OBSTETRICAL HEMORRHAGE

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Catastrophic Obstetrical Hemorrhage

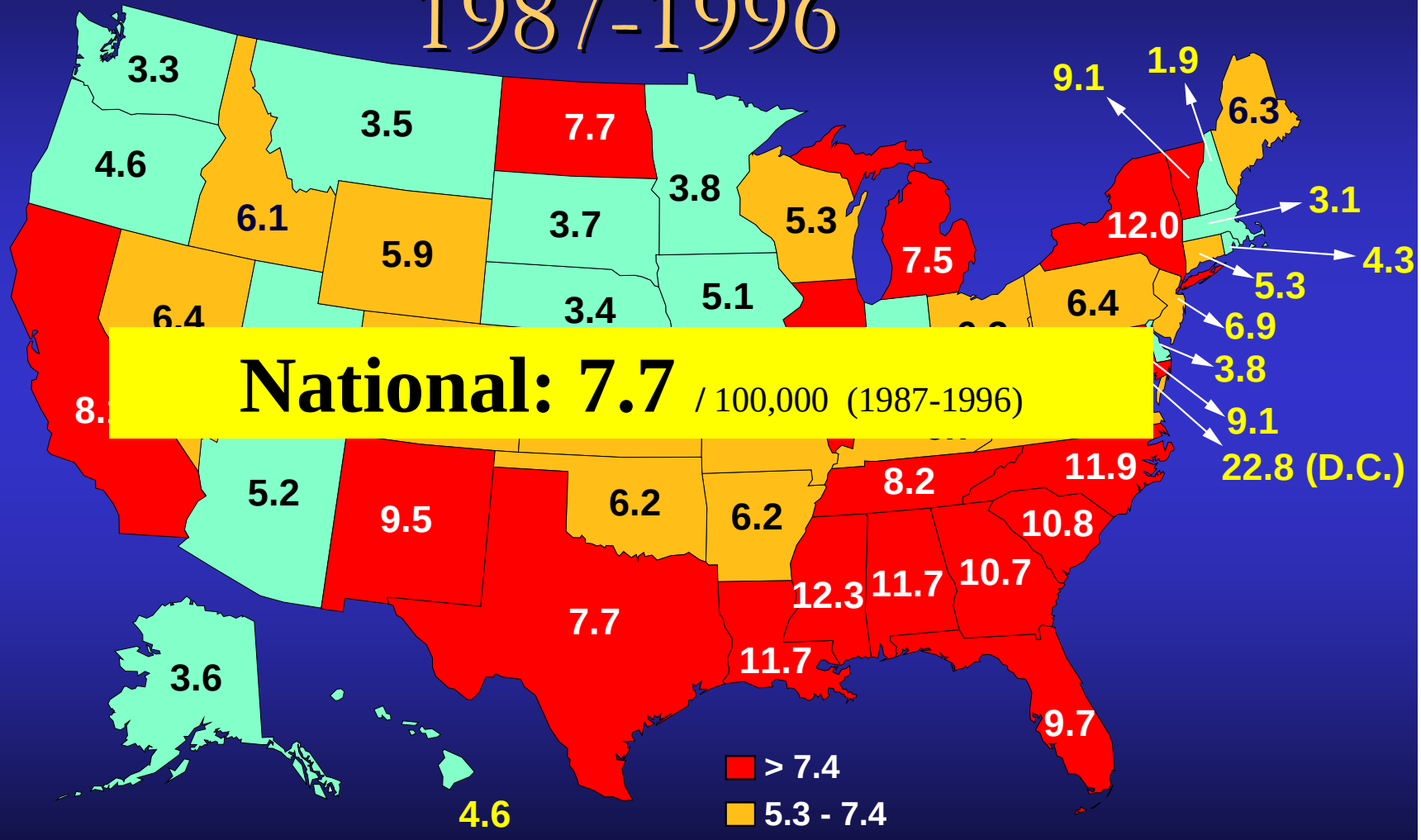
- Educational Objectives
  - Review hematological changes in pregnancy
  - Evaluate definitions and classification
  - Consider etiology and risk factors
  - Explore effect of mode of delivery
  - Develop management strategy
  - Propose conclusions

OB Hemorrhage

- OB hemorrhage accounts for 50% of all postpartum maternal fatalities
- The single most important cause of maternal death worldwide
- 88% of deaths from postpartum hemorrhage occur within 4 hours of delivery

Int. J. Gynecol. Obstet 1996;54:1-10

Maternal Mortality Rates 1987-1996

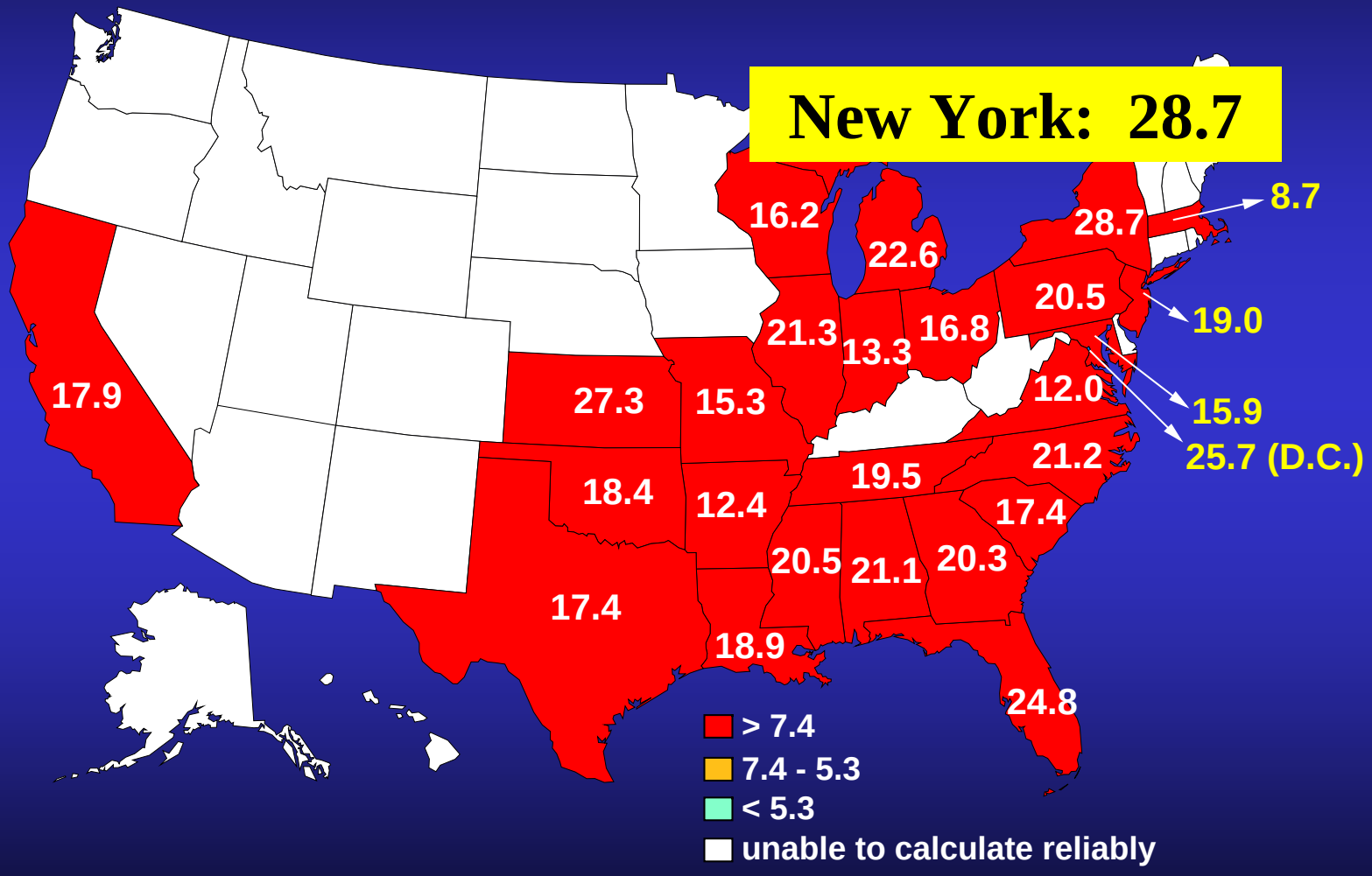


National: 7.7 / 100,000 (1987-1996)

Source: NCHS, Vital statistics

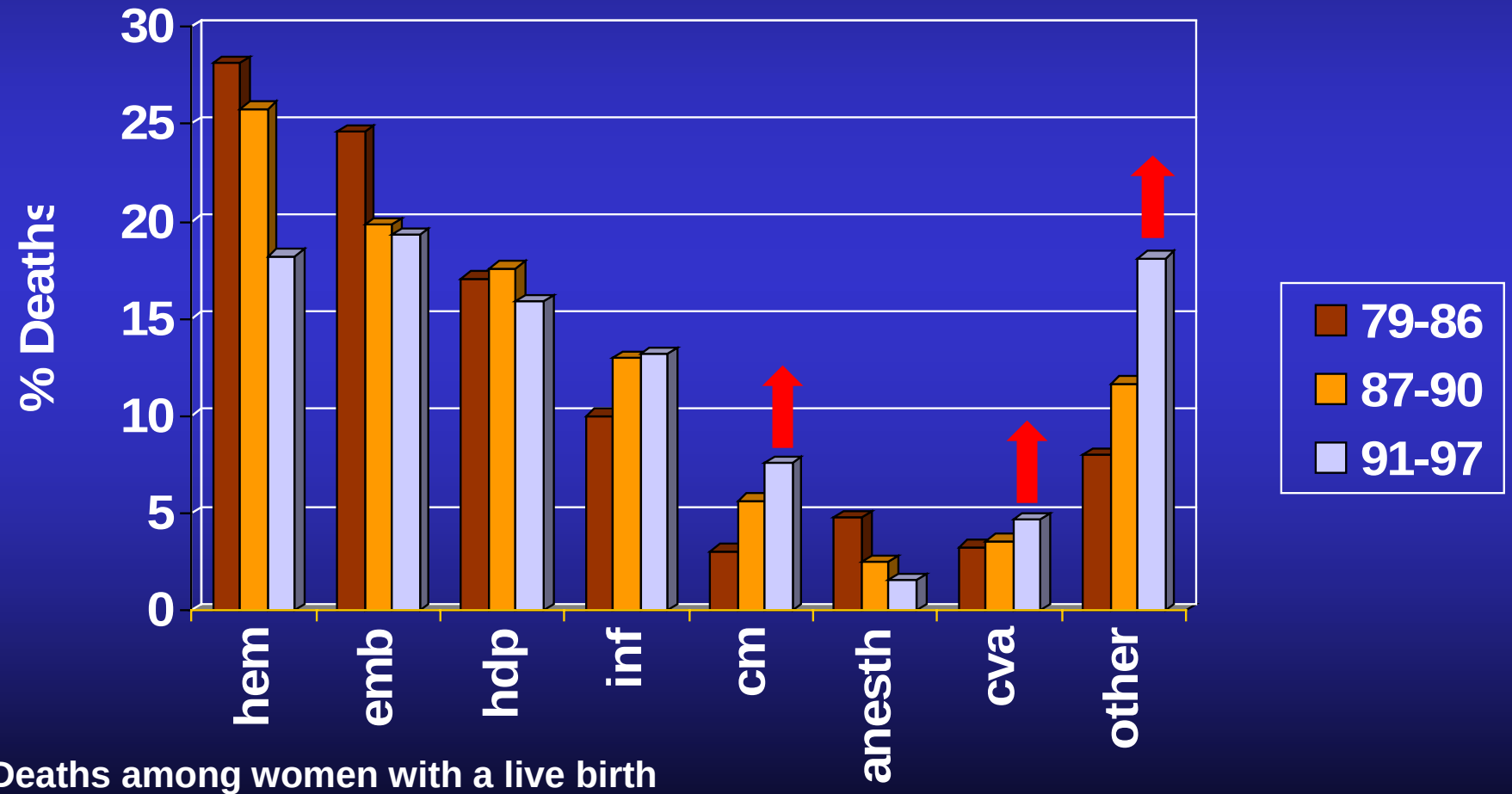
CDC

Maternal Mortality Rates for Black Women 1987-1996



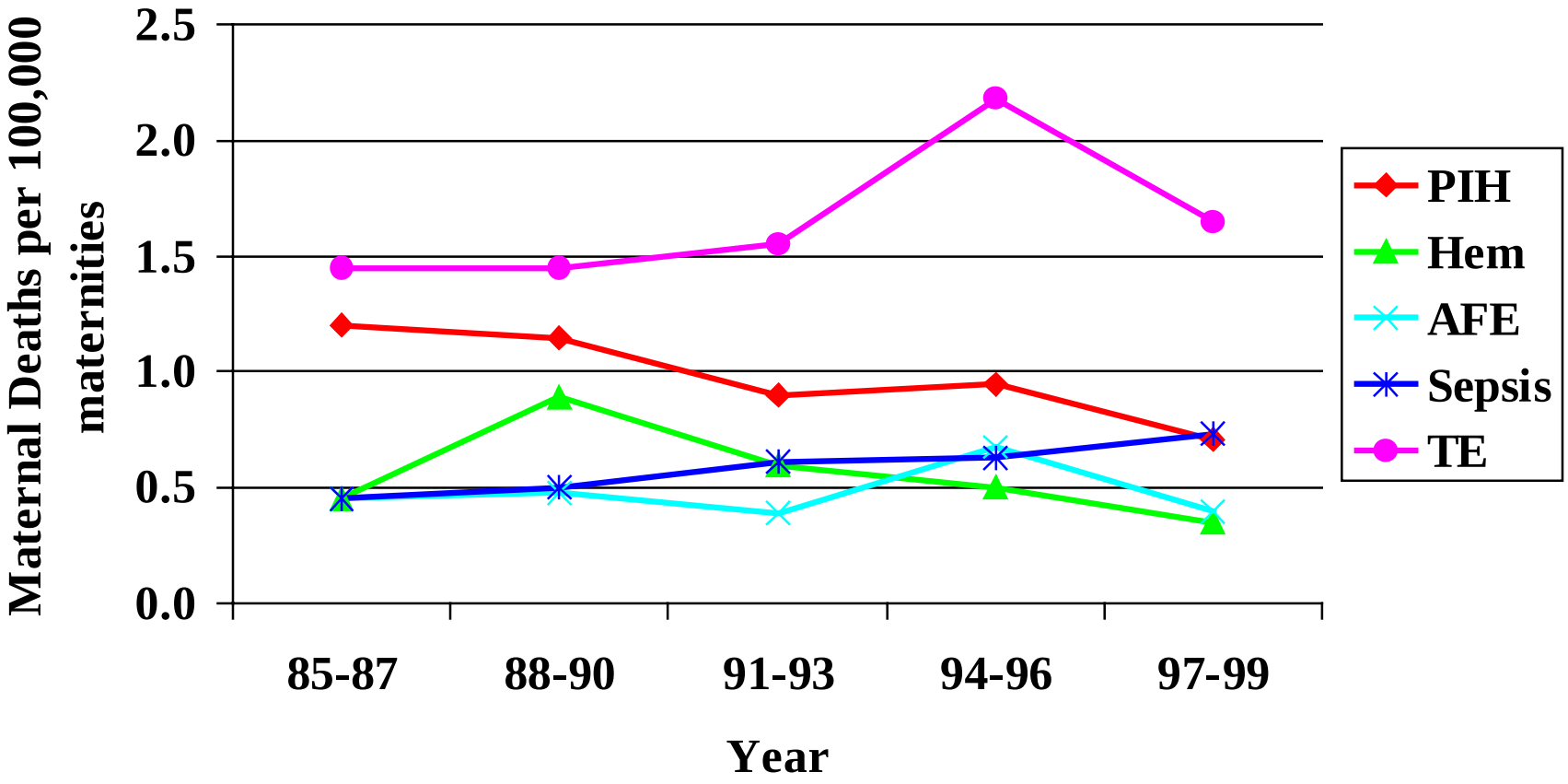
Source: NCHS, Vital statistics

Trends in Cause of Pregnancy-Related Deaths* by Year



* Deaths among women with a live birth

Direct Maternal Deaths



Why Mother Die 1997 - 1999, CEMD

Why Mothers Die 1997–1999

Executive Summary and Key Recommendations

The
Confidential Enquiries
into Maternal Deaths
in the United Kingdom

on behalf of:
The National Institute
for Clinical Excellence

The Scottish Executive
Health Department

The Department of Health,
Social Services and Public Safety:
Northern Ireland

Approximately one-half of maternal deaths are preventable!!

Hematological Changes in Pregnancy

- 40% expansion of blood volume by 30 weeks
- 600 ml/min of blood flows through intervillous space
- Appreciable increase in concentration of Factors I (fibrinogen), VII, VIII, IX, X
- Plasminogen appreciably increased
- Plasmin activity decreased
- Decreased colloid oncotic pressure secondary to 25% reduction in serum albumin

Estimation of Blood Loss

- Visual
  - Underestimates by ½ to 1/3
- Hypotension
  - May be masked by hypertensive disorders
- Tilt-test
  - False positives (conduction anesthesia)
  - False negatives (hypervolemia of pregnancy)
- Tachycardia
  - Unreliable
- Urine flow
  - Reflects adequate of perfusion

Reduced Maternal Blood Volume

- Small stature
- Severe preeclampsia/eclampsia
- Early gestational age

Effect of Acute Blood Loss on Hematocrit

- Change usually delayed at least 4 hours
- Complete compensation takes 24 hours
- Above affected by degree of intravenous hydration

Average Blood Loss and Complexity of Delivery

- Vaginal delivery–500 ml
- Cesarean section–1000 ml
- Repeat cesarean section & TAH–1500 ml
- Emergency hysterectomy–3500 ml.

Pritchard AJOB 1961
Clark Obstet Gynecol 1984

Classification of Hemorrhage in the Pregnant Patient *

Hemorrhage Class	Acute Blood Loss (ml)	Percentage Lost
1	900	15
2	1200-1500	20-25
3	1800-2100	30-35
4	2400	40

Classification of Hemorrhage in the Pregnant Patient

Hemorrhage Class	Signs and Symptoms
1	Usually none
2	Tachycardia, tachypnea orthostatic changes, prolonged hypothenar blanching, narrowing of pulse pressure
3	Overt hypotension, marked tachycardia (120-160 bpm), marked tachypnea (30-40/mln, cold, clammy skin
4	No discernible blood pressure, oliguria or anuria, absent peripheral pulses

Etiology of Obstetrical Hemorrhage

- Abnormal placentation
- Trauma
- Uterine atony
- Coagulation defects

Etiology of Obstetrical Hemorrhage

- Trauma
  - Episiotomy
  - Vulvar Lacerations
  - Vaginal lacerations
  - Cervical lacerations
  - Cesarean section extensions
  - Uterine rupture

Risk Factors for Uterine Rupture

- Prior uterine scar
- High parity
- Hyperstimulation
- Obstructed labor
- Intrauterine manipulation
- Midforceps rotation

Etiology of Obstetrical Hemorrhage

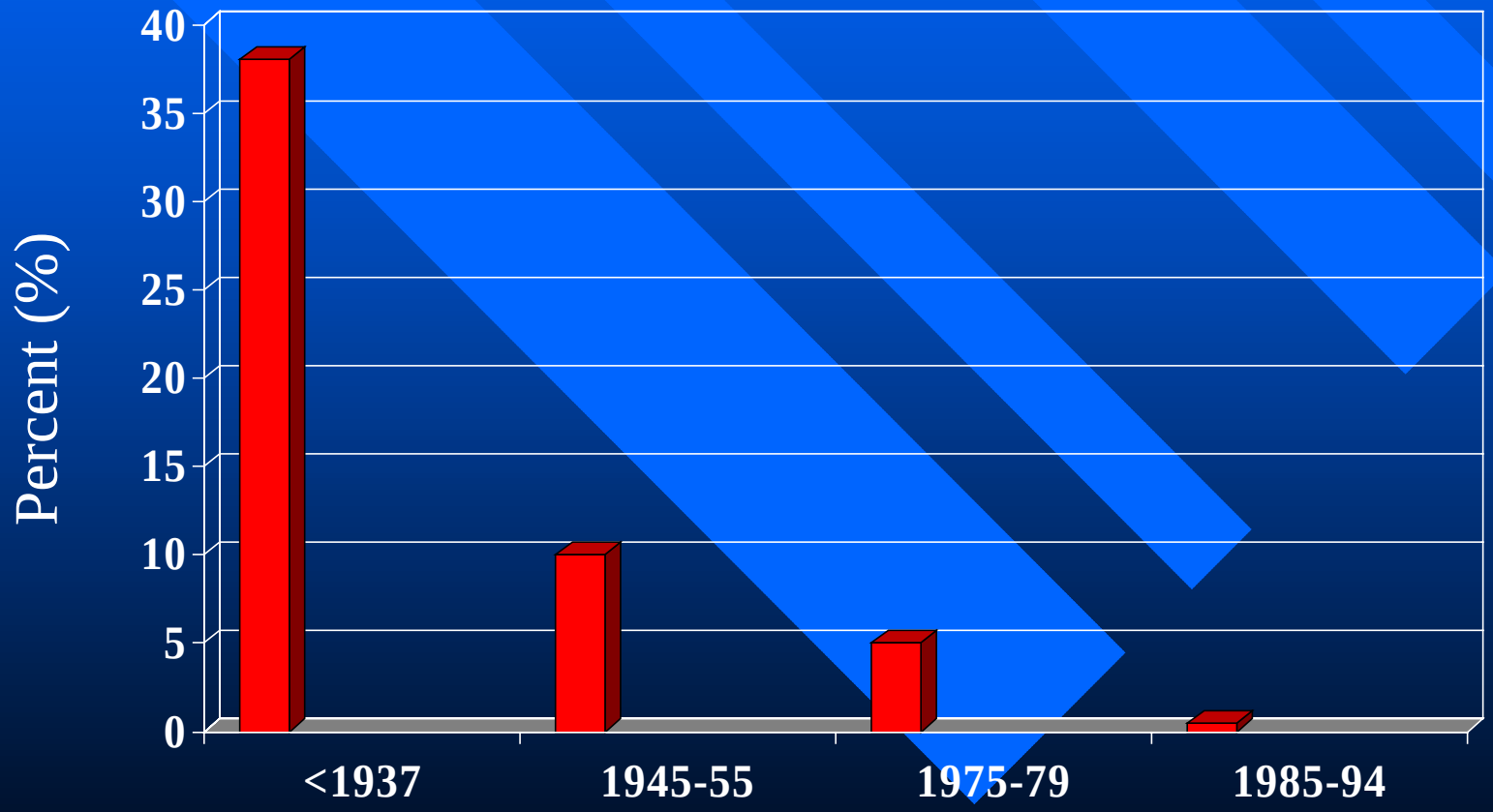
- Abnormal Placentation
  - Placenta previa
  - Abruptio placenta
  - Placenta accreta
  - Ectopic pregnancy
  - Hydatidiform mole

Placenta Accreta-Increta-Percreta as a Cause of Bleeding

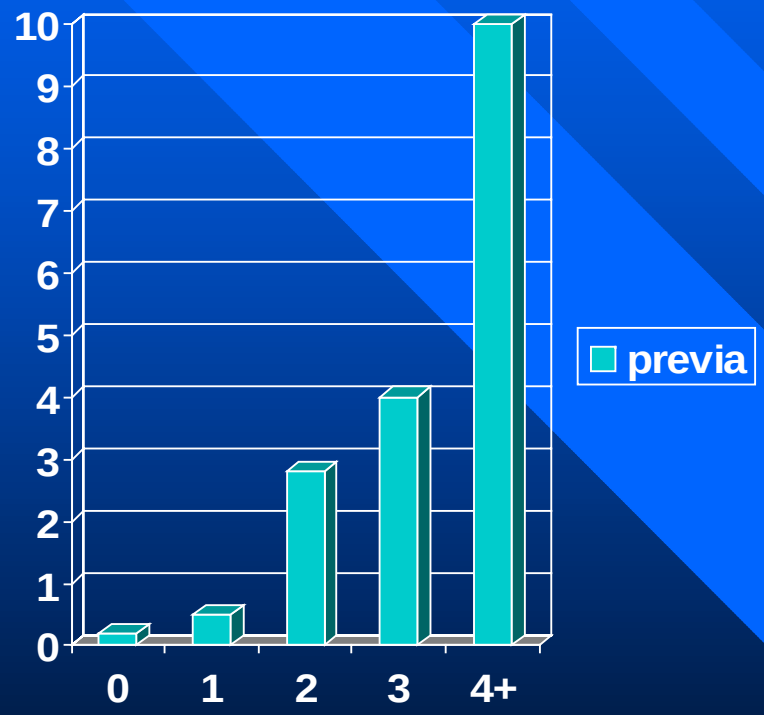
- Increased incidence over last 20 years
  - »Increased cesarean section rate
  - »Increased risk from placenta previa
    - Previa and unscarred uterus-5% risk

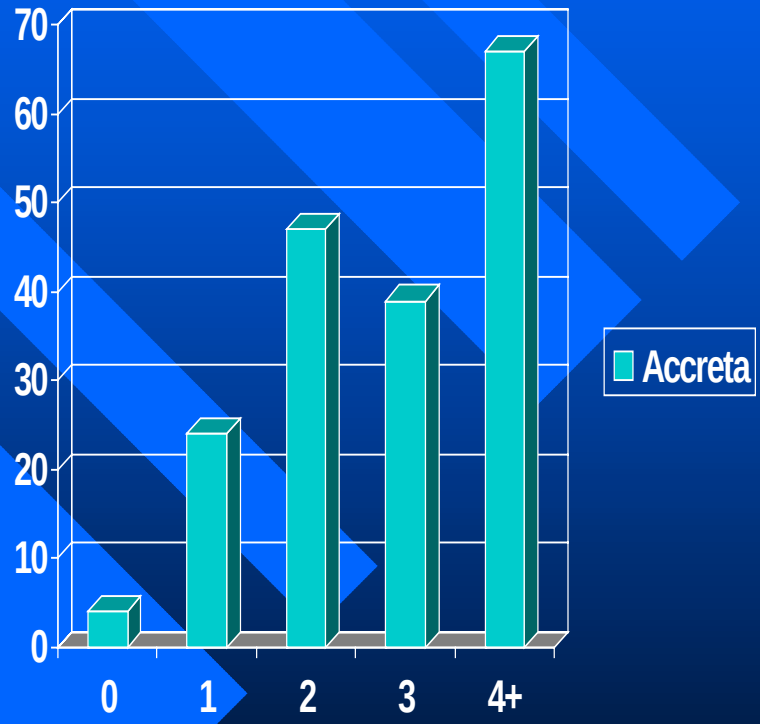
Clark et al Obstet Gynecol 1985

Maternal Mortality of Placenta Accreta During the 20th Century



Incidence of Placenta Previa/Accreta as a Function of Number of Cesarean Sections





Midsagittal Sonographic Image of Placenta Previa-Percreta

Risk Factors for Uterine Atony

- Excessive uterine distension
  - Macrosomia
  - Hydramnios
  - Multiple gestation
  - Clots
- Anesthetic agents
  - Halogenated agents
- Myometrial exhaustion
  - Rapid or prolonged labor
  - Oxytocin
  - Chorioamnionitis
- Prior uterine atony

Risk Factors for Coagulation Defects

- Placental abruption
- Severe preeclampsia
- Amniotic fluid embolus
- Massive transfusions
- Severe intravascular hemolysis
- Congenital or acquired coagulopathies
- Retention of dead fetus
- Sepsis
- Anticoagulant therapy

Postpartum Hemorrhage

- Definitions
- Traditional: >500 ml
  - Immediate: Within 24 hours of delivery
  - Delayed: More than 24 hours following delivery
- Coombs et al, 1991
  - Amount requiring transfusion or producing 10 volume % reduction in hct

Postpartum Hemorrhage Following Vaginal Delivery

- 30,000 deliveries
- 1976 – 1996 at Beth Israel Hospital
- 2.6% overall transfusion rate
- 4.6% in 1976; 1.9% in 1996
- 20% of transfusions > 3 units

Postpartum Hemorrhage Following Vaginal Delivery

Risk Factor	Relative Risk
Prolonged 3rd stage	7.6
Pre-eclampsia	5
Mediolateral episiotomy	4.7
Postpartum hemorrhage	3.6
Twins	3.3
Arrest of Descent	2.9
Lacerations	2

Coombs, et al, 1991

Postpartum Hemorrhage Following Cesarean Deliveries

Risk Factor	Relative Risk
General Anesthesia	2.9
Amnionitis	2.7
Protracted Active Phase	2.4
Preeclampsia	2.2
Second-stage Arrest	1.9
Hispanic	1.8
Classical Incision	1.1

Coombs, et al, 1991

Strategies for the Prevention of Postpartum Hemorrhage

- Enhance natural contractions of the uterus
- Shortening of the 3rd stage
- Treat aggressively

Active Management of the 3rd Stage of Labor

- Principal action
  - Hasten and augment uterine contractions after delivery of the baby
  - Prevent hemorrhage due to uterine atony
- Prevent blood loss

Active Management versus Expectant Management

- Main Components of Active Management
  - Administration of a prophylactic uterotonic agent soon after delivery
  - Early clamping and cutting of the umbilical cord
  - Controlled cord traction after the uterus has contracted

Active Management versus Expectant Management

- Main Components of Expectant Management
  - Wait for signs of placental separation
  - Allow placenta to deliver spontaneously
    - » Aided by gravity or nipple stimulation

Active vs. Expectant Management of the 3rd Stage of Labor

- Cochrane systematic review of 5 randomized controlled trials (1988, 1990, 1993, 1997, 1998)
- Findings
  - Active management reduced risk of maternal blood loss
  - Reduced prolonged 3rd stage of labor
- Side Effects
  - Increased nausea and vomiting
  - Elevated BP's
- Recommendations
  - Active management should be the routine approach for women having a vaginal delivery in a hospital

MacDonald et al 2003

Prophylactic use of Oxytocin in the 3rd Stage of Labor

- Cochrane review of seven trials (1961, 1964, 1990, 1991, 1992 1996, 1997)
  - Findings
    - » Reduced blood loss
    - » Reduced need for additional uterotonic drugs
    - » Nonsignificant trend towards more manual removal of placenta and more blood transfusion in the expectant management subgroup

Elbourne et al 2003

Alternative Agents for Prevention of Postpartum Hemorrhage

- Umbilical Uterotonic Agents:
  - 1st trial in 1987 using Oxytocin vs. Saline – not significant
  - 3 other trials (1988, 1991, 1996) showed the same NS
  - Two placebo controlled trials (1991, 1998)
    - » Oxytocin decreased the length of 3rd stage but not blood loss

Alternative Agents for Prevention of Postpartum Hemorrhage

- Oral Ergometrine and Methylergometrine
  - Both drugs have a strong uterotonic effect and slight vasoconstriction
  - Act differently than Oxytocin and Prostaglandins
  - Unfortunately both are unstable even refrigerated
  - No place in modern obstetrics

DeGroot et al: Drugs, 1998

Alternative Agents for Prevention of Postpartum Hemorrhage

- Sublingual Oxytocin
  - Widely varying bio-availability
  - Long lag time, long half life
  - Not used in modern obstetrics

DeGroot et al J Pharm Pharmacol 1995

Alternative Agents for Prevention of Postpartum Hemorrhage

- Injectable Prostaglandins
  - International trial in 1996
    - » Similar results to prophylactive IM/IV Oxytocin
      - Higher rates of diarrhea, higher cost
    - » 2001 Randomized trial in United Kingdom using hemabate
      - Study stopped early due to side effects
        - 21% with severe diarrhea
      - As effective as Oxytocin in preventing hemorrhage
    - » Cochrane Review in 2000
      - Injectable PG's have decrease blood loss and shortened 3rd stage but should be used when other measures fail

Alternative Agents for Prevention of Postpartum Hemorrhage

- Carbetocin
  - Long acting Oxytocin receptor agonist
  - Produces tetanic contractions within 2 minutes lasting 6 minutes, lasts for approximately 1 hour
  - IM has a prolonged effect (2 hours) versus IV
  - 1998 and 1999 – 2 trials in Canada – double-blind, randomized for patients having a cesarean section
    - » Was more effective in a single IV dose than continuous Oxytocin
    - » Similar safety profile to Oxytocin
  - No clinical trials for postpartum hemorrhage prevention

Alternative Agents for Prevention of Postpartum Hemorrhage

- Misoprostil
  - Synthetic analog of PGE_1
  - 1996-1st trial outlining its use to prevent 3rd stage
  - 24 randomized controlled trials from 1998-2003
  - 3 systematic reviews (2002, 2002, 2003)
    - » Oral and rectal Misoprostil not as effective as conventional injectable uterotonics
    - » High rate of side effects
  - May be useful in less-developed countries where administration of parenteral uterotonic agents are problematic

Surgical Therapy

- Uterine packing
- Uterine artery ligation
- Internal iliac (hypogastric) artery ligation
- Hysterectomy
- Suture techniques

Surgical Management of Uterine Atony General Considerations

- Stability of patient
- Reproductive status of patient
- Skill of surgeon
- Skill of assistants
- Availability of blood products
- Visualization of pelvis
  - Choice of incision
  - Retroperitoneal approach
  - Anatomic distortion

Uterine Packing

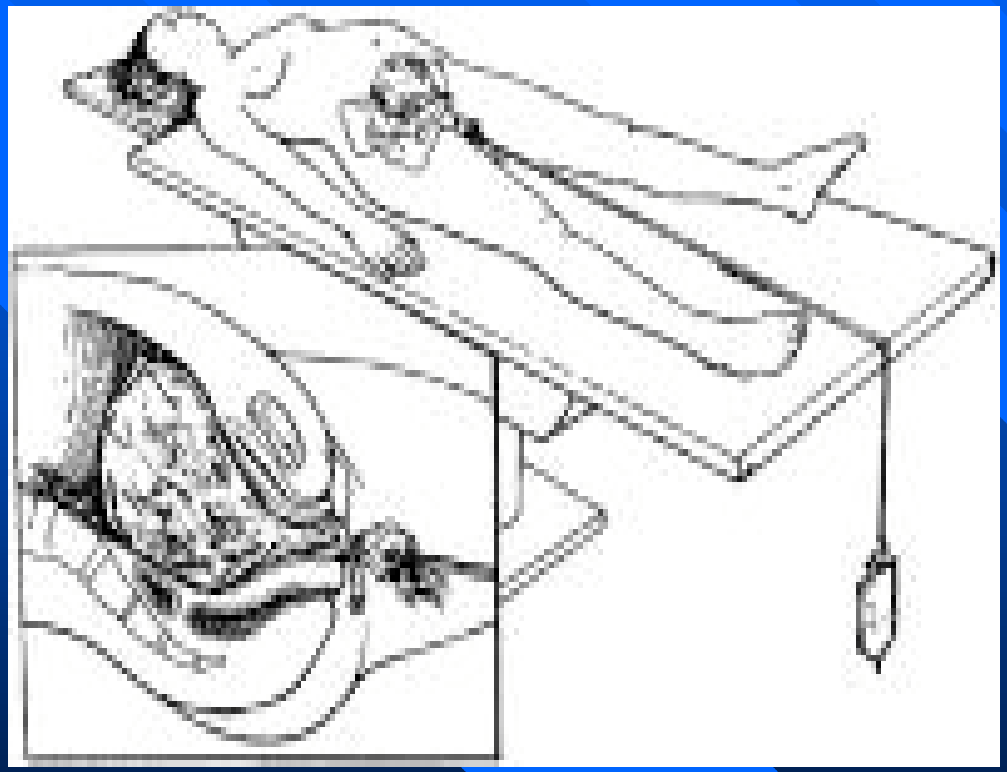
- Fell into disfavor in 1950's
  - Concealed hemorrhage
  - Infection
  - Non-physiologic approach
- Maier AJOB, 1993
  - Simple, safe, effective
  - Pack side to side
    - » Avoid dead space

Pelvic Pressure Pack

- Bleeding may persist post hysterectomy
- Original description by Logothetopulos in 1926
- High success rate, but numbers are limited

Year	Author	OB	GYN	Total
1962	Parente	0	14	14/14
1968	Burchell	0	8	8/8
1985	Cassels	1	0	1/1
1990	Robie	1	0	1/1
1991	Hallak	1	0	1/1
2000	Dildy	7	1	7/8

The Pelvic Pressure Pack for Persistent Post hysterectomy Hemorrhage



Dildy AJOG 2000

Postpartum Uterine Hemorrhage
Uterine Artery Ligation

- Waters, 1952
  - Original description
- O'Leary & O'Leary, 1974
  - Post-cesarean hemorrhage
  - Simpler more rapid technique
- Reported efficacy 80-92%

Stepwise Uterine Devascularization

- Alexandria, Egypt – Shatby Maternity University Hospital
- 103 patients with non-traumatic postpartum hemorrhage
- Failure of non-surgical management
- Absorbable sutures
- No vessels clamped or divided

AbdRabbo, 1994

Stepwise Uterine Devascularization

- Unilateral uterine vessel ligation
- Contralateral (bilateral) uterine vessel ligation
- Low bilateral uterine vessel ligation
- Unilateral ovarian vessel ligation
- Contralateral (bilateral)ovarian vessel ligation

AbdRabbo, 1994

Stepwise Uterine Devascularization Step Employed (%)

Indications	Patients	1	2	3	4	5
Uterine Atony	66	14	85	0	2	0
Abruptio Placenta	17	0	88	0	12	0
Couvelaire Uterus	9	0	33	0	44	22
Placenta Previa	5	0	100	0	0	0
Placenta Previa with Accreta	2	0	50	50	0	0
Afibrinogenemia	4	0	0	0	0	100
Total	103	9	75	4	7	6

AbdRabbo, 1994

Stepwise Uterine Devascularization Follow-Up

- All patients resumed normal menstruation
- 11/15 patients conceived following discontinuation of contraception
- Subsequent pregnancies normal
  - 4 Vaginal deliveries
  - 7 Cesarean sections
  - No postpartum hemorrhage

AbdRabbo, 1994

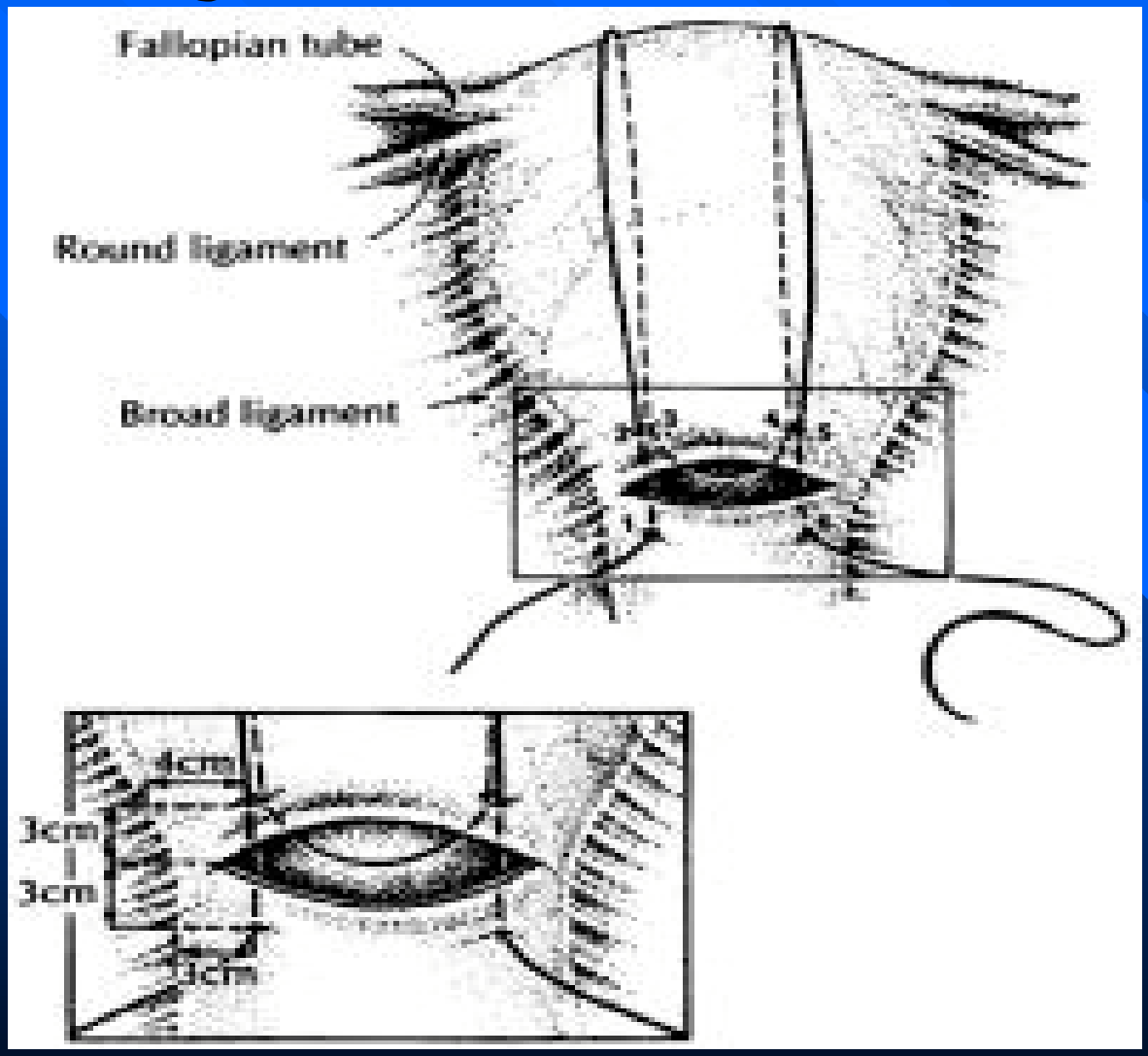
Suture Techniques

- B-Lynch procedure
  - Fundal Compression suture

    #2 chromic on a 75 mm heavy, round bodied needle
- 4 Case reports total

B-Lynch	BJOB 1997	5/5
Ferguson	OB & GYN 2000	2/2
Dacus	JMFM 2000	1/1
Vangsgaard	Ugesker Laeger 2000	12/12

B-Lynch Procedure



Internal Iliac (Hypogastric) Artery Ligation

- Controls blood loss by reducing art. pulse pressure
  - Converts pelvic art. circulation into a venous system
- Burchell et al Obstet Gynecol 1964
  - Arterial pulse pressure reduced
    - 14% by contra lateral
    - 77% by homolateral
    - 85% by bilateral
- Need experienced surgeon
- Need hemodynamically stable patient

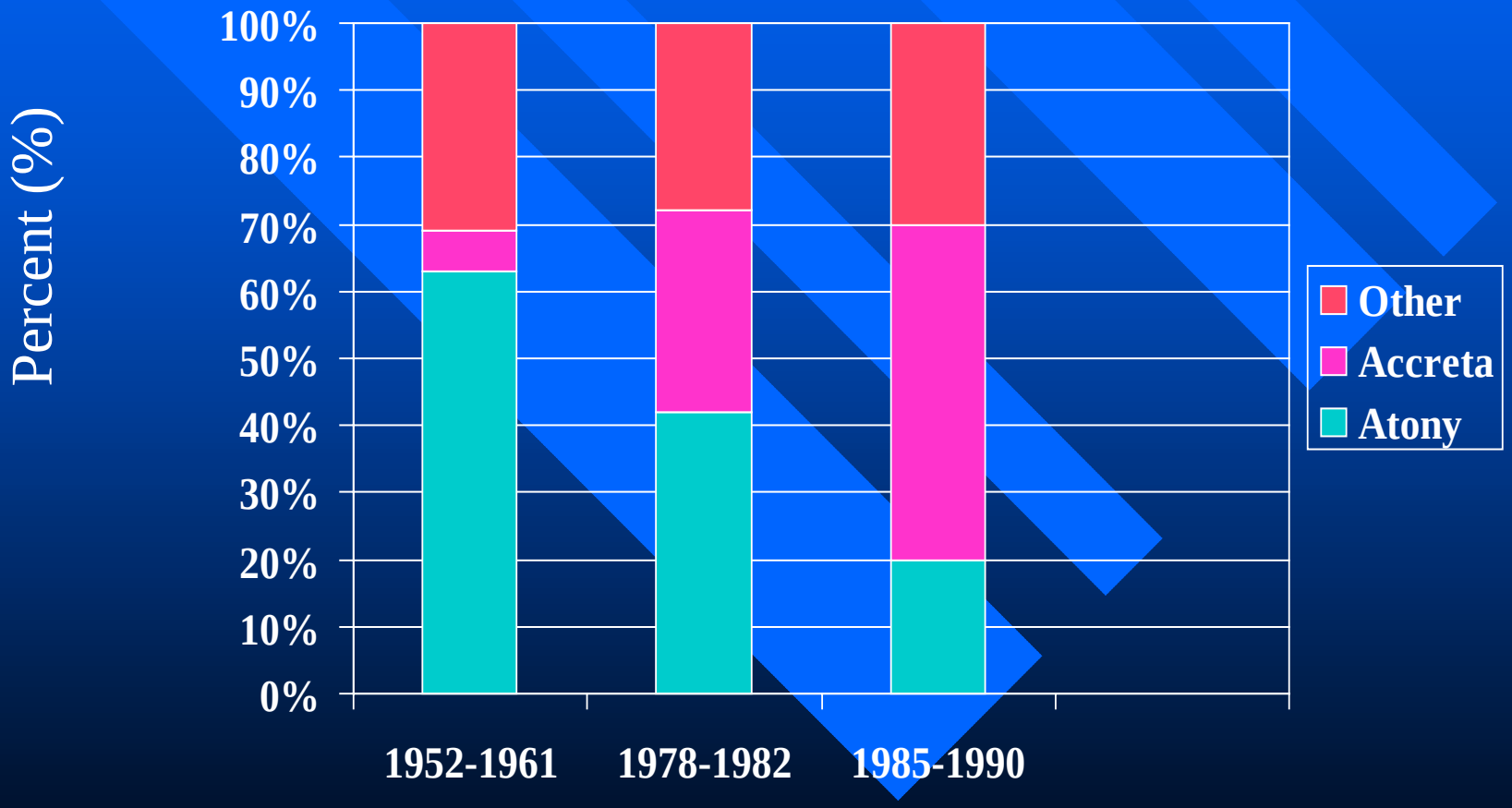
Selective Arterial Embolization

- Widely used for management of uncontrollable hemorrhage
- First OB trial 1979 (Brown et al Obstet. Gynecol)
- 7 Trials from 1998-2000
  - Cumulative success rate = 97%
- Excellent first line therapy but . . .
  - Difficult to perform in Labor and Delivery
  - Availability of interventional radiologist

Hysterectomy

- Clark et al Obstet Gynecol 1984
- Largest series of emergency hysterectomy
  - 70 cases 1978-1982
    - » 60 Post cesarean sections
    - » 10 post vaginal delivery
  - Indications
    - » Atony – 43%
    - » Placenta accreta – 30%
    - » Uterine rupture – 13%
    - » Extension of low transverse incision – 10%
    - » Fibroids preventing closure – 4%
  - TAH for atony
    - » Higher rates; amniotics, C/S for labor arrest, augmentation of labor, $MgSO_4$ infusion, larger fetal weight

Changing Indications for Emergency Hysterectomy



Autotransfusion

- Use of cell saver to collect blood from operative field, processing and reintroducing red cells to patients.
- Not well defined in obstetrics
- Three small studies (1989, 1990, 1997)
  - Removal of fetal and amniotic debris
  - Appears effective
- Largest series to date (Rebarber AJOB 1998)
  - 139 cases performed at cesarean section
  - No complications related to AFE or coagulopathies
- Use two separate suction devices
  - Amniotic fluid and red cell product
  - Increase wash volume
  - Measure clotting factors and platelets every 1 to 1.5 blood volumes lost
- Contraindications
  - Heavy bacterial contamination
  - Malignancies

Fluid and Blood Component Replacement

- Whole blood vs. components, debate continues
- Maintain urine output > 30 cc/hr
- Maintain hematocrit > 30% (with acute blood loss)
- Choice of components:
  - Hemoglobin – packed red blood cells
  - Fibrinogen-cryoprecipitate
  - Other clotting factors-fresh frozen plasma
  - Platelets-platelet packs
  - Volume-lactated Ringer's solution

Risks of Blood Transfusion

- HIV 1:2,135,000
- Hepatitis A 1:1,000,000
- Hepatitis B 1:205,000
- Hepatitis C 1:276,000
- HTLV I/II 1:2,993,000
- Transfusion-related acute lung injury
  - 1:5,000
- Alloimmunization 0.5%

Int. Anesthesia Clinics 2004

Catastrophic Obstetrical Hemorrhage Conclusions

- Incidence low, but significant
- Amount of blood loss hard to determine; catastrophic clearer
- Earlier the intervention, less the blood loss
- Organized approach essential to management
- Exhaust medical measures prior to surgery
- Precise fluid and blood component therapy essential