L'ecografia muscolare bed-side nella valutazione della Sarcopenia

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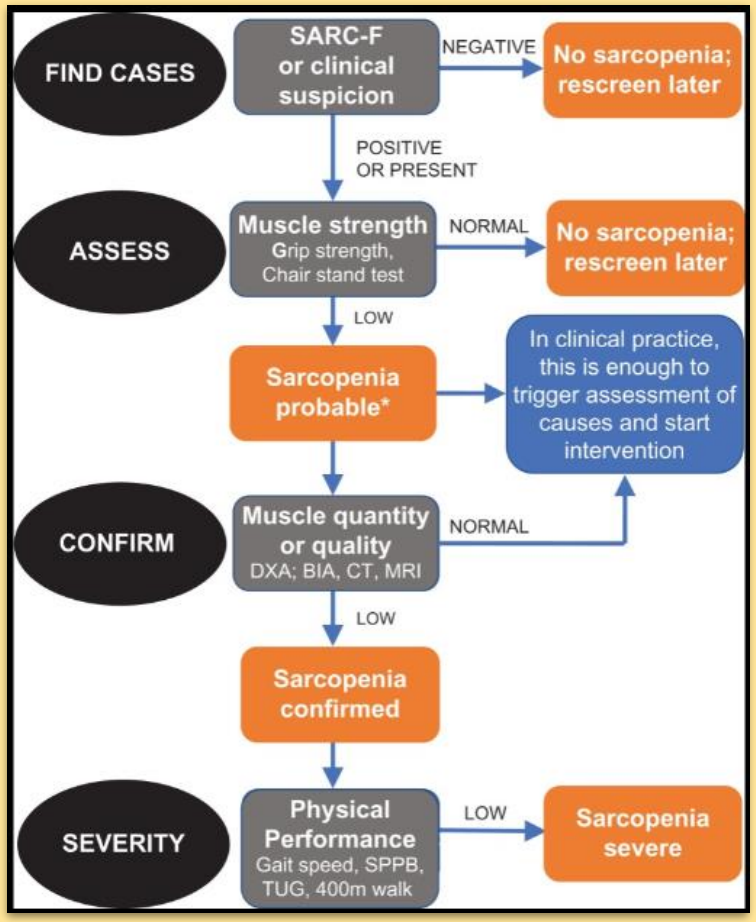
❖ Definizione: l'algoritmo EWGSOP2



Cruz-Jentoft et al. Age Ageing 2019

Age Ageing. 2019 Jan 1;48(1):16-31. doi: 10.1093/ageing/afy169.

Sarcopenia: revised European consensus on definition and diagnosis

Table 1.

2018 operational definition of sarcopenia

Probable sarcopenia is identified by Criterion 1.

Diagnosis is confirmed by additional documentation of Criterion 2.

If Criteria 1, 2 and 3 are all met, sarcopenia is considered severe.

1. Low muscle strength
2. Low muscle quantity or quality
3. Low physical performance

Cruz-Jentoft et al. Age Ageing 2019

❖ Diagnosi: metodiche a confronto

Table 2 Main advantages and disadvantages of each technique in assessment of body composition

Technique	Advantages	Disadvantages
DXA	High precision, accuracy and reproducibility	Variability of instrument calibration procedures, hardware and software version between manufacturers
	Quick and noninvasive	Requires specific technical skills and operator experience
	Good availability	Contraindicated in pregnancy
	Low radiation exposure	Body thickness and hydration status may influence the measurements
	Able to differentiate FM, LM and BMC	Inability to discriminate the different types of fat (visceral, subcutaneous and intramuscular)
	Possibility of obtaining regional measures (e.g., ALM)	
BIA	Quick and noninvasive	Results based on population-specific regression equations, not always available
	Good availability	Variation in hydration status of the patient, in the positioning of the electrodes and in numerous other variables may alter consistently the results
	No radiation exposure	
	Ease of use	
CT	High accuracy and reproducibility	Requires specific technical skills and operator experience
	High image resolution	High cost
	Able to discriminate the different tissues at anatomical level, also estimating the degree of fat infiltration into the muscle	High radiation exposure
		Not always available
		Requires high patient compliance
MRI	High accuracy and reproducibility	Requires specific technical skills and operator experience
	High image resolution	High cost
	Most accurate technique able to discriminate the different tissues at anatomical level	Scarcely available
		Requires high patient compliance
	Most accurate estimation of the degree of fat infiltration into the muscle	

Guglielmi et al, Aging Clin Exp Res, 2016

❖ Diagnosi: metodiche a confronto

METODICA	QUANTITATIVA	QUALITATIVA	PRATICITÀ CLINICA
DXA	✓	✗	✓
BIA	✓	✗	✓
CT	✓	✓	✗
MRI	✓	✓	✗

- Diagnosi: Eco bed-side 2020 SARCUS update

European Geriatric Medicine
https://doi.org/10.1007/s41999-020-00433-9

REVIEW

Check for updates

Application of ultrasound for muscle assessment in sarcopenia: 2020 SARCUS update

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- Diagnosi: Eco bed-side 2020 SARCUS update

European Geriatric Medicine
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REVIEW

Check for updates

Application of ultrasound for muscle assessment in sarcopenia: 2020 SARCUS update

Key summary points

Aim Standardizing the use of ultrasound in the assessment of muscle and sarcopenia.

Findings Approach of muscle assessment has been updated according to the most recent literature and anatomical landmarks for 39 different muscles are provided.

Message Using these recommendations, ultrasonographical muscle assessment can be standardized worldwide.

❖ Diagnosi: Eco bed-side 2020 SARCUS update

VANTAGGI ✓

- Veloce, non invasiva
- Disponibilità al letto del paziente
- Assenza di radioesposizione
- Valutazione qualitativa
- Accuratezza comparabile al gold-standard (TC, RM, DXA)
- Basso costo

SVANTAGGI ✗

- Specifiche competenze tecniche ed esperienza dell'operatore
- Elevata compliance da parte del paziente
- Bassa riproducibilità per operatore-dipendenza
- Esperienza limitata

❖ Diagnosi: Eco bed-side 2020 SARCUS update

METODICA	QUANTITATIVA	QUALITATIVA	PRATICITÀ CLINICA	CUT-OFF
CT	✓	✓	✗	✗
MRI	✓	✓	✗	✗
DXA	✓	✗	✓	✓
BIA	✓	✗	✓	✓
US	✓	✓	✓	✗

❖ Eco bed-side 2020 SARCUS update

Database di PUBMED, WEB OF SCIENCE, SCOPUS (n = 1848 → n = 65)
1.01.2018 - 31.01.2020

- ❑ POSIZIONE DEL PAZIENTE
  - ❑ Clinostatismo (decubito supino, laterale,... in base al muscolo da esplorare)
  - ❑ **t0' - t5'** - t10' - t15'
- ❑ PARAMETRI MUSCOLARI:
  - ❑ 5 parametri di base: Muscle thickness **(MT)**, Muscle cross-sectional area **(CSA)**, Pennation angle **(PA)**, Fascicle length **(Lf)**, Echo-intensity **(EI)**
  - ❑ 4 parametri aggiuntivi: Muscle volume **(MV)**, Muscle stiffness **(MS)**, Muscle contraction, Muscle microcirculation
- ❑ "LANDMARKS" ANATOMICI
  - ❑ Testa e collo
  - ❑ Arti superiori ed inferiori
  - ❑ Torace
  - ❑ Addome

❖ Eco bed-side 2020 SARCUS update

Database di PUBMED, WEB OF SCIENCE, SCOPUS (n = 1848 → n = 65)
1.01.2018 - 31.01.2020

❖ Eco bed-side 2020 SARCUS update: LA POSIZIONE DEL PAZIENTE

Raccomandazioni:

1. EVITARE ESERCIZIO FISICO 30 MINUTI PRIMA DELL'ESAME
2. DOPO L'ASSUNZIONE DI CLINOSTATISMO:
   - Evidenza di variazione tra t0' - t5'
   - "Plateau" a t10' - t15' (MT, CSA, EI)

1. POSIZIONARE CUSCINO SOTTO LE GAMBE:
   - Piedi puntati verso l'alto, no rotazione esterna delle anche
   - Diverso grado di flessione delle anche

NEI CONTROLLI USARE SEMPRE LA STESSA POSIZIONE NELLO STESSO PAZIENTE PER LO STESSO MUSCOLO/GRUPPO MUSCOLARE RISPETTO LA PRIMA MISURAZIONE

❖ Eco bed-side 2020 SARCUS update: I PARAMETRI MUSCOLARI

Stany Perkisas et al. - European Geriatric Medicine Society 2018

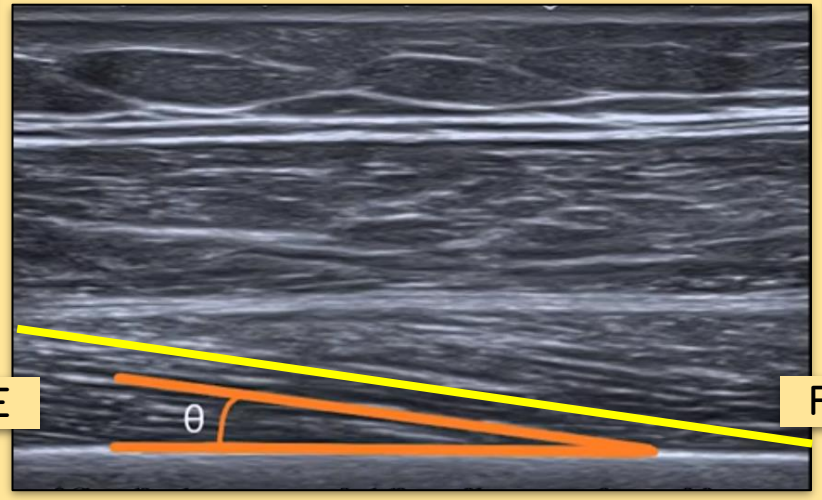
- ❑ **MUSCLE THICKNESS (MT):** distanza tra aponeurosi superficiale e profonda
  → scansione trasversale/longitudinale
- ❑ **CROSS-SECTIONAL AREA (CSA):** Anatomical CSA vs Physiological CSA
  → scansione trasversale
- ❑ **PENNATION ANGLE:** angolo di inserzione delle fibre presso aponeurosi profonda
  → proporzionale a n° sarcomeri in parallelo → forza
- ❑ **FASCICLE LENGHT (Lf):** lunghezza del fascio tra aponeurosi profonda e superficiale
  → proporzionale a n° sarcomeri in serie → escursione contrattile
- ❑ **ECHO INTENSITY (EI):** "brightness" delle immagini
  → miosteatosi? fibrosi?

❖ Eco bed-side 2020 SARCUS update: I PARAMETRI MUSCOLARI

MUSCLE THICKNESS

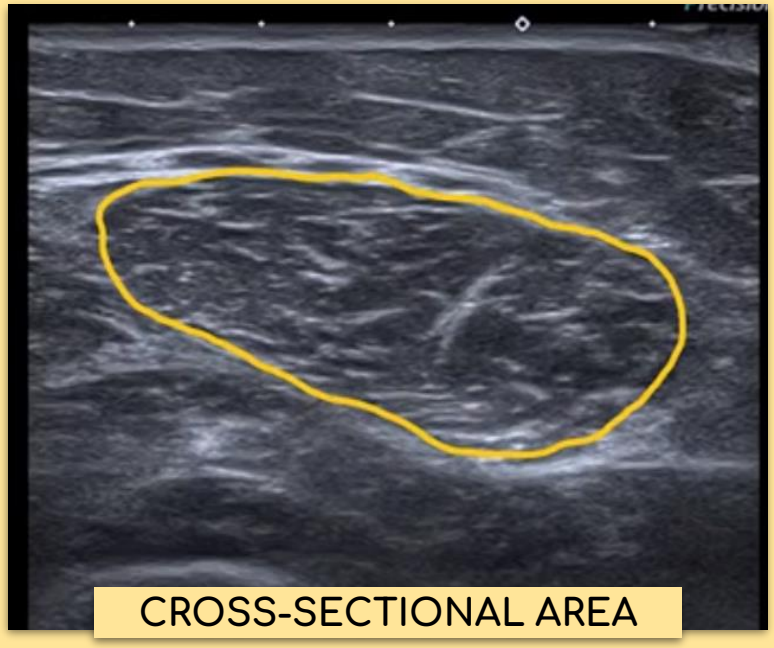
Nuove proposte: MT/peso; MT/BMI

The SARCUS project.
2019, February, 9.
SARCUS instructional video



PENNATION ANGLE

Propozionale a n° sarcomeri in //
e quindi alla FORZA GENERABILE



CROSS-SECTIONAL AREA

In muscoli pennati: CSA ≠ PSCA

FASCICLE LENGTH

FL (mm) = MT(mm) ∗ sin (PA)–1
FL = sin (AA + 90◦) ∗ MT/sin [180◦ – (AA + 180◦ – PA)

❖ Eco bed-side 2020 SARCUS update: I PARAMETRI MUSCOLARI

- ❑ **MUSCLE VOLUME:** MV = 0.3 * MT + 30.5 * LL (MV=muscle volume, MT=muscle thickness, LL=limb length)
- ❑ **STIFFNESS:** il ruolo dell'elastografia muscolare

  → rapporto tra potenziale di deformazione e compressione del muscolo

  → correlazione tra ridotta elasticità → massa → forza → performance fisica
- ❑ **MUSCLE CONTRACTION:** relazione tra CSA a riposo e CSA in massima contrazione
- ❑ **MICROCIRCULATION:**

  → CEUS

❖ Eco bed-side 2020 SARCUS update: I PARAMETRI MUSCOLARI

QUANTITATIVI	QUALITATIVI
➢ MUSCLE THICKNESS	➢ ECHO-INTENSITY
➢ MUSCLE CROSS-SECTIONAL AREA	➢ FASCICLE LENGHT
➢ MUSCLE VOLUME	➢ PENNATION ANGLE
	➢ MUSCLE CONTRACTION
	➢ MICROCIRCULATION
	➢ STIFFNESS

❖ Eco bed-side 2020 SARCUS update: I "LANDMARKS" ANATOMICI

Stany Perkisas et al. - European Geriatric Medicine Society 2018

Table 6 Proposed anatomical landmarks for each muscle discussed

	Proximal landmark	Distal landmark	Asymmetry
Lower limb			
Rectus femoris	Greater trochanter	Proximal border of patella	Minimal
Vastus lateralis	Greater trochanter	Proximal border of patella	Minimal
Vastus medialis	Greater trochanter	Proximal border of patella	Minimal
Vastus intermedius	Greater trochanter	Proximal border of patella	Minimal
Biceps femoris (long head)	Ischial tuberosity	Proximal head of fibula	Minimal
Tibialis anterior	Lateral condyle (anterior) of tibia	US-measurement dependant	Minimal
Gastrocnemius (medialis)	Medial condyle (posterior) of the femur	US-measurement dependant	Minimal
Gastrocnemius (lateralis)	Medial condyle (posterior) of the femur	US-measurement dependant	Minimal
Soleus	Proximal head of fibula (posterior part)	Posterior superior part of calcaneus	Yes
Upper limb			
Biceps brachii	Anterior part of acromion process (acromio-clavicular joint)	Elbow crease where tendon can be palpated	Yes
Triceps brachii	Most lateral distal part of acromion	Tip of olecranon	Yes

❖ Eco bed-side 2020 SARCUS update: I "LANDMARKS" ANATOMICI

Stany Perkisas et al. - European Geriatric Medicine Society 2018

Raccomandazioni:

EFFETTUARE LE MISURE DEI PARAMETRI AL PUNTO DI **"MAXIMAL MUSCLE BULK"**

→ REGOLA DEL 50% PER I MUSCOLI SIMMETRICI
(e.g. muscolo quadricipite e componenti)

→ MISURAZIONI A 30 - 40 - 50 - 60 - 70 % PER I MUSCOLI ASIMMETRICI
(e.g. tricipite surale e componenti)

Problemi aperti/emergenti:

DEFINIRE IL PUNTO ESATTO DI MISURAZIONE PER OGNI MUSCOLO

❖ Eco bed-side 2020 SARCUS update: I "LANDMARKS" ANATOMICI

Table 3 Proposed anatomical landmarks for each muscle of the lower extremity discussed

	Proximal landmark	Distal landmark	Exact point	Remark
Upper leg muscles				
Gluteus medius	Top point of the iliac wing (femur-line, neutral position)	Medial surface of the trochanter major	50%	LNP
Semimembranosus	Ischial tuberosity	Most medial part of articular cleft of knee		
Semitendinosus				
Biceps femoris		Proximal head of fibula		
Rectus femoris	Greater trochanter	Proximal patella border		
Vastus intermedius				
Vastus lateralis				
Lower leg muscles				
Soleus	Middle point of the knee cavity	Insertion of Achilles tendon on calcaneus	Proximal 30%	Sitting position*
Lateral gastrocnemius	Most lateral point of articular cleft of the knee	Most lateral t		
Medial gastrocnemius	Most medial point of articular cleft of the knee	Most medial		
Tibialis anterior	Most lateral point of articular cleft of the knee			

Table 2 Proposed anatomical landmarks for each muscle of the upper extremity discussed

	Proximal landmark	Distal landmark	Exact point
Upper arm muscles			
Biceps brachii	Anterior part of acromion process (acromioclavicular joint)	Elbow crease where tendon can be palpated	50%
Triceps brachii	Most lateral distal part of acromion process	Tip of olecranon	
Coracobrachialis	Anterior part of acromion process (acromioclavicular joint)	TBV	

❖ Eco bed-side 2020 SARCUS update: I "LANDMARKS" ANATOMICI

Table 1 Overview of muscles of upper and lower extremity, head and trunk described in this article

Upper extremity muscles	Upper arm	Biceps brachii
		Triceps brachii
		Coracobrachialis
	Lower arm	Forearm musculature
	Hand	Thenar
		Hypothenar
		First dorsal interosseous
Lower extremity muscles	Upper leg	Gluteus medius
		Semimembranosus
		Semitendinosus
		Biceps femoris
		Quadriceps
		Rectus femoris
		Vastus intermedius
		Vastus lateralis
	Lower leg	Soleus
		Lateral gastrocnemius
		Medial gastrocnemius
		Tibialis anterior
		Tibialis posterior
		Flexor digitorum longus
		Flexor hallucis longus
	Foot	Flexor hallucis brevis
		Abductor hallucis
		Flexor digitorum brevis
		Abductor digiti minimi
Head and neck muscles		Temporal
		Masseter
		Suprahyoid musculature
		Neck extensor musculature
		Sternocleidomastoid
Thoracic muscles		Serratus anterior
		Lower trapezius
		Diaphragm
Abdominal muscles		Transversus abdominis
		Internal oblique
		External oblique
		Rectus abdominis
		Lumbar multifidus
		Quadratus lumborum

❖ Eco muscolare bed-side nella valutazione della sarcopenia: CONCLUSIONI

L'UTILIZZO DELL'ECOGRAFIA MUSCOLARE BED-SIDE NELLA VALUTAZIONE DELLA SARCOPENIA RISULTA PROMETTENTE IN TERMINI DI:

1. MANEGEVOLEZZA NEL CONTESTO DELLA VISITA CLINICA
   → Diagnosi bed-side → *"Ecoscopia"*
2. VALUTAZIONE QUANTITATIVA
   → Comparabilmente alle altre metodiche Gold Standard
3. VALUTAZIONE QUALITATIVA
   → Nuovi emergenti parametri
4. VALUTAZIONE FUNZIONALE REAL-TIME
5. APPLICABILITÀ AD UN NUMERO SEMPRE MAGGIORE DI DISTRETTI MUSCOLARI
6. MONITORAGGIO: FOLLOW-UP CLINICO-STRUMENTALE
   → Agevole, non invasivo, a basso costo
7. INTERVENTI MIRATI E PERSONALIZZATI (E.g. Terapia fisica-riabilitativa)

- Eco bed-side SARCUS 2020 update: CONCLUSIONI

NECESSITÀ' DI IMPLEMENTARE (punto 1) E DEFINIRE (punti 2,3):

1. DATI NORMATIVI SU SCALA DI POPOLAZIONE AFFETTA DA SARCOPENIA
2. PROTOCOLLI STANDARDIZZATI
3. CUTOFF POINTS

Conclusion

The emerging field of ultrasonographic assessment of muscle mass only highlights the need for a standardization of measurement technique. Through this article, new insights regarding the use of ultrasound in muscle assessment are addressed and incorporated in measurement propositions for a largely expanded set of muscles/muscle groups. Because of the variety of muscles described, the foundations are laid out for a broad consensus for both muscle research in general and sarcopenia assessment in particular. As already noted, the propositions made in this article are to be viewed as starting points. Future studies will need to help guide the evolution of these modest guidelines to become an evidence-based worldwide consensus.

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