

CHAPTER 5

BREAST, TRUNK AND EXTERNAL GENITALIA

Reconstructive challenges of the breast, trunk and genitalia focus first on restoring structural and functional integrity. Restoration of the normal body contours of both male and female anatomy also deserves consideration.

I. BREAST

A. Breast Anatomy:

1. Breast:
 - a. Glandular and adipose tissue enclosed by superficial fascial system and deep fascia overlying chest wall muscles
 - b. Cooper's ligaments: suspensory attachment of the breast to the overlying fascia anteriorly
 - c. Boundaries:
 - i. Level of 2nd to 6th rib anteriorly
 - ii. Superior border is clavicle, inferior border is rectus abdominis fascia
 - iii. Medial border is sternum, lateral border is anterior border of latissimus dorsi muscle
1. Vasculature:
 - a. Internal mammary artery perforators (60%)
 - b. Lateral thoracic artery (30%)
 - c. Thoracoacromial artery: pectoral branches supply pectoralis major muscle and overlying breast tissue
 - d. Intercostal arteries 3, 4, 5
 - e. Venous drainage mainly to axillary vein but some to internal mammary and intercostal veins
2. Lymphatics:
 - a. 97% drainage to axilla
 - b. 3% drainage to internal mammary nodes
 - c. Level I: nodes lateral to lateral border of pectoralis minor
 - d. Level II: nodes lying beneath pectoralis minor
 - e. Level III: nodes medial to medial border of pectoralis minor and extending to apex of the axilla
3. Nerve supply:
 - a. Cervical plexus: sensory branches of C3, 4 from supraclavicular nerve
 - b. Lateral branches of intercostal nerves:
 - i. Provide sensation to lateral side of breast
 - ii. Lateral 4th provides major sensory innervation to nipple (T4 dermatome)
 - c. Medial branches of intercostal nerves 2-7 provide sensation to medial breast

B. Breast Reconstruction:

1. Breast cancer now affects one in eight women over the course of their lifetime and is the leading cause of cancer related death in women.
2. The breast is a symbol and attribute of femininity

3. All patients that have undergone or will undergo mastectomy are entitled to breast reconstructive surgery covered by insurance (Women's Health Act, 1998)
4. Surgeons need to understand individual needs with regard to acceptable results and range of preferences:
 - a. No reconstruction: women may choose to simply wear a prosthetic.
 - b. Reconstruction of breast mound to attain close to natural breast shape, feel, contour
 - c. Breast mound reconstruction may or may not be followed with nipple/areolar reconstruction depending on patient goals.
 - i. Post-mastectomy defects are usually complicated by complete loss of the nipple/ areolar complex and loss of skin.
 - ii. Previous irradiation may cause difficulties with wound healing, skin contraction, capsular contracture, fat necrosis, and discoloration.
 - iii. If desired, following unilateral breast reconstruction, the opposite breast can be contoured, using mastopexy, reduction or augmentation mammoplasty for improved symmetry. Women's Health Act of 1998 provides assurance that contralateral matching (symmetry) procedures are to be covered by insurance.

C. Mastectomy options

1. Partial / lumpectomy: removal of the affected portion of the breast only. Often requires post-op radiation.
2. Subcutaneous mastectomy: removal of all breast tissue with preservation of all skin, including nipple/ areolar complex. There may be a slightly increased risk of breast cancer / recurrence in the future. Care must be taken to select and counsel patients appropriately.
3. Skin-sparing mastectomy: simple mastectomy with preservation of all skin except the nipple areolar complex and a 1-2cm margin around the biopsy site
4. Simple (total) mastectomy: removal of all breast tissue, including nipple areola complex
5. Modified radical mastectomy: removal of all breast tissue, nipple-areola complex, pectoralis fascia, as well as Level I and II lymph nodes
6. Halsted radical mastectomy: removal of all breast tissue, nipple/ areolar complex, pectoralis major and minor muscles, muscular fascia, Level I, II, and III lymph nodes (this procedure does not improve disease control compared to modified radical mastectomy and is largely of historical interest now)

D. Techniques of breast reconstruction:

1. Implant Based / Prosthetic:
 - a. Can be single stage (straight to implant) reconstruction or gradual tissue expansion with the use of sub-pectorally placed expanders, with eventual breast implant insertion once adequate skin expansion has occurred.
 - b. May utilize acellular dermal matrix for partial coverage of device.
 - c. Breast implants may be saline or silicone (silicone implants have long been approved by the FDA for use in patients following mastectomy and can offer a more natural feel).
2. Autogenous:
 - a. Pedicled flaps:

- i. Latissimus dorsi myocutaneous flaps used widely (can be combined with breast implant, which is usually required for adequate volume)
 - ii. Pedicled TRAM flap using superior epigastric vessels for blood supply (rectus abdominus muscle is used as a “carrier” for the blood vessel)
 - b. Free flaps:
 - i. Technically more demanding, requiring microvascular techniques
 - ii. Recipient vessels tend to be internal mammary vessels (or their breast perforators) or less commonly, the thoracodorsal vessels.
 - iii. Lower risk of partial flap loss and fat necrosis, but potential total flap loss
- 3. Types Free of flaps:
 - a. TRAM (Transverse Rectus Abdominis Myocutaneous) flap
 - b. Muscle sparing TRAM flap
 - c. DIEP (Deep Inferior Epigastric Perforator) flap
 - d. SIEA (Superficial Inferior Epigastric Artery) flap
 - e. The first 3 flaps use the deep inferior epigastric vessels for blood supply, whereas the SIEA uses the superficial inferior epigastric vessels
 - f. SIEA has to be of adequate caliber (artery with a palpable pulse, vein >1mm) to be used for anastomosis (only 10% of women will have an adequate SIEA)
 - g. TRAM and the muscle-sparing TRAM flaps take some element of muscle tissue as well as the fat and skin as a “carrier” for the deep inferior epigastric vessels (technically easier)
 - h. DIEP and SIEA flaps are technically harder to do as they do not take any muscle from the abdominal wall and require dissection of the blood vessels away from the “carrier” rectus abdominis muscle (advantage of less abdominal wall donor site complications)
 - i. Clinical relevance of not taking any muscle is still under debate, but may be advantageous for women who are athletic
 - j. Gluteal artery perforator flap (GAP) is another option, but is generally reserved for patients without sufficient abdominal wall tissue or patients that have previously undergone abdominal wall surgery (e.g. abdominoplasty)
 - k. Transverse upper gracilis flap (TUG) is again another secondary option but has a high donor site morbidity
 - l. Turbocharging:
 - i. Vascular augmentation using the vascular sources within the flap territory
 - ii. Example: performing a DIEP flap to the recipient internal mammary vessels then anastomosing an additional vessel from this system
 - m. Supercharging:
 - i. Vascular augmentation using a distant source of vessels such as axillary or thoracodorsal vessels
 - ii. Example: performing a pedicled TRAM flap, then augmenting the flow by anastomosing the deep inferior epigastric vessels to the thoracodorsal vessels
- E. Nipple areolar complex reconstruction
 - 1. Nipple sharing (graft from the contralateral nipple) if available
 - 2. Local skin flaps +/- use of cartilage or acellular dermal matrix graft
 - 3. Intra-dermal color tattoo to match opposite nipple
 - 4. In-situ or remote-donor skin graft may also be used for areola

F. Breast Reduction

1. Indications:
 - a. Physical:
 - i. Neck, back, shoulder pain
 - ii. Shoulder grooving, bra straps cutting into shoulders
 - iii. Infection and maceration within inframammary fold (intertrigo)
 - iv. Neurological sequelae
 - b. Psychological:
 - i. Embarrassment
 - ii. Self-consciousness
 - iii. Loss of sexual appeal and femininity
2. Techniques:
 - a. Traditional: Wise pattern (inferior or central pedicle)
 - i. Advantage: predictable outcome
 - ii. Disadvantages: long scar length, “bottoming out” of breast, loss of superior pole
 - b. Vertical reduction pattern (superior or medial pedicle)
 - i. Advantage: attractive long term breast shape
 - ii. Disadvantages: steep learning curve, unattractive postoperative appearance
 - c. Large reductions may require nipple/areolar complex free grafting if pedicle is too long for blood supply
 - d. Liposuction can assist with “touch up”
3. Outcomes:
 - a. Excellent long term satisfaction
 - b. Lactation is possible if underlying glands are preserved
 - c. Nerve supply of nipple usually preserved, but outcomes can be variable
 - d. Occult breast cancer detected in 0.4% of specimens

II. CHEST WALL RECONSTRUCTION

- A. Goals of reconstruction:
 1. Rigid airtight cavity
 2. Protection of the thoracic and abdominal contents
 3. Optimization of respiration
 4. Obliteration of dead space for intrathoracic defects
 5. Stable soft tissue coverage
 6. Aesthetic reconstruction (whenever possible)
- B. Soft tissue chest wall defects:
 1. VAC therapy can be utilized
 2. Regional muscle flaps most frequently used:
 - a. Pectoralis major
 - b. Latissimus dorsi
 - c. Serratus anterior
 - d. Rectus abdominis
 3. Microvascular free flaps (when regional flaps have failed or are unavailable):
 - a. Contralateral latissimus dorsi

- b. Antero-lateral thigh (ALT)
 - c. Tensor Fascia Lata
 - d. Multiple recipient vessels are available for microvascular anastomosis (e.g., thoracodorsal system, transverse cervical, thyroacromial trunk)
- C. Skeletal chest wall defects:
1. Indications / Need for reconstruction (to avoid flail chest)
 - a. En bloc resection resulting in a defect larger than 5 cm or four or more ribs
 - b. Anterior and posterior defects are typically better tolerated than lateral defects
 - c. In patients with prior radiation, even larger defects may be tolerated owing to fibrosis
 - d. Small defects of skeletal chest wall are most often functionally insignificant
 2. Autogenous
 - a. Rib grafts, free or vascularized
 - b. Fascia
 - c. Pedicled or free flaps (especially those containing fascia like the ALT)
 3. Alloplastic
 - d. Mesh - several synthetics available and most commonly used is a polypropylene knitted mesh (Prolene / Marlex). Others options: PTFE, polyglactin, polyester
 - e. Bioprosthetic mesh: Human acellular dermal matrices (Alloderm, Allomax...) and xenograft (Strattice...)
 - f. Larger reconstruction may also incorporate methyl-methacrylate to enhance chest wall stabilization
 - g. Frequently, vascularized soft tissue (as described above) is needed to cover these forms of skeletal reconstruction
- D. Sternal wound infection and dehiscence:
1. Mediastinitis and sternal wound dehiscence are devastating and life threatening complications of median sternotomy incision
 2. Occurs in 0.25-5% of cases
 3. Sternal dehiscence involves separation of the bony sternum and often infection of the deep soft tissues, referred to as mediastinitis, as well as osteomyelitis.
 4. Mortality rates in initial studies near 50% (significantly improved with better ICU and surgical care)
 5. Treatment options:
 - a. Early debridement/ wound excision
 - b. VAC therapy
 - c. Infection control with directed antimicrobial therapy based on blood and tissue culture
 - d. Development of granulation tissue
 - e. Further debridement if necessary
 - f. Rigid sternal plate fixation (provides improved chest and respiratory function as well as cosmetic appearance)
 - g. Primary rigid sternal plate fixation (in lieu of circlage wires) has been shown to decrease complications
 - h. Primary wound closure +/- myocutaneous, muscle, or omentum flaps (usually pectoralis major but others have been described: rectus abdominis, latissimus dorsi and omentum)

- E. Congenital chest wall defects:
 - 1. Pectus excavatum (sunken chest) and pectus carinatum (pigeon chest)
 - a. Pectus excavatum 10 times more common than pectus carinatum
 - b. Indications for treatment:
 - i. Aesthetic
 - ii. Relief of cardio respiratory dysfunction in severe cases
 - iii. Costal cartilage disorganized growth
 - c. Pectus excavatum treatment:
 - i. Nuss procedure:
 - a) Curved, custom-shaped, stainless steel rod is guided through the rib cage and beneath the sternum
 - b) Rod then rotated, turning the curved portion against the chest wall, pushing the ribs and sternum out
 - d. Pectus carinatum treatment:
 - i. Multiple osteotomies of sternum and affected ribs
 - 2. Poland's Syndrome:
 - a. Etiology: subclavian artery supply disruption sequence
 - b. Features:
 - i. Absence of sternal head of pectoralis major
 - ii. Hypoplasia of breast or nipple
 - iii. Deficiency of subcutaneous fat and axillary hair
 - iv. Bony abnormalities of anterior chest wall
 - v. Syndactyly or hypoplasia of ipsilateral extremity
 - vi. Shortening of forearm
 - c. Treatment:
 - i. Can place tissue expander in adolescent female and expand as contralateral breast develops and replace with a permanent implant when the patient reaches breast maturity.
 - ii. May also await full breast development
 - iii. Breast reconstruction (flaps, implants)
 - iv. Can use innervated ipsilateral latissimus to recreate anterior axillary fold

III. ABDOMINAL WALL RECONSTRUCTION

- A. Clinical problems that require abdominal wall reconstruction:
 - 1. Tumor resection
 - 2. Infection (necrotizing fasciitis)
 - 3. Trauma
 - 4. Recurrent ventral wall hernias
 - 5. Congenital abdominal wall defects (gastroschisis, omphalocele)
- B. Principles for abdominal wall reconstruction:
 - 1. To protect and cover the intra-abdominal viscera
 - 2. To repair and prevent herniation with strong fascial support
 - 3. To achieve acceptable surface contour
- C. Algorithm for abdominal wall reconstruction:
 - 1. Primary closure (avoid tension)
 - 2. Mesh (10% hernia recurrence, 7% infection)

3. Allografts / human acellular dermal matrices (ie Alloderm, Allomax)
4. Autogenous skin grafts (over viscera with or without mesh and omentum)
5. Methods of reconstruction relying on local tissues (not applicable in patients who have had multiple previous procedures):
 - a. Components separation release
 - i. Relaxing incisions can be made unilaterally or bilaterally in the external oblique fascia, just lateral to rectus muscle
 - ii. Enables medial transposition of rectus muscle sheath
 - iii. Advancement attainable: 10cm in epigastrium, 20cm at umbilicus and 6cm in suprapubic region
 - b. Tissue expansion
- D. Pedicled muscle and myocutaneous flaps (when synthetic mesh and fascial separation are contraindicated)
 1. Antero-lateral thigh (ALT)
 2. Tensor fascia lata
 3. Gracilis
 4. Rectus femoris
 5. Propeller flaps (flaps pedicled on a particular perforator)
- E. Free flaps
- F. Split thickness skin and/or synthetic mesh directly over bowel (in emergency situations; will often requires further reconstructive surgery)
- G. VAC use can be integrated into the treatment of patients with compromised wound healing
 1. Cases of enteric fistula formation have been associated with the VAC; paradoxically, however, VAC has also been used successfully for the management of fistulae

IV. PRESSURE ULCERS

- A. Unrelieved pressure can lead to tissue ischemia in deep tissue layers near bony prominences leading to tissue necrosis
- B. Can develop within 2 hours of unrelieved pressure
- C. Decubitus was term to describe lying position, however, any area that has sustained pressure can develop into an ulcer, including the sitting position
- D. Term “pressure ulcer” is now preferred over “decubitus ulcer”
- E. Pressure sores often have “iceberg phenomenon”
 1. Since skin can withstand ischemia much better than fat or muscle, a small skin wound on surface can reflect a large amount of deeper tissue necrosis underneath.
- F. Common areas include:
 1. Occipital region
 2. Spine
 3. Sacrum
 4. Coccyx
 5. Ischial tuberosity
 6. Greater trochanter
 7. Heel
 8. Malleoli
- G. Other factors contributing to pressure sore formation:

1. Altered sensory perception
2. Incontinence
3. Exposure to moisture
4. Altered activity and mobility
5. Friction and shear forces (damage to superficial layers can allow bacteria to colonize and result in deeper ulceration)
6. Muscle contractures
7. Cognitive impairment
8. Immunocompromise
9. Prolonged ventilator dependence

H. Staging system:

1. Stage I: Erythema of the skin (may be overlooked in dark-skinned patients)
2. Stage II: Skin ulceration and necrosis into subcutaneous tissue
3. Stage III: Grade II plus muscle necrosis
4. Stage IV: Grade III plus exposed bone/joint involvement

I. Incidence:

1. Bed-bound hospital patients: 10-15%
2. ICU patients: 33%
3. Hip fracture patients: up to 66%

J. Non-surgical treatment:

1. Prevention is the best treatment
 - a. Keep skin clean and dry
 - b. Appropriate nursing care, including turning the patient ever 2 hours (avoid dragging/shearing skin of the patient while repositioning)
 - c. Optimizing nutrition
 - d. Relieving pressure using air mattresses, cushions, heel protectors
 - e. Air fluidized beds (Clinitron®) gold standard for ulcer prevention
2. Systemic infection/sepsis unlikely with pressure ulcer (unless immunocompromised): look for other source, e.g., urinary tract infection or respiratory tract when patients with pressure ulcers present with fevers
3. If localized infection is present (look for signs of local cellulitis) topical antimicrobial agents (Silvadene, Sulfamylon) can be used
4. Bone biopsy best method to assess osteomyelitis vs. osteitis
5. Can direct antibiotic therapy to treat osteomyelitis, but virtually impossible to eradicate infection
6. MRI may be helpful as imaging study, while bone scans are often nonspecific due to presence of periostitis associated with open wounds
7. Long term antibiotics are not indicated
8. Ulcer closure may be accelerated using topical protein growth factors
9. Stage III patients require sharp debridement, highly absorptive dressings (alginates, hydrocolloid beads, foams, hydrogels)
10. VAC therapy may be beneficial to assist closure

K. Surgical treatment:

1. Due to high recurrence rates, surgery tends to be reserved for patients with reversible pathologies
2. Patient motivation is an important determinant of recurrence risk in the alert patient

3. Excisional debridement of ulcer and bursa and any heterotopic calcification
4. Partial or complete ostectomy to reduce bony prominence – may lead to new pressure ulcers elsewhere (be careful when off-loading)
5. Closure of the wound with healthy, durable tissue that can provide adequate padding over the bony prominence (myocutaneous vs. fasciocutaneous flap)
6. Aftercare including appropriate surfaces and wound management are paramount
7. Lifestyle and activity modification often required in order to reduce recurrence risk

V. EXTERNAL GENITALIA

A. Congenital defects:

1. Male child with congenital genital defect should not be circumcised to preserve tissue that may be needed for surgery
2. Hypospadias
 - a. Urethral opening develops abnormally, usually on the underside of the penis
 - b. Occurs in 1/350 male births
 - c. Can be associated with undescended testicles
 - d. Operation around 1 year of age (stimulation with testosterone may increase penile size and aid in wound healing)
 - e. Distal cases can be repaired using local tissue flaps or urethral advancement
 - f. Proximal cases can be repaired using graft urethroplasty or vascularized prepuce flap urethroplasty
3. Epispadias and exstrophy of the bladder
 - a. Failure or blockage of normal development of the dorsal surface of the penis, abdomen, and anterior bladder wall
 - b. 1/30,000 births, three times more common in males
 - c. Epispadias treated similarly to hypospadias, with local tissue flaps
 - d. Bladder exstrophy requires staged, functional reconstruction
 - i. Neonatal period: bladder is closed
 - ii. 1-2 years: epispadia repair
 - iii. 3-4 years: bladder neck reconstruction
4. Ambiguous genitalia
 - a. Evaluation and management requires a team approach and great sensitivity towards the family
 - b. Caused by adrenal hyperplasia, maternal drug ingestion, hermaphroditism
 - c. Karyotype should be obtained immediately
 - d. Pelvic ultrasound can be performed to assess Müllerian anatomy
 - e. Gender assignment needs to take multiple biopsychosocial factors into account
5. Vaginal agenesis
 - a. 1 in 5000 female births
 - b. Absence of proximal portion of vagina in an otherwise phenotypically, chromosomally, and hormonally intact female
 - c. Often undiagnosed until amenorrhea noted
 - d. Reconstruction in puberty by progressive dilation, grafts, or flaps

B. Trauma:

1. Penile and scrotal skin loss injuries

- a. Can bury shaft of penis temporarily then use full thickness or split thickness skin graft
 - b. Scrotum can have split thickness skin grafted
- 2. Penetrating injuries to penis
 - a. Require immediate operative repair
- 3. Penis amputation
 - a. Reattachment is feasible with cold ischemia time of up to 24 hours
 - b. Debride wound and opposing surfaces thoroughly
 - c. Microsurgical approach is preferable
 - i. Urethra re-approximated with Foley as indwelling stent and suprapubic catheter for bladder drainage
 - ii. Dorsal arteries, veins, nerves reconnected
 - iii. Corpora reattached
- 4. Testicle amputation
 - a. microsurgical replantation
 - b. future prosthetic replacement
- C. Phallic reconstruction
 - 1. Subtotal penile loss: release penile suspensory ligament, recess scrotum and suprapubic skin, apply skin graft to remaining stump
 - 2. Total penile loss:
 - a. Pedicled flaps – ALT, tubed abdominal flap, gracilis myocutaneous flap, groin flap
 - b. Free flap – radial forearm, ulnar forearm, ALT, osteocutaneous fibula
 - c. Can be done in one-stage procedure, sensation may be restored, better appearance, competent urethra, may have adequate rigidity (fibula)
 - d. May place inflatable / malleable prosthesis in secondary surgery
- D. Vaginal reconstruction
 - 1. Lining
 - a. Full-thickness skin grafts
 - b. Skin flaps
 - c. Intestinal segments
 - 2. Pedicled VRAM (vertical rectus abdominus myocutaneous) flap
 - 3. Pudendal thigh flap
 - 4. Rectosigmoid vaginoplasty
- E. Infectious:
 - 1. Fournier's gangrene and other necrotizing infections
 - a. Multiple organs commonly cultured
 - b. Infection begins at skin, urinary tract, rectum and spreads to penis, scrotum, perineum, abdomen, thighs, and flanks in the Dartos, Scarpa's, and Colles fascia
 - c. Corpora bodies, glans, urethra, and testes not usually involved
 - d. Treatment primarily extensive surgical debridement of involved tissue
 - e. Drains placed as deemed necessary
 - f. High dose, broad-spectrum antibiotics
 - g. Urinary diversion
 - h. Colostomy if cause from rectal/ perirectal area
 - 2. Hidradenitis suppurativa

- a. Chronic condition
- b. Multiple painful, swollen lesions in the axilla, groin, and other parts of the body that contain apocrine glands
- c. Can involve adjacent subcutaneous tissue and fascia
- d. Sinus tracts form (which can become draining fistulas) in the apocrine gland body areas
- e. Treatment of infected lesions is incision and drainage
- f. Cure may require massive surgical excision to eliminate all apocrine glandular tissue with healing by secondary intention
- g. Antibiotics: Tetracycline and erythromycin may be helpful long-term

CHAPTER 5 – BIBLIOGRAPHY

BREAST, TRUNK AND EXTERNAL GENITALIA

1. Greer SE, Benhaim P, Lorenz HP, Chang J, Hedrick MH. Handbook of Plastic Surgery. Marcel Dekker New York 2004.
2. Thorne CH, Bartlett SP, Bealsey RW, Aston SJ. Grabb and Smith's Plastic Surgery 6th Edition. Lippincott Williams and Wilkins, Philadelphia 2006.
3. Mathes S and Nahai F. **Reconstructive Surgery: Principles, anatomy and technique.** New York, Churchill Livingstone, 1997.
4. Serletti JM, Fosnot J, Nelson JA, Disa JJ, Bucky LP. Breast reconstruction after breast cancer. Plast reconstr Surg 127(6):124e-135e.
5. Hammond DC, Loffredo M. Breast reduction. Plast Reconstr Surg 129(5):829e-839e.
6. Netscher DT, Baumholtz MA. Chest reconstruction: Anterior and anterolateral chest wall and wounds affecting respiratory function. Plast Reconstr Surg 124(5):240e-52e.
7. Netscher DT, Baumholtz MA Bullocks J. Chest reconstruction: Regional reconstruction of chest wall wounds that do not affect respiratory function (axilla, posterolateral chest, and posterior trunk). Plast Reconstr Surg 124(6):427e-35e.
8. Rubayi S, Chandrasekhar BS. Trunk, abdomen and pressure sore reconstruction. Plast Reconstr Surg 128(3):201e-215e.
9. Walsh PC, Retik AB, Vaughan ED, Wein AJ. Campbell's Urology 8th Edition. Saunders Philadelphia 2002.