

# **ACUTE MYOCARDIAL INFARCTION AND PREGNANCY:**

**Clinical profile, Treatment and Outcome**

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# INTRODUCTION

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- Acute MI in women during the child bearing age is rare.
- Pregnancy however, has been shown to increase the risk of AMI 3-4 folds.
- With the continuing trend of childbearing at older age it is expected that AMI occurrence will increase.

# INTRODUCTION

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- Early reports have indicated a high maternal mortality and fetal loss associated with pregnancy related AMI.
- The last decade however, has witnessed major changes in both diagnosis and therapy of AMI and improved outcome in nonpregnant patients.
- These changes may have affected pregnant patients as well.

# STUDY OBJECTIVES

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The purpose of this study was to characterize the clinical profile of patients who developed pregnancy related AMI in the current era.

# METHODS

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- A literature search for pregnancy related AMI reported between 1995 and 2005 using MEDLINE was performed.
- All original articles were obtained from either the libraries of the Universities of Tel Aviv, Israel or Southern California, interlibrary communication, or the authors of the articles.
- Medical translators were used to translate all original articles written in languages other than English.

# METHODS

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- Only cases of AMI documented by chest pain , standard ECG criteria, typical enzymatic changes or histological findings in those who died, were selected for review.
- Data were analyzed for the entire group as well as for the following subgroups:
  - 1 Antepartum (Up to 24 h before labor).
  - 2 Peripartum (Within 24 h before and after delivery).
  - 3 Postpartum (From 24h to 3 mo after delivery).

# PATIENT POPULATION

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- A total of 103 cases were included in our analysis. Of these 98 cases were published in the world literature and 5 patients were cared by or referred to the authors.
- Data were compared to those of 125 patients diagnosed between 1922 and 1995 included in our previous review (Roth et al. *Ann Intern Med* 1996).

# Clinical profile of 103 Patients with Pregnancy Related AMI Diagnosed Between 1995 and 2005

## Demographics and Risks Factors

Demographics	Age range (yrs)	19 - 44
	Mean Age (yrs)	33±5
	Older than 30 yrs	70%
	Older than 40 Years	15%
	Multiparous	60%
	Anterior MI	78%
Risk Factors	Hypertension	15%
	Diabetes	11%
	Smoking	40%
	Family Hx of AMI	22%
	Hyperlipidemia	27%

# Clinical profile of 103 Patients with Pregnancy Related AMI Diagnosed Between 1995 and 2005

## Demographics and Risks Factors

### Coronary Anatomy

Coronary anatomy available	93%
Atherosclerosis	43%
Thrombus	8%
Dissection	29%
Spasm	2%
Embolus	2%
Normal	14%

# Clinical profile of 103 Patients with Pregnancy Related AMI Diagnosed Between 1995 and 2005 Demographics and Risks Factors

## Treatment and Outcome

Elective C- Section	19%
Urgent/Emergent C-section	19%
Heart Failure/Cardiogenic Shock	9%
Thrombolytic Therapy	9%
PCI	42%
Maternal Mortality	11%
Fetal Mortality	9%

# Selected Data on 103 Patients With Pregnancy Related AMI according to the Time of Presentation

Variable	Antepartum (N=46)	Peripartum (N=22)	Postpartum (N=35)
Mean Age (years)	33±6	32 ±5	32 ±5
Anterior MI	73%	73%	<b>87%</b>
Coronary Anatomy			
Available	89%	95%	97%
Atherosclerosis	<b>61%</b>	29%	29%
Dissection	12%	<b>50%</b>	35%
Thrombus	5%	4%	<b>15%</b>
Normal	15%	14%	12%
CHF/Cardiogenic Shock	4%	14%	11%
Maternal Mortality	9%	<b>18%</b>	9%
Fetal Mortality	11%	1%	0%

## Comparison of Patients with Pregnancy Related AMI Diagnosed Prior to and Since 1995

Variable	1922-1995	1995-2005	P-Value
Age range (yrs)	13-45	19-44	---
Mean age $\pm$ SD (yrs)	33 $\pm$ 6	33 $\pm$ 5	1.0
Anterior MI	73%	78%	0.42
Multiparous	84%	66%	<0.01

## Comparison of Patients with Pregnancy Related AMI Diagnosed Prior to and Since 1995

Variable	1922-1995	1995-2005	P-Value
Hypertension	19%	15%	0.35
Diabetes	5%	11%	0.93
Smoking	26%	45%	<0.01
Family Hx of AMI	8%	22%	<0.01
Hyperlipidemia	2%	24%	<0.01

## Comparison of Patients with Pregnancy Related AMI Diagnosed Prior to and Since 1995

Variable	1922-1995	1995-2005	P-Value
C- Section Delivery	26 %	38 %	<0.05
Thrombolytic Tx	12 %	19 %	0.14
PCI	2 %	42 %	<0.01
CHF/ Cardiogenic shock	20 %	9 %	<0.05
Maternal Mortality	21 %	11 %	<0.05
Fetal Death	13 %	9 %	<0.05

# SUMMARY

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- Pregnancy related AMI can occur in women at a wide range of ages but is more common (>70%) in patients >30 years of age.
- The location of AMI in pregnancy is mostly anterior (78%).
- Coronary dissection is a common cause for pregnancy related AMI , especially in the peripartum (50%) and postpartum (35%) periods.

# SUMMARY Cont.

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- Evidence of atherosclerotic CAD is found mostly in women with antepartal AMI.
- Angiographically normal coronary anatomy was relatively common and found in ~ 15% of cases regardless of the timing of AMI.
- A finding of coronary thrombus without evidence of atherosclerotic CAD was found in 8% of all patients and in 15% of cases with postpartal AMI.

# SUMMARY Cont.

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- A comparison between patients with pregnancy related AMI diagnosed before and after 1995 revealed the following findings :
  1. A significantly higher incidence of invasive diagnostic procedures as well as reperfusion therapy either with thrombolysis or PCI.
  2. A significantly lower rate of heart failure or cardiogenic shock as well as mortality.

# Conclusions

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- In comparison with cases of pregnancy related AMI reported prior to 1995 , those reported in the last decade have shown a marked improvement of both maternal and fetal outcome.
- The use of invasive diagnostic approach and reperfusion therapy has increased significantly in the current era in pregnancy related AMI and is a possible reason for improved outcome.

**Many thanks for your attention**



# Additional comments

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The management of pregnant women with AMI and its complications should in general, follow the usual standard of care, although maternal and fetal considerations may affect the choice of therapy.

Ideally, the patient should be treated in an intensive care unit that is capable of providing maternal monitoring along with comprehensive obstetric service.

A plan for prompt rescue of a potentially viable fetus in the case of sudden maternal deterioration should be established.

# Ethiology

**Atherosclerosis** with or without intracoronary thrombus was found in 43% & definite or probable coronary thrombus without evidence of atherosclerotic disease was present in 8%.

**Coronary thrombosis may be explained by:**

**Profound alterations in the coagulation and fibrinolytic system** (decreased releasable tissue plasminogen activator (t-PA) increased fast-acting t-PA inhibitor A significant further activation of the thrombotic system as indicated by an increase in the level of plasma alpha 2-plasmin inhibitor – plasmin complexes occurs at the time of separation of the placenta, change in the level of coagulation factors & reduction in functional protein S levels

**Lack of prostacycline synthesis-stimulating plasma factor and elevated lipoproteine (a)**

**Cigarette smoking during pregnancy reported in 45% of the patients** may further increases risk for thrombosis due to enhanced platelet aggregability.

# Ethiology Cont.

**Coronary dissection**, was reported in 29 pts. (29%) who had 41 dissected coronary arteries.

In 9 women dissection was limited to 1 vessel

**3 – LM**

**4 – LAD**

**1 – CX**

**1 - RCA**

When > 1 vessel was involved the dissection included:

**LM - 3 pts**

**LAD - 17 pts.**

**CX & RCA - 6 pts each**

**The normal physiologic changes resulting in increased blood volume & CO may magnify shear forces of the blood column in large vessels resulting in a greater propensity for dissection. Indeed, the fact that coronary dissection frequently occurs in more than one vessel points toward a generalized rather than a localized disease.**

# Ethiology Cont.

**Pregnancy related spontaneous coronary dissection is thought to be related to:**

**Excess of progesterone** (leading to biochemical and structural changes to the vessel wall (e.g., loss of normal corrugation in elastic fibers, fragmentation of reticular fibers and decrease in the content of acid mucopolysaccharides)

**An association between eosinophils** (probably lytic action of proteases released from them)

**A transient coronary spasm is a possible explanation for this finding and may be caused by previously described enhanced vascular reactivity to angiotensin II and norepinephrine and due to endothelial dysfunction**

**Renin release and angiotensin production** due to decreased uterine perfusion in the supine position

**Ergot derivatives** (used to control or post abortion hemorrhage or to suppress lactation .

# Ethiology Cont.

## **Other potential causes published include:**

Aortic dissection

Coronary artery dissection due to type IV Ehlers- Danlos syndrome

Fibromuscular dysplasia

Coronary aneurysm

Collagen vascular disease

Kawasaki disease

Cocaine use

Administration of sulprostone to induce labor following intrauterine fetal death

Embolization from aortic valve prosthetic thrombosis or  
from a fragment of a left atrial myxoma

Paradoxical embolus of a blood clot originated in the venous system through a patent foramen ovale in the association of a septal aneurysm

Occlusion of coronary ostium by ingrowing endocardial vegetation

Sickle cell chronic lung disease

Pheochromocytoma

Fibrosis of a coronary ostium secondary to repeated trauma by a papillary fibroelastoma

# Comments - Diagnosis

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## General

As in non - pregnant patients

Dx approach also influenced by fetal safety and normal changes of pregnancy .

## ECG

Changes described also in normal pregnancy include: T wave inversion, Q wave in III and increased **R/S** ratio in leads **V1** and **V2**.

Although these may mimic ischemic changes they are usually distinguishable by being less pronounced.

At the same time, ST segment depression mimicking myocardial ischemia has been observed in many healthy women after the induction of anesthesia for cesarean section and can be misleading.

# Comments - Diagnosis (cont.)

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## Cardiac markers

Complicated in the pregnant patients, due to changes that may occur during normal labor and delivery.

An increase in the mean concentration of myoglobin, Creatine kinase and its MB fraction enzyme nearly 2 folds within 30 minute after delivery was reported.

In contrast, troponin I levels were reported a small increase after the delivery and to remain below the upper limit of normal.

It should be noted however, that mild elevation of troponin has been reported in women with preclampsia and gestational hypertension, possibly due to minor myocardial injury in these disorders.

# Comments - Diagnosis (cont.)

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## Echocardiogram

Can be performed safely to confirm the presence of wall-motion abnormalities due to possible myocardial infarction that correspond to ECG changes.

## X ray

Should be generally be kept to minimum. The amount of fetal exposure to radiation during chest radiography is extremely small and should probably be considered safe for use when appropriate.

## Radionuclide imaging

Using technetium 99m labeled sestamibi or thallium 201 is expected to yield less than 1 rad of radiation to the conceptus; nevertheless, these approaches should be used during pregnancy only when the potential benefit seems to outweigh the risk.

# Comments - Intervention

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## Cardiac catheterization & interventional procedures

May also result in fetal exposure of less than 1 rad. Procedures requiring longer fluoroscopy time, could easily yield a fetal radiation exposure of 5 to 10 rads.

While termination of pregnancy is not generally recommended for fetal doses of radiation  $< 5$  rads, it may be considered when the dose  $> 10$  rads.

Because of the possible increased risk of coronary dissection, a noninvasive risk stratification may be preferred during pregnancy or early postpartum period in the stable & low risk patient.

# Comments – Intervention (cont)

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## *Percutaneous Coronary Intervention (PCI):*

James et al reported PCI in 135 patients with pregnancy related AMI with stenting in 127 of the cases.

No information however, was provided on the timing of these procedures as well as their outcome.

# Revascularization

Coronary angiography - 92/103 pts. PCI - 38/92 (41%)

49 – antepartum & PCI in 23 ▲

43 – peri and postpartum & PCI in 16

Stent placement in 55% of these pts.

Duration of pregnancy in 23 patients (61%) who underwent the procedure in the antepartum period, ranged from 6-38 weeks (mostly in the 3rd trimester).

1 pt died (as did her fetus) during the procedure secondary to extensive coronary dissection, which occurred during cardiac catheterization.

6 women underwent PCI in the peripartum period with no fatalities.

Spontaneous and uneventful vaginal delivery occurred 1 hour following angioplasty in one patient & PCI and stenting were preformed immediately or shortly after an emergency CS.

# Revascularization

10 pts underwent primary PCI for AMI in the postpartum period without mortality. Balloon angioplasty, which was performed in 1 patient, however, resulted in extensive coronary dissection necessitating the performance of CABG.

All reported stenting during the acute phase of MI during pregnancy utilized BMS.

Safety of DES in pregnant woman is therefore, still unknown.

Since DES require prolonged antiplatelet therapy with clopidogrel and since the incidence of a C-section delivery in patients with heart disease is relatively high, the use of drug eluting stent during pregnancy may be problematic and should be avoided if possible.

# Drug Therapy

limited information is available regarding the safety of many of these drugs when used in pregnancy.

**Morphine sulfate** - No teratogenicity, crosses the placenta, may cause neonatal respiratory depression when given shortly before delivery.  
Enters breast milk only in trace, compatible with breast-feeding.

**Nitrates** - No adverse effects however, is recommended to avoid maternal hypotension, which may lead to reduced uterine perfusion & to fetal distress.  
No data available on breast-feeding in women treated with these drugs.

**Beta-Adrenergic Blocking Agents** - No reports of teratogenic effect.  
Side effects such as bradycardia, hypoglycemia, hyperbilirubinemia & apnea at birth have been anecdotally reported.  
In addition, a possible increase in rate of fetal growth retardation was linked to the use of atenolol.  
Because nonselective bb may facilitate an increase in uterine activity, use of beta-1 selective agents may be preferred .  
Nursing infants should be monitored for adverse effects in light of the fact that all bb accumulate in greater concentrations in breast milk than in plasma.

# Drug Therapy Cont.

**Calcium Channel Blockers (CCB)** - : Currently, only nifedipine, has been shown to be safe during gestation.

Information regarding the use of verapamil, and diltiazem during pregnancy is limited and a surveillance study has suggested that diltiazem may have teratogenic effects.

Nifedipine, verapamil and diltiazem are all excreted in human milk, breastfeeding is therefore not recommended in women taking these drugs.

**ACE Inhibitors & ARBs** - contraindicated in pregnant patients.

**Eplerenone** - lack of safety information in human,

# Drug Therapy Cont.

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**Statins** - information is very limited. Information obtained from a worldwide postmarketing surveillance based on 137 reports to the manufacturer of inadvertent exposure to simvastatin or lovastatin during pregnancy did not show adverse pregnancy outcome.

However, since these drugs inhibit the synthesis of mevalonic acid (plays an important role in DNA replication and is essential for the synthesis of steroids and cell membrane in fetal development) the use of statins is not recommended.

**Unfractionated & LMWH** - Both do not cross the placenta & several reports have indicated lack of fetal adverse effects.

Discontinuation of treatment with either form of heparin (6 hours with UFH and 24 hours with LMWH) is desirable before delivery.

If indicated, treatment can be resumed after delivery as soon as hemostasis appears to be adequate.

# Drug Therapy Cont.

## Anti-Platelet Aggregants

**Aspirin** – During the 1<sup>st</sup> trimester safety is still a subject of debate, since animal studies have shown that ASA cause malformations.

During both the 2nd & 3rd trimesters low dose ASA ( $\leq 150$  mg/d) has been shown to be safe.

Safety of high dose ASA is debatable especially during the 3<sup>rd</sup> trimester, since it may lead to increased maternal & fetal hemorrhage, and premature closure of the ductus arteriosus.

Although ASA is secreted in breast milk in low concentrations, no adverse effects have been reported thus far.

# Drug Therapy Cont.

## Anti-Platelet Aggregants

***Thienopyridine derivatives***- Information on the use of Clopidogrel or Ticlopidine is very limited.

Ticlopidine use has been reported in 4 pts for a period of 1-4 weeks at 17-38 weeks of gestation and no adverse reactions were reported for both mother and fetus.

Clopidogrel was administered in 6 pts for several weeks during weeks 6-37 of pregnancy.

1 case of intrauterine mortality was reported, however this pt course was complicated by the need for CABG and thus no conclusion could be reached.

It is not known whether these drugs are excreted in human milk and breastfeeding is therefore not recommended in women taking ticlodipine or clopidogrel

# Drug Therapy Cont.

## Anti-Platelet Aggregants

***Glycoprotein IIb/IIIa Inhibitors*** - no current human data on the safety of IIb/IIIa inhibitors. Thus, available information is limited to 3 case reports. Abciximab was administered to a 30-year-old pregnant woman following PCI & stenting of an LAD lesion in the course of treatment of an extensive AMI at 36 weeks of gestation. She had an uneventful normal vaginal delivery of a healthy child 2 weeks later.

Eptifibatide was given to a 27-year-old woman who underwent PCI in the course of an AMI during the 26th week of pregnancy. Due to hemodynamic instability, the patient then required a CABG surgery, which resulted in fetal loss.

Eptifibatide was given to a 36-year-old woman during her 34th week of pregnancy, with ACS and received the drug during PCI in the cath lab. There were no reported bleeding complications and labor was induced 3 days later.

# Drug Therapy Cont.

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## Anti-Platelet Aggregants

In an in vitro term human placental lobular dual perfusion model, only pharmaceutically insignificant amounts of *abciximab* was detected in the fetal circulation.

This suggests that abciximab may be safe during the late stages of pregnancy if delivery is not imminent.

Until more information on fetal safety becomes available, a cesarean section should be considered as the method of delivery to avoid the risk of fetal intracranial hemorrhage if delivery occurs while the antiplatelet effects of these agents are present.

# Complications

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## **Arrhythmias**

similar to the non pregnant patient but should also take into account fetal safety.

## **Drug Therapy**

All commonly used antiarrhythmic agents cross the placenta.

In general, drugs which have been available for use for longer periods of time, have the most clinical data regarding safety.

Digoxin and quinidine during gestation are considered to be safe for the fetus.

Procainamide & disopyramide have been successfully used to treat maternal & fetal arrhythmias, but experience with these drugs is less extensive.

Adenosine seems to be safe, although information on its use in the 1st trimester is limited.

# Complications

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Lidocaine - can be used as an antiarrhythmic agent as long as blood levels are closely monitored. Elevated levels can cause apnea, hypotonia, dilated pupils, seizures and bradycardia in infants.

Mexiletine, flecainide, propafenone, & sotalol - Safety of these drugs is not well established.

Amiodarone - may lead to transient neonatal hypothyroidism and mild abnormalities of neurodevelopment & should therefore be limited to maternal/fetal tachyarrhythmias which are resistant to other drugs or are life threatening .

# Pregnancy and pacing during AMI

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- A pacemaker for the alleviation of symptomatic bradycardia can be implanted at any stage of pregnancy. Indications as for nonpregnant patients.
- Experience with transvenous temporary pacing in pregnant patients indicated no problems.
- An attempt should be made, to use ECG & echo guidance when possible, in order to minimize fluoroscopy time.
- Whenever possible the external transcutaneous pacing should be used as the preferred option.

# Electrical Cardioversion

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Indicated for the treatment of maternal tachyarrhythmias associated with maternal hemodynamic instability which may also risk fetal safety (systemic hypotension, overt heart failure or myocardial ischemia)

Current energy requirements for non – pregnant adult defibrillation are appropriate for use during pregnancy.

Several investigators have reported the safe and effective cardioversion and defibrillation in the setting of myocardial infarction during pregnancy.

Due to a recent report describing the development of sustained uterine contractions, causing fetal distress, necessitating emergency CS in a patient with SVT after electrical cardioversion it is suggested to perform DC cardioversion with facilities available for fetal monitoring & emergency CS if indicated.

# Cardiopulmonary Resuscitation Cont.

- Cardiac arrest was reported in 17/103 pts.
- All 9 pts who experienced VF (5 in the antepartum period between 12-36 weeks), were successfully resuscitated with no fetal injury or loss.
- CPR in 7/8 pts who exhibited an asystolic cardiac arrest failed, with fetal mortality in 6 cases which occurred in the antepartum (5 cases) and peripartum (1 case) periods.
- Before the onset of fetal viability (at about the 24th week of gestation), the objectives of CPR can be guided almost exclusively by maternal considerations, later, consideration should also be given to fetal safety.
- The best hope of fetal survival, however, is maternal survival.

# Cardiopulmonary Resuscitation Cont.

Success of CPR may be hampered by:

less compressible thorax.

reduced venous return & increased obstruction to arterial forward flow.

Elevated diaphragm increases resistance to airflow & to thoracic compression.

anatomical changes make it difficult to maintain a clear airway & perform intubation

hormonal changes promote insufficiency of the gastroesophageal sphincter, increasing the risk of regurgitation & of pulmonary aspiration.

All these in face of increased  $O_2$  consumption & increased  $CO_2$  & hydrogen ion production by the fetoplacental metabolism

In general, external cardiac massage should be performed higher on the sternum than usual.

# Cardiopulmonary Resuscitation Cont.

To minimize the effects of the gravid uterus on venous return and CO a wedge (such as a pillow) should be placed under the flank of the right abdomen and hip to displace the uterus to the left side.

Defibrillation and drug administration should be in accordance with advanced CPR.

If fetal/uterine monitors are in place, they should be removed before delivering shocks.

At gestational age  $\geq 24$  weeks early evacuation of the uterus by bedside C-section should be considered in a patient who does not generate adequate BP despite vigorous CPR measures in order to completely relieve inferior vena cava compression and thus improve venous return. Delivery also improves thoracic compliance, which will enhance the efficacy of chest compressions and improve lung ventilation.

# Cardiopulmonary Resuscitation Cont.

At gestational age <20 weeks, urgent CS delivery is not recommended

At gestational age of approximately 20–23 weeks, emergency hysterotomy should be considered to enable successful CPR of the mother.

Open chest cardiac massage have been recommended between 24 and 32 weeks gestation if standard CPR is ineffective.

In case of maternal mortality, survival of the infant has been directly proportional to the time interval between the death of the mother and delivery.

Delivery taking place more than 15 minutes after maternal death has rarely produced a viable infant or without some neurological sequela.

All surviving infants delivered within 5 minutes after maternal death were healthy.

Successful rescue and long-term maintenance of brain-death and comatose mothers have been accomplished, allowing for delivery at a time that was more beneficial for the fetus.

# Congestive Heart Failure

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**Diuretics** - should be used cautiously to prevent excessive diuresis, hypovolemia & subsequent reduction in uteroplacental blood flow

**Nitrates** - careful dose titration is recommended to avoid reducing BP below acceptable levels.

**Sodium nitroprusside** - has been used in some patients during pregnancy, but its safety is unknown.

**Dopamine** - has had only limited use in pregnant humans and was used to increase blood flow in oliguric, eclamptic pts and to treat spinal anesthesia-related hypotension during C-section without apparent adverse effects.

**dobutamine** - Information is limited. Short-term use of has been reported in a patient with MI at 18 weeks gestation, in another patient with pulmonary hypertension before delivery and in a 3rd women with Marfan syndrome following operation for dissection of the aorta at 24 weeks of gestation without adverse effect

# Congestive Heart Failure Cont.

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**Mirnone** – used in 1 patient.

**Niseritide** - no information on the safety and efficacy.

**ACE inhibitors & ARBs** - contraindicated during pregnancy

**IAPC** – can be used

**C-section** - was reported to improve dramatically Cardiogenic shock  
accompanying AMI

# Thrombolytic Therapy

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Considered to be relatively contraindicated.

Since pregnant pts have traditionally been excluded from clinical trials, the information available is anecdotal.

Clinical experience has been mostly with t-PA and primarily in pts with stroke, cardiac prosthetic valves thrombosis, PE & DVT.

Several studies have demonstrated that placental transfer of SK & t-Pa is too low to cause fibrinolytic effects in the fetus.

UK & rt-PA were not found to be teratogenic in rats or mice nor in human.

# Thrombolytic Therapy Cont.

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Although maternal & fetal outcomes were favorable in most cases some reports have documented complications such as:

maternal hemorrhage

preterm delivery

fetal loss

spontaneous abortion

minor vaginal bleeding

massive subchorionic hematomas

abruption placenta

uterine bleeding requiring emergency cesarean section, & postpartum hemorrhage that required transfusion.

# CABG for MI during pregnancy

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Limited available information precludes reaching any conclusions regarding the safety of CABG surgery during pregnancy.

Surgical revascularization was reported in 61 women with AMI during pregnancy by James et al. No information, however, was provided on the outcome of these surgeries.

10 women included in our study underwent CABG, 7 due to coronary dissection.

Surgery was done in the antepartum period in 5 pts (usually after the 2nd week of pregnancy) of whom 1 had Turner syndrome and underwent the operation for aortic aneurysm dissection with occlusion of the ostium of the RCA. The latter pt died 3 months post surgery due to continuous deterioration and CHF her fetus was delivered alive through a planned elective cs.

1 intrauterine fetal death was reported in a pt undergoing CABG surgery due to dissection of the left main coronary artery subsequent to PCI.

# CABG for MI during pregnancy

Weiss et al (22) described the results of 161 cases (137 with and 24 without cardiopulmonary bypass) operated during pregnancy or early post partum between 1984 and 1996.

Surgery during pregnancy resulted in 9% fetal and 29%, neonatal mortality and in 24% maternal morbidity and 6% mortality.

Duration of pregnancy at time of surgery, the use of cardiopulmonary bypass, duration and lowest temperature of cardiopulmonary bypass, and the use of fetal monitoring did not predict fetal and neonatal outcome.

Maternal risk was higher with surgery > 27w of gestation or emergently and overall was higher than that expected in nonpregnant patients.

Based on this information it seems that cardiac surgery during pregnancy is associated with a high and unavoidable risk of fetal loss and possible increased risk to the mother. For these reasons cardiac surgery should be delayed and performed if all possible, after the delivery.

# Labor

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## **Goal to minimize myocardial work.**

Selected anesthetic technique is not critical, provided that the hemodynamic goals are considered and maintained.

Mode of delivery should be determined by obstetric considerations & the clinical status of the mother. Both vaginal and cesarean deliveries have advantages and disadvantages.

**Elective cesarean section** avoids a long or stressful labor and allows a better control of the time of delivery and the presence of the appropriate medical team including an experienced obstetrician, obstetrical anesthesiologist, a cardiologist and a pediatrician.

**Vaginal delivery**, eliminates the risks associated with anesthesia and a major surgical procedure which include: hemodynamic fluctuations, larger blood loss, pain, infection, respiratory complications.

# Labor

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In general, vaginal delivery can be accomplished relatively safely in the stable pt. when measures aimed to reduce cardiac workload and oxygen demands are taken.

Instrumental vaginal delivery is recommended to avoid excessive maternal efforts & the left lateral position is preferred for optimization of CO during labor and delivery.

Pt's pain, fear, and apprehension, all of which can increase myocardial oxygen demand, must be minimized and controlled.

Tachycardia and hypertension should be prevented and promptly corrected if occur.

Vital signs as well as oxygen saturation, ECG, and fetal heart rate should be monitored continuously.

In cases with possible coronary spasm, it may be wise to avoid oxytocin infusion during labor and ergonovine in the postpartum period. Ischemia that develops during labor and delivery can be treated by intravenous nitroglycerin, bb & ccb.

# Labor Cont.

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It should be noted that nitroglycerin and ccb, have shown some tocolytic effect and may prolong labor.

**Cesarean section** should be performed for obstetrical reasons and in the high risk pt. such as those with ongoing ischemia or chf.

These recommendations are supported by a rate of cesarean delivery of only 19% in the entire group of patients included in our review and 21% in the antepartum group.

This rate is lower than the contemporary rate of 30% recently reported in the general population.

# Subsequent pregnancies

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- >30 reports of successful pregnancies have been reported in pts. with a previous MI including pts. With:
  - poorly controlled type I DM
  - mildly impaired LV function
  - twin pregnancy
  - history of 2 infarctions and S/P CABG or PCI.
- Risks associated with subsequent pregnancy probably depend on multiple factors, including:
  - cumulative amount of myocardial damage and residual LVF
  - coronary anatomy
  - & ongoing myocardial ischemia
- The risks of recurrent coronary spasm or coronary dissection are not known.

# Subsequent pregnancies Cont.

- Cardiac status should be carefully assessed and treated before conceiving.
- those in functional NYHA class III - IV are at high risk whatever the underlying condition may be.
- Medications contraindicated in the pregnant state:
  - ACE inhibitors
  - ARB's
  - diltiazem
  - statines
  - amiodaroneshould be changed prior to conception.
- In patients with a possible coronary spasm as the mechanism for AMI:
  - beta mimetics
  - ergot alkaloids
  - bromocriptine
  - & prostaglandinsshould be avoided.

# Concluding remarks

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- The management of pregnant women with AMI and its complications should in general, follow the usual standard of care although maternal and fetal considerations may affect the choice of therapy.
- Close consultation among the attending obstetrician and cardiologist, regarding management is essential to optimize maternal and fetal well being.
- Ideally, the patient should be treated in an intensive care unit that is capable of providing maternal monitoring along with comprehensive obstetric service.
- A plan for prompt rescue of a potentially viable fetus in the case of sudden maternal deterioration should be established.