**NÃO ULTRAPASSAR O LIMIAR**

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

**Circulation**  
Journal of the American Heart Association

**Exercise Standards for Testing and Training: A Statement for Healthcare Professionals From the American Heart Association**  
 Gerald F. Fletcher, Gary J. DiIulio, Ezra A. Amsterdam, Bernard Chaitman, Robert Eckel, Jerome Fleg, Victor F. Froelicher, Arthur S. Leon, Ilana L. Pina, Roxanne Rodney, Denise A. Simons-Morton, Mark A. Williams and Terry Bazzone

Circulation. 2001;104:1694-1740  
 doi: 10.1161/hc3901.095960  
 Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75221  
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 Print ISSN: 0009-7322. Online ISSN: 1524-4539

methodology (40% to 60% of  $\dot{V}O_{2\max}$ ), but with the designated heart rate and work rate below the identified threshold of ischemia (ie, angina and/or  $\geq 1$  mm ischemic ST segment depression on the exercise test). In general, the heart rate prescription should be a minimum of 10 beats/min below the heart rate at which the abnormality occurs.

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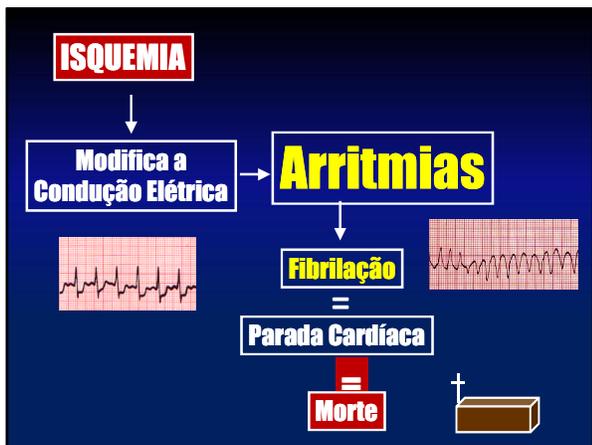
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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO AERÓBIO E DOENÇA ISQUÊMICA DO CORAÇÃO**

REVIEW ARTICLE

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**High-Intensity Interval Training in Cardiac Rehabilitation**

Thibaut Guiraud,<sup>1,2,3</sup> Anil Nigam,<sup>1</sup> Vincent Gremeaux,<sup>1,4,5</sup> Philippe Meyer,<sup>1,6</sup> Martin Juneau<sup>1,7</sup> and Laurent Bosquet<sup>7,8</sup>

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**PRESCRIÇÃO DE EXERCÍCIO FÍSICO E  
DOENÇA ISQUÊMICA DO CORAÇÃO (DIC)**

**DÚVIDAS ?**

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