SerenaGroup
Building the Nation's Leading Wound Care Team

EDUCATION SERIES

THINK HBO!

Presented by: SerenaGroup Education Committee

OCTOBER 2023

TODAY'S Agenda

- What is HBO?
- Types of Chambers
- Effects of Hyperbaric on Body
- Insurance and Approved Indications
- Hyperbaric Evaluation & Checklist
- DFU's & Wagner Grading Grading
- Acute Peripheral Arterial Insufficiency
- Acute Traumatic Ischemia
- Chronic Refractory Osteomyelitis
- Radiation Necrosis
- Compromised Skin Grafts/Flaps
- Necrotizing Tissue Infections

SerenaGroup
Building the Nation's Leading Wound Care Team

What is HBO?

Hyperbaric oxygen therapy, or HBO, is a medical treatment that increases the amount of oxygen in the patient's blood, allowing oxygen to pass more easily through the plasma into the wounds to heal them.

HBO chambers pressurize and surround patients with 100% oxygen at higher than normal atmospheric pressure.(a point greater than at sea level)

This is usually 2 to 2.5 ATA (absolute atmospheres) or mimics the same pressure as scuba diving into 33-45 feet into sea water

SerenaGroup
Building the Nation's Leading Wound Care Team

Two Types of Chambers

Hyperbaric Oxygen Therapy treatments are performed in either Multiplace or Monoplace Chambers.

Treatments are typically Monday – Friday and lasts approximately 2 hours for each treatment. Usual treatment range is between 10 to 60 treatments.

SerenaGroup
Building the Nation's Leading Wound Care Team

Multiplace Chambers

- 1 Technician inside the chamber with the patient during treatment
- 1 Technician on the outside
- More patients at one time
- Allows for monitoring and care of the critically ill patient

◦ EKG monitoring

◦ Ventilators

◦ IV drips

- Allows closer supervision of special needs patients
- Ability to administer mixed gases

SerenaGroup
Building the Nation's Leading Wound Care Team

Monoplace Chambers

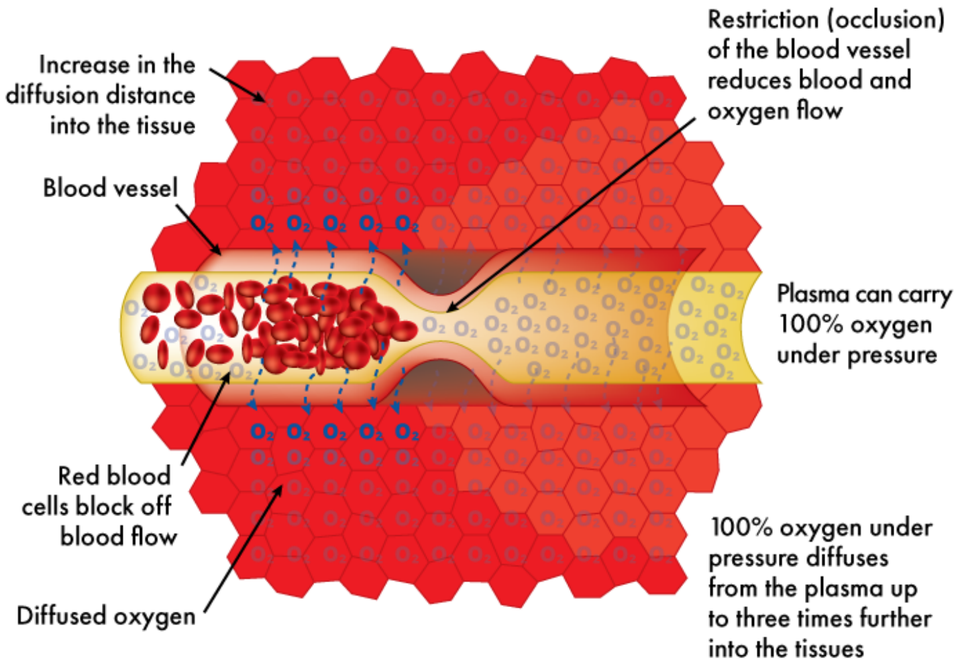
- 1 Patient
- 1 Technician within eyes view at all times
- Intercom for communication
- 100% Oxygen
- TV/DVD Chamber Hook-Up

SerenaGroup
Building the Nation's Leading Wound Care Team

Oxygen & Wound Healing

Hyperbaric Oxygen Therapy can be viewed as an old, established technology with new treatment applications.

One such application is the enhancement of problem healing wounds & certain patients benefit from increased levels of oxygen.



SerenaGroup
Building the Nation's Leading Wound Care Team

Effects Hyperbaric has on the Body

Bactericidal/Bacteriostatic Effects

Think of HBO as an antibiotic enhancing leukocyte bactericidal function,
direct toxic effects on anaerobic bacteria and suppression of exotoxin production

Decreases Swelling

Vasoconstriction causing increase venous return

Increases Angiogenesis

Growth of new blood vessels improving circulation and enhanced collagen synthesis.
Promotes cross-linking and other matrix deposition and increases growth factor production.

Hypoxia

Supply oxygen to tissues that are lacking and increases cellular effects of oxygen

Mechanical Effects

Affects size of gas molecules- decreasing bubble size

Poisoning

Reverse effects of carbon monoxide and cyanide

SerenaGroup
Building the Nation's Leading Wound Care Team

UHMS, Medicare and Insurance

Undersea and Hyperbaric Medicine Society

-They developed, researched and investigated the use of hyperbaric for different conditions (indications) and set up the recommendations based these results.

Medicare

-Determined of these indications which would be a covered condition according to their guidelines

Most Private Insurers

-Follow Medicare guideline- Always good to pull up the individual insures guidelines/policies.

SerenaGroup
Building the Nation's Leading Wound Care Team

UHMS and Medicare Approved Conditions for HBOT

- Radiation Necrosis-Soft and Bony (Osteo)
- Skin Grafts or Flaps (Failed/Compromised)
- Crush Injuries
- Acute Peripheral Arterial Insufficiencies
- Acute Traumatic Ischemia
- Osteomyelitis (Chronic Refractory)
- Gas Gangrene (Clostridial)
- Anaerobic Infection (Actinomycosis)
- Necrotizing Infections
- Diabetic Wounds- Wagner Grade 3 or higher with no response to standard wound care

SerenaGroup
Building the Nation's Leading Wound Care Team

Acute Indications (Usually Critically Ill)

Multiplace Chamber Recommended

- Decompression Sickness
- Carbon Monoxide Poisoning
- Air/Gas Embolus (Acute)
- Cyanide Poisoning

Other Additional Indications
-LCD Driven-

- Exceptional Blood Loss (Anemia)
- Thermal Burns

SerenaGroup
Building the Nation's Leading Wound Care Team

Hyperbaric Evaluation

UHMS and payer sources, i.e., Medicare, require that a physician with specialty training in Hyperbaric Medicine evaluate the patient according to rigid criteria.

Wound Care Providers cannot perform consultation unless they have had Hyperbaric training.

The Hyperbaric staff cannot perform HBOT treatments on any patient unless ordered by a Hyperbaric Medicine Physician.

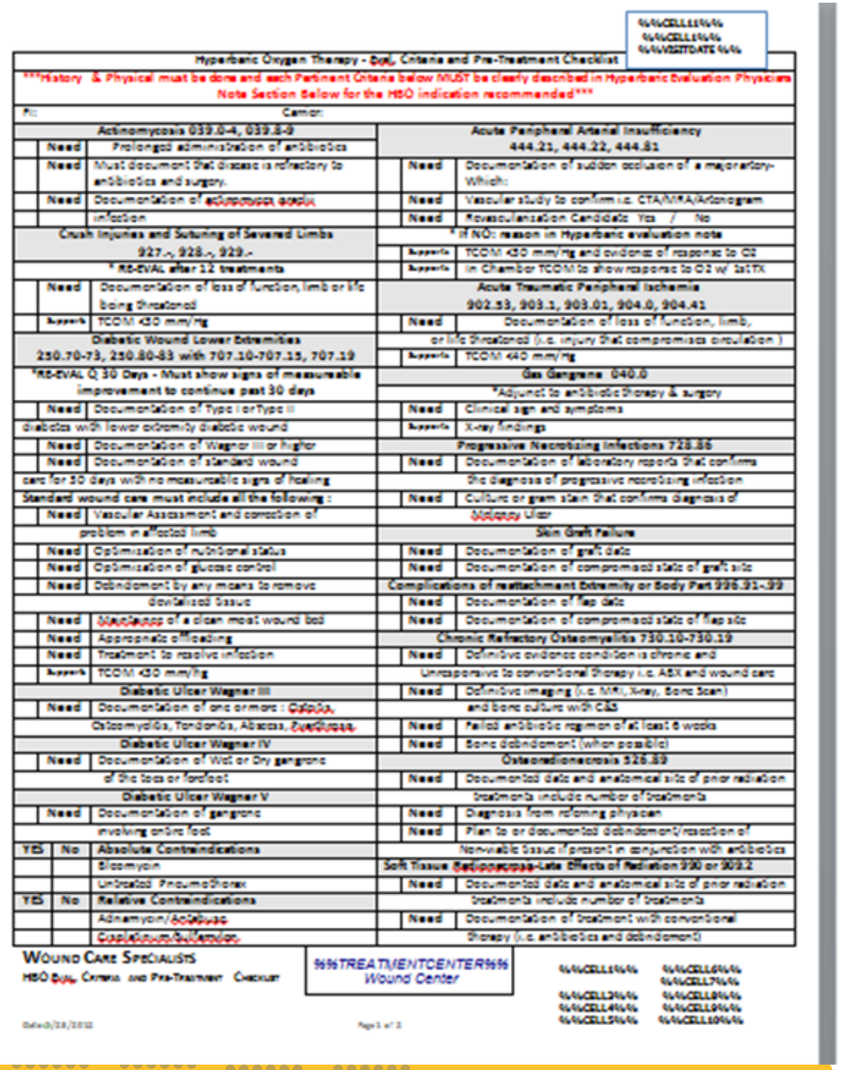
SerenaGroup
Building the Nation's Leading Wound Care Team

Hyperbaric Evaluation

- Clear Clinical Documentation of Medical Necessity!
- HBO Eval, Criteria and Pre-Treatment Checklist (if rolled out)
- HBO Initial Start Orders
- HBO Consent
- HBO Patient/Caregiver Education
- HBO Plan of Care
- HBO Daily Treatment Record
- HBO Utilization Review & Orders

SerenaGroup
Building the Nation's Leading Wound Care Team

Hyperbaric Eval, Criteria and Pre-Treatment Checklist



%%CELL11%%
%%CELL12%%
%%VISITDATE%%

Hyperbaric Oxygen Therapy - Eval, Criteria and Pre-Treatment Checklist

History & Physical must be done and each Pertinent Criteria below MUST be clearly described in Hyperbaric Evaluation Physicians Note Section Below for the HBO indication recommended

Pt: Cancer:

Actinomycosis 039.0-4, 039.8-9		
	Need	Prolonged administration of antibiotics
	Need	Must document that disease is refractory to antibiotics and surgery.
	Need	Documentation of actinomyces israelii infection
Crush Injuries and Suturing of Severed Limbs 927.-, 928.-, 929.-		
*** RE-EVAL after 12 treatments**		
	Need	Documentation of loss of function, limb or life being threatened
	Supports	TCOM <30 mm/Hg
Diabetic Wound Lower Extremities 250.70-73, 250.80-83 with 707.10-707.15, 707.19		
***RE-EVAL Q 30 Days - Must show signs of measureable improvement to continue past 30 days**		
	Need	Documentation of Type I or Type II diabetes with lower extremity diabetic wound
	Need	Documentation of Wagner III or higher
	Need	Documentation of standard wound care for 30 days with no measurable signs of healing
Standard wound care must include all the following :		
	Need	Vascular Assessment and correction of problem in affected limb
	Need	Optimization of nutritional status
	Need	Optimization of glucose control
	Need	Debridement by any means to remove devitalized tissue
	Need	Maintenance of a clean moist wound bed
	Need	Appropriate offloading
	Need	Treatment to resolve infection
	Supports	TCOM <30 mm/Hg
Diabetic Ulcer Wagner III		
	Need	Documentation of one or more : Cellulitis, Osteomyelitis, Tendonitis, Abscess, Fasciitis
Diabetic Ulcer Wagner IV		
	Need	Documentation of Wet or Dry gangrene of the toes or forefoot
Diabetic Ulcer Wagner V		
	Need	Documentation of gangrene involving entire foot
YES / No		**Absolute Contraindications**
		Bleomycin
		Untreated Pneumothorax
YES / No		**Relative Contraindications**
		Adriamycin/ Actinomycin
		Cisplatin/Oxaliplatin

Acute Peripheral Arterial Insufficiency 444.21, 444.22, 444.81		
	Need	Documentation of sudden occlusion of a major artery- Which:
	Need	Vascular study to confirm i.e. CTA/MRA/Arteriogram
	Need	Revascularization Candidate Yes / No
		* If NO: reason in Hyperbaric evaluation note
	Supports	TCOM <30 mm/Hg and evidence of response to O2
	Supports	In Chamber TCOM to show response to O2 w/ 1st Tx
Acute Traumatic Peripheral Ischemia 902.53, 903.1, 903.01, 904.0, 904.41		
	Need	Documentation of loss of function, limb, or life threatened (i.e. injury that compromises circulation)
	Supports	TCOM <40 mm/Hg
Gas Gangrene 040.0		
		*Adjunct to antibiotic therapy & surgery
	Need	Clinical sign and symptoms
	Supports	X-ray findings
Progressive Necrotizing Infections 728.86		
	Need	Documentation of laboratory reports that confirms the diagnosis of progressive necrotizing infection
	Need	Culture or gram stain that confirms diagnosis of Mixed Flora Ulcer
Skin Graft Failure		
	Need	Documentation of graft date
	Need	Documentation of compromised state of graft site
Complications of reattachment Extremity or Body Part 996.91-.99		
	Need	Documentation of flap date
	Need	Documentation of compromised state of flap site
Chronic Refractory Osteomyelitis 730.10-730.19		
	Need	Definitive evidence condition is chronic and unresponsive to conventional therapy i.e. ABX and wound care
	Need	Definitive imaging (i.e. MRI, X-ray, Bone Scan) and bone culture with C&S
	Need	Failed antibiotic regimen of at least 6 weeks
	Need	Bone debridement (when possible)
Osteoradionecrosis 526.89		
	Need	Documented date and anatomical site of prior radiation treatments include number of treatments
	Need	Diagnosis from referring physician
	Need	Plan to or documented debridement/resection of Non-viable tissue if present in conjunction with antibiotics
Soft Tissue Radionecrosis-Late Effects of Radiation 990 or 909.2		
	Need	Documented date and anatomical site of prior radiation treatments include number of treatments
	Need	Documentation of treatment with conventional therapy (i.e. antibiotics and debridement)

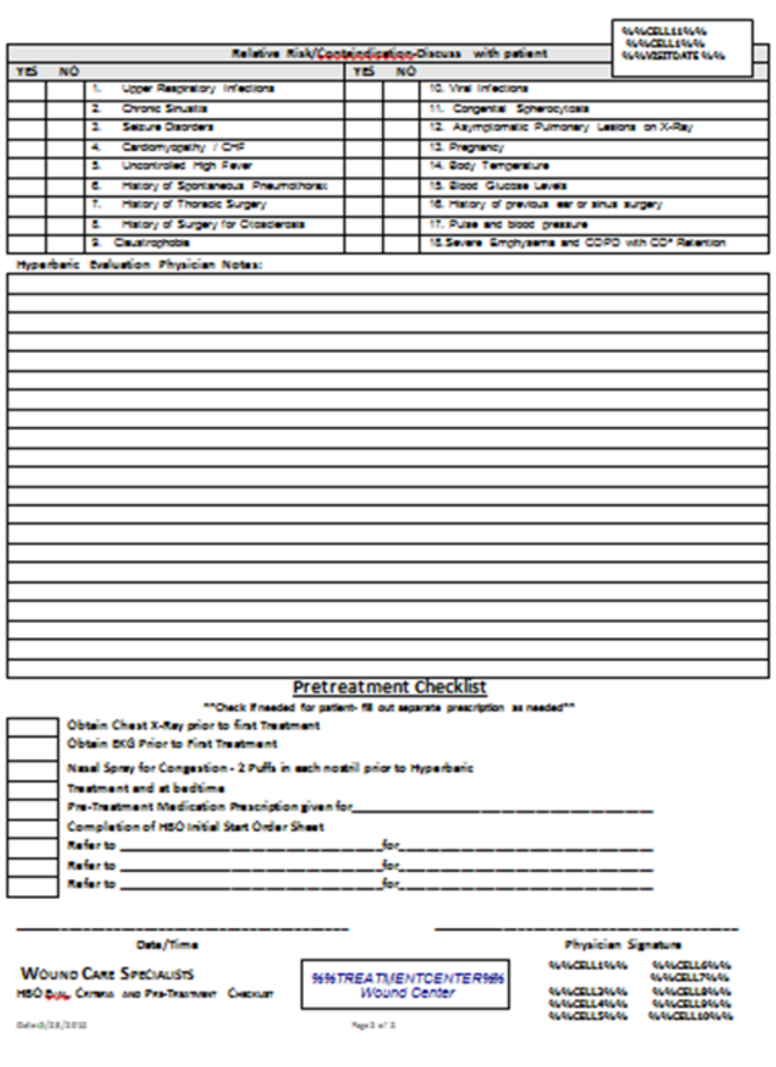
WOUND CARE SPECIALISTS
HBO Eval, Criteria and Pre-Treatment Checklist

%%TREATMENTCENTER%%
Wound Center

%%CELL1%% %%CELL6%%
%%CELL2%% %%CELL7%%
%%CELL3%% %%CELL8%%
%%CELL4%% %%CELL9%%
%%CELL5%% %%CELL10%%

Date/Time

Page 1 of 2



%%CELL11%%
%%CELL12%%
%%VISITDATE%%

Relative Risk/Contraindication-Discuss with patient

YES	NO		YES	NO	
		1. Upper Respiratory Infections			10. Viral Infections
		2. Chronic Sinusitis			11. Congenital Spherocytosis
		3. Seizure Disorders			12. Asymptomatic Pulmonary Lesions on X-Ray
		4. Cardiomyopathy / CHF			13. Pregnancy
		5. Uncontrolled High Fever			14. Body Temperature
		6. History of Spontaneous Pneumothorax			15. Blood Glucose Levels
		7. History of Thoracic Surgery			16. History of previous ear or sinus surgery
		8. History of Surgery for Otosclerosis			17. Pulse and blood pressure
		9. Claustrophobia			18.Severe Emphysema and COPD with CO2 Retention

Hyperbaric Evaluation Physician Notes:

Pretreatment Checklist

Check if needed for patient- fill out separate prescription as needed

- Obtain Chest X-Ray prior to First Treatment
- Obtain EKG Prior to First Treatment
- Nasal Spray for Congestion - 2 Puffs in each nostril prior to Hyperbaric Treatment and at bedtime
- Pre-Treatment Medication Prescription given for_____
- Completion of HBO Initial Start Order Sheet
- Refer to _____for_____
- Refer to _____for_____
- Refer to _____for_____

Physician Signature

WOUND CARE SPECIALISTS
HBO Eval, Criteria and Pre-Treatment Checklist

%%TREATMENTCENTER%%
Wound Center

%%CELL1%% %%CELL6%%
%%CELL2%% %%CELL7%%
%%CELL3%% %%CELL8%%
%%CELL4%% %%CELL9%%
%%CELL5%% %%CELL10%%

Page 2 of 2

SerenaGroup
Building the Nation's Leading Wound Care Team

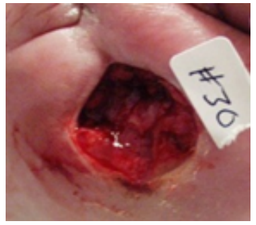
Diabetic Lower Extremity Ulcers

- Lower extremity ulcers in diabetic patients are complex and problem healing wounds that often have co-morbid problems that require attention.
- Lower extremity ulcers and amputations are an increasing problem for people with diabetes.
- In all diabetics who experience a hospital admission up to 6% of them include a lower extremity ulcer as a discharge diagnosis.
- Approximately 5% of diabetics develop foot ulcers each year and 1% require amputation.
- Once an amputation occurs, 9-20% of diabetic patients will experience an ipsilateral or contralateral amputation within 12 months and 28-52% within five years.
- The cost of care for a new diabetic foot ulcer has been calculated to be $27,987 in the two years following diagnosis.

Hyperbaric Oxygen 2003: Indications and Results, The Hyperbaric Oxygen Therapy Committee Report by John J. Feldmeier, D.O., Chairman and Editor. Copyright 2003, Undersea and Hyperbaric Medical Society, Inc., Kensington, MD.

SerenaGroup
Building the Nation's Leading Wound Care Team

Wagner Grading System

Grade 0	Intact Skin	
Grade I	Superficial without penetration deeper layers	
Grade II	Which penetrates through Subcutaneous tissue and may reach tendon, bone, or joint capsule (No Infection) (Rule out Infection)	
Grade III	Deeper with abscess, osteomyelitis, osteitis, pyarthrosis, or infection of the tendon and tendon sheaths **Consider HBO**	
Grade IV	Wet or dry gangrene in a toe, toes, forefoot or any area with localized gangrene. **Consider HBO**	
Grade V	Gangrene of lower extremity requiring amputation **Consider HBO**	

SerenaGroup
Building the Nation's Leading Wound Care Team

Hyperbaric for Diabetic Foot Ulcers

Diabetic Type I or II

-Who is documented as controlled

-Diabetic Wagner Grade 3 or higher ulcer

-Documentation of Standard Wound Care for 30 days with no measurable signs of healing.

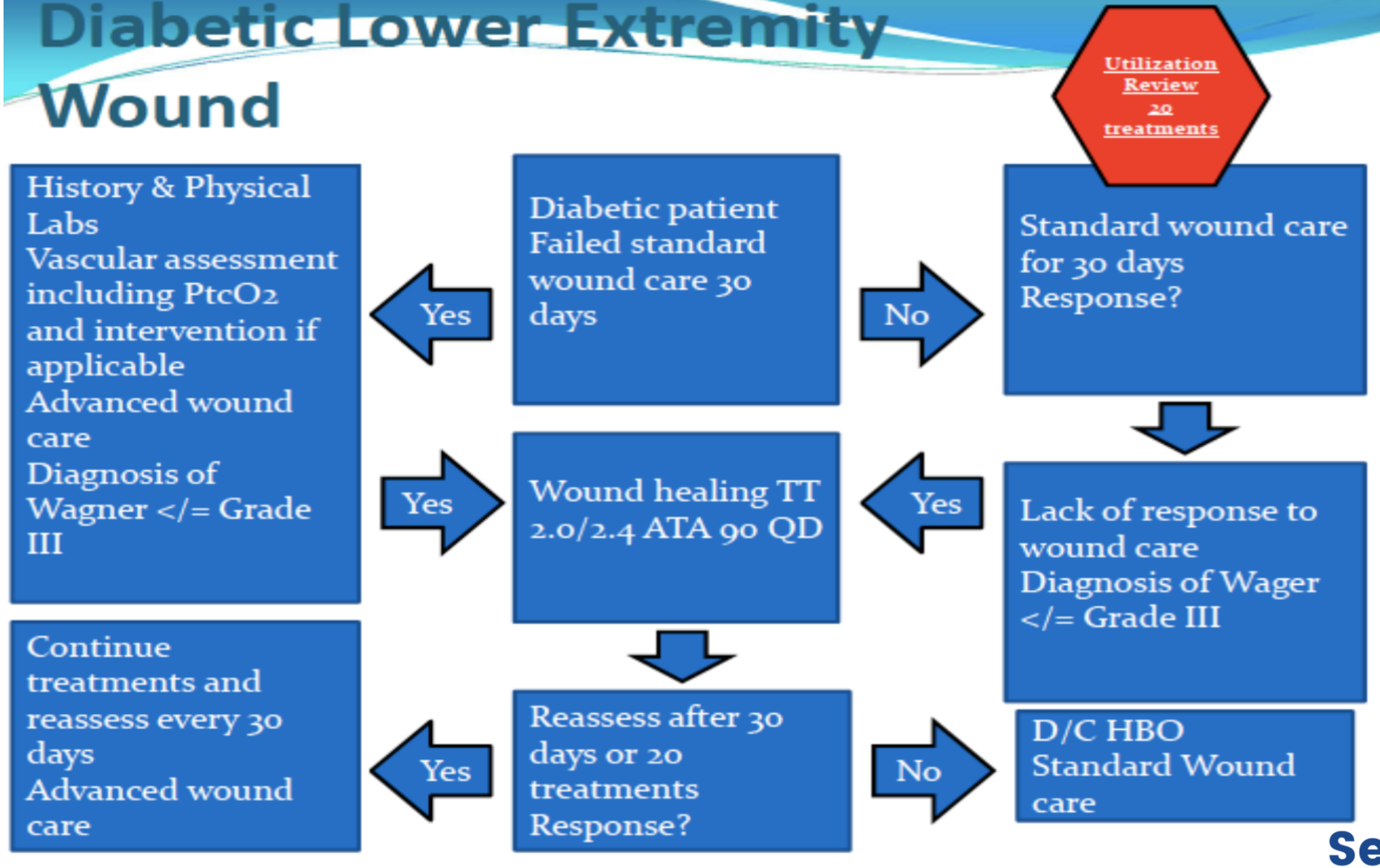
SerenaGroup
Building the Nation's Leading Wound Care Team

What is Standard Wound Care?

- Vascular Assessment (ABI >.6) and correction of problem to affected limb or reasoning of why not!
- Optimization of nutritional status
- Optimization of Glucose control(HgBA1C <8)
- Debridement by any means to remove devitalized tissue
- Maintenance of a clean , moist wound bed
- Appropriate offloading
- Treatment to resolve infection
- Smoking Cessation Education

SerenaGroup
Building the Nation's Leading Wound Care Team

Diabetic Lower Extremity Wound



Acute Peripheral Arterial Insufficiency- Thrombus/Embolism

- **Must** have a vascular study to confirm- i.e.- MRA/CTA Arteriogram
- Documentation of a **sudden** occlusion of a major artery
- Documentation that the extremity is at risk for necrosis or amputation
- **Surgery/Revascularization is treatment choice** - if not reason must be documented
- Recommended to have a transcutaneous oxygen measurement of **less than 30 mm/hg** with an oxygen challenge and evidence of a response to oxygen

Acute Traumatic Ischemia

Necessary to document loss of function, limb or life threatening condition

Includes:

- Crush Injuries
- Acute Traumatic Peripheral Ischemia
- Severed Limbs
- Compartment syndromes
  - -A result of injury by and external force or violence compromising circulation to an extremity
  - -Documentation that the extremity is at risk for necrosis or amputation
  - -Recommended to have a TCOM oxygen measurement of less than 30 mm/hg with an oxygen challenge and evidence of response to oxygen

Crush Injury / Acute Peripheral Ischemia

Acute traumatic thrombotic or embolic extremity injury
Elevated compartment pressures
History & physical
Labs X-rays
PtcO2 study
Advanced wound care

Yes

Extremity danger
Increased compartment pressures

No

History & physical
Surgical consult if extremity is in danger

Wound healing TT 2.0/2.4 ATA TID in 48 hrs

Wound healing TT 2.0/2.4 ATA as required

Continue advanced wound care

Utilization Review 5-7 days

Chronic Refractory Osteomyelitis

HBOT is useful as adjunctive therapy for this serious condition

- Osteomyelitis is the infection of bone or bone marrow
- Refractory – is defined as a chronic osteomyelitis that persists or reoccurs after appropriate interventions have been performed or where acute osteomyelitis has not responded to the accepted management techniques
- Must be documented as unresponsive to conventional therapy i.e. antibiotics and wound care
- Patient must have an X-Ray, MRI, or nuclear scan for imaging and bone culture with C&S
- Must have received a complete series of culture sensitive antibiotics
- Bone debridement should be preformed when possible

Chronic Refractory Osteomyelitis

Clinical presentation & diagnosis with C&S of bone
Failure of antibiotic therapy & surgical intervention

Yes

Confirm diagnosis of chronic osteomyelitis
History & physical
Labs
X-ray
$PtcO_2$ study
C&S
Surgical management
Antibiotic therapy
Advanced wound care

NO

Continue standard therapies until resolution or becomes chronic

Wound healing TT
2.0/2.4 ATA QD

Reassessment after 30 days or 20 treatm
Continue to treat with resolution
Surgical management
C&S
Advanced wound care

Utilization Review 30 treatments

SerenaGroup
Building the Nation's Leading Wound Care Team

Chronic Refractory Osteomyelitis: Case Study

- 7.0 cm L x 3.5cm W x3.4D
- IV and long term PO antibiotic therapy based on specific organisms (Bone cultures)
- Debridement
- Wound Care
- Offloading if pressure

Added HBOT

SerenaGroup
Building the Nation's Leading Wound Care Team

Chronic Refractory Osteomyelitis: Case Study

Post HBOT

- Patient completed 40 HBOT Treatments
- Measurements:
  2.3cm L x 0.8 cm W x 0.6 cm D
- Continued Wound Care.
- Patient healed four weeks post HBOT

SerenaGroup
Building the Nation's Leading Wound Care Team

Radiation Necrosis

Late Effects of Radiation or Delayed Radiation Injury

Types

- Soft Tissue
  - -Laryngeal
  - -Soft tissue of the Head or Neck
  - -Internally- Cystitis, Enteritis, Proctitis
  - -Extremity
  - -Any area that has been radiated and there is now wound with poor healing
- Bony Tissue
  - -Osteoradionecrosis
  - -Mandibular Radiation Necrosis

NOTE: (ORN)(MARX Protocol- ONLY Preventative Indication)

Radiation Tissue Damage (Osteoradionecrosis)

Clinical presentation – non healing wound or surgical failure
History of radiation therapy
Planned dental extraction

Yes

Confirm diagnosis
History of radiation
History & physical
Labs
Chest X-ray
Consider culture & biopsy
$PtcO_2$ study
Surgical Consult
Advanced wound care

No

Continue standard therapies until resolution

Wound healing TT 2.0/2.4 ATA QD x 20 treatments (Marx protocol)

Surgical intervention

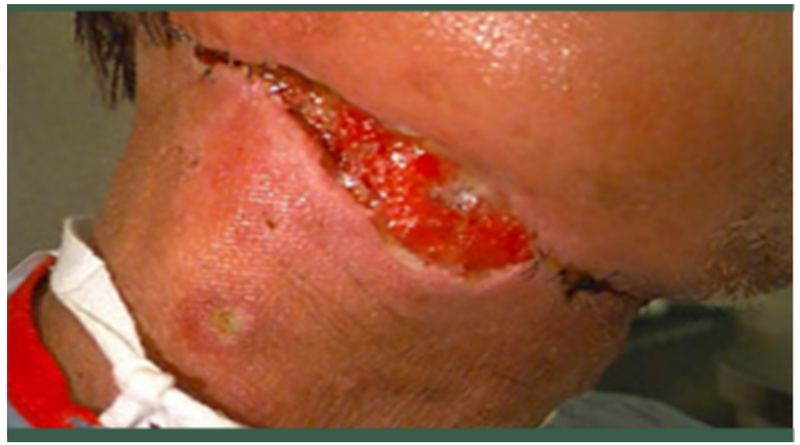
Utilization Review 60 treatments

Wound healing TT 2.0/2.4 ATA QD x 10 treatments post surgery (Marx protocol continuation)

SerenaGroup
Building the Nation's Leading Wound Care Team

Delayed Radiation Injury: Case Study

Initial



After 5 Treatments

After 13 Treatments

After 36 Treatments

Compromised Skin Grafts/Flaps

HBOT is useful in comprised, high risk grafts & flaps

- Any skin grafts that has any signs of failing or not completely healed post-op.
- Any surgical closure with a flap documented that has not healed (including amputation sites)

**Important that patients with grafts or flaps are looked at as soon as possible after surgery to determine if the graft looks at all dusky, discolored , cyanotic if so they should begin HBO and initially up to 2 times a day.

Compromised Skin Grafts or Flaps

Presentation of compromised or failed skin graft or flap (not in the primary management)

Yes

Confirm failed graft or flap
Compromised skin graft or flap – dusky or dark
History & physical
Labs
PtcO2 study
Chest X-ray
Surgical management
Advanced wound care

No

If future failure or compromise of skin graft or flap consider HBO
PtcO2 study to determine compromise

Wound healing TT 2.0/2.4 ATA TID –BID- QD

More aggressive TT in 1st 24 hours with compromise

Surgical management
Reassess every 10 treatments
D/C treatment when stabilized or bed is prepared

Utilization Review 20 treatments

SerenaGroup
Building the Nation's Leading Wound Care Team

Failed Skin Graft: Case Study

- Traumatic Injury with bone exposure - 8 weeks ago
- Skin graft performed and failure to heal
- Bone exposed with 0.6 cm depth at 5 o'clock

Added HBOT

SerenaGroup
Building the Nation's Leading Wound Care Team

Failed Skin Graft: Case Study

Post HBOT

Complete healing after 6 weeks of HBOT

Necrotizing Tissue Infections

Including

- Gas Gangrene- Positive culture for clostridia and Gas in the tissue***
- Progressive Bacterial Gangrene- Culture positive with Staph , Strep with proteus and a gangrenous appearance
- Necrotizing Fascitis- Culture positive Strep pyogenes (Group A hemolytic Strep), Staph Aureus and Enterbacteriacea
- Fournier's Gangrene-genital pain, redness, swelling- can be scrotal or vuvular
- Actinomycosis-Culture positive for Actnimycosis and painful abscess usually mouth, lungs, or GI tract

Some of the other infections can have gas in tissues

The majority of these types of infections are typically treated as inpatients.

SerenaGroup
Building the Nation's Leading Wound Care Team

Necrotizing Soft Tissue Infections

ALS
History & physical
Surgical management
Labs
Chest X-ray
X-ray affected areas
ECG
Antibiotic therapy
Advanced wound care

Yes

Clinical presentation & diagnosis with C&S
Necrotizing fasciitis, Fournier' s gangrene, polymicrobial anaerobic infections

No

Surgical management
Antibiotic therapy
Advanced wound care

Wound healing TT 2.0/2.4 ATA TID for 24 hours

Utilization Review
30 treatments

Wound healing TT 2.0/2.4 ATA QD as required

Response dictates number of treatments

Necrotizing Fasciitis

Gas Gangrene

THANK YOU

The SerenaGroup Education Committee

SerenaGroup
Building the Nation's Leading Wound Care Team