ОБЗОРИ
REVIEWS

A SYSTEMATIC REVIEW OF POINT-OF-CARE ULTRASOUND (POCUS) OF MULTIORGAN ASSESSMENT OF SYSTEMIC LUPUS ERYTHEMATOSUS

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Abstract. Background: *Systemic lupus erythematosus (SLE) can affect multiple organs, presenting a diverse array of clinical symptoms. In recent years, Point-of-Care Ultrasound (POCUS) has become increasingly accessible, supported by robust evidence. POCUS can be particularly beneficial for evaluating SLE patients improving diagnostic accuracy and reducing time-to-decision.* ***Purpose:*** *To systematically identify the assessment of SLE patients through the use of POCUS.* ***Methods:*** *The data sources MEDLINE, EMBASE, LILACS, Google Scholar and ProQuest One Academic were used, English and Spanish languages were included, no limits regarding publication date or age, and review articles were excluded. Articles screening and data extraction were performed by two authors independently. Disagreements were resolved through a third author. Organ or system evaluations using POCUS were collected.* ***Results:*** *A total of 52 articles met the inclusion criteria. Assessment using POCUS detected various acute and chronic complications arising from SLE, particularly articular and cardiac compromise. Synovitis and pericardial effusion were the most frequently reported complications. Most of the reports (92%) did not specify whether they evaluated other organs with POCUS. Limitation: Most of the studies were case reports.* ***Conclusion:*** *Multiorgan POCUS assessment in patients with SLE, especially those suspected of disease activity, holds the potential to offer improved evaluation of SLE complications and activity. Studies are needed to develop a standardized multiorgan assessment protocol for SLE using POCUS to improve diagnosis and treatment.*

Key words: *early diagnosis, lupus erythematosus, systemic, point-of-care ultrasound, POCUS, systematic review, ultrasound*

Introduction

Systemic lupus erythematosus (SLE) is an autoimmune disease, characterized by the production of autoantibodies with a heterogeneous systemic affection [1]. The global incidence of SLE is between 1.4 and 15.3 cases per 100,000 person-year [2]. This disease presents numerous complications affecting multiple systems and organs. There are global registries including GLADEL from Latin America [3], Euro-Lupus from Europe [4], RELESSER from Spain [5], CSTAR from China [6], and the Hopkins Cohort from the United States [7] that provide valuable insights in SLE characteristics (Table 1).

In recent years, the use of Point of Care Ultrasound (POCUS) as a diagnostic tool for physicians has gained prominence. The integration between the clinician (excluding radiologist or cardiologist) and the ultrasound at the bedside of the patient leads to diagnosis or treatment response follow up [8]. This diagnostic tool has shown potential to increase diagnostic accuracy, appropriate treatment and decrease time-to-decision or time-to-treatment [9].

Currently, there is a limited literature on the use of POCUS as a physical exam extension in SLE patients. Incorporating POCUS to identify and evaluate various organs or systems involvements in SLE could enhance diagnostic accuracy and efficiency. There is no protocol, data, or systematic review published until the date this study is conducted regarding the use of POCUS as a multiorgan assessment for patients with SLE in any clinical scenario. There-

Table 1. Different global cohort comparison of cumulative organ involvement of lupus manifestation

Characteristic/Cohort	GLADEL 1	EuroLupus 2	RELESSER 3	CSTAR 4	Hopkins Lupus Cohort 5
Publication Year	2004	2009	2015	2013	2014
Country/s	Argentina, Brazil, Colombia, Cuba, Chile, Guatemala, Mexico, Peru and venezuela	Spain, United Kingdom, Italy, Poland, Turkey, Norway and Belgium	Spain	China	United States
Number of patients	1214	1000	4024	2104	1354
Sjögren Syndrome	-	-	14.4%	-	-
Serositis	Pericarditis: 17.2% Pleuritis: 22.1%	16%	28.1%	16.4%	-
Respiratory/Pulmonary	6.1%	-	30.6%	5.5%	17.1%
Cardiovascular	42.9%	-	28.2%	3.5%	16%
Vascular / Vascular Thrombosis	5.6%	9.2%	37.6%	-	7.4%
Renal (Total)	51.7%	27.9%	32.1%	47.4%	10.3%
End-Stage renal disease	1.7%		2.8%	-	-
Musculoskeletal (Total)	-		80.1%	-	40.6%
Arthritis	93.2%	48.1%	77.9%	53.5%	-
Weight Loss (nutritional)	26.6%		9.9%	-	-

fore, there is a gap in the knowledge of the usage of POCUS for this specific population. To address this gap, we conducted a systematic review of the literature on the use of POCUS to evaluate both acute and chronic complications in SLE patients and to know the actual situation of the usage of POCUS for SLE in any clinical scenario.

Methods

This systematic review of the literature was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [10]. Studies included addressed the assessment outcome of any SLE complication identified by POCUS. It was registered in PROSPERO (CRD42024529087).

Data Sources and Searches

The search was done using the following databases: MEDLINE via PubMed, EMBASE, LILACS via Virtual Health Library, Google Scholar, and ProQuest One Academic. To include clinical trials, meeting abstracts, thesis, and gray literature it was also used: ClinicalTrials.gov, International Clinical Trials Registry Platform (ICTRP), Cochrane Central Register of Controlled Trials, The Kings Fund (England), The New York Academy of Medicine (United States), doctoral thesis: TESEO (Spain) and LAReferencia (Latin America) (URL exposed in appendix). The entry terms and webpage for each database are shown in the Appendix.

Study Selection

Studies in English and Spanish were included. No limits regarding publication date, age, or geographical location were used. Eligible studies were those utilizing POCUS or bedside ultrasound to detect any lupus complication. This encompasses the use of POCUS as an adjunctive tool in the clinical assessment of lupus-related complications or differential diagnoses. Studies that solely utilize ultrasound as a diagnostic test separated from clinical assessment or guidance or presented as echocardiography by a cardiologist or ultrasound by a radiologist were excluded. Additionally, studies lacking explicit specifications of the use of bedside ultrasound, POCUS, or clinical ultrasound in the context of lupus-related assessments were excluded. Studies with insufficient information about the use and findings of POCUS were also excluded. Clinical cases, randomized control trials, case and control studies or cohort studies could have been included if found. It excluded reviews or any document that does not contain original data. Also, references cited in study reports included in the systematic review were explored and incorporated if considered. The study selection was done by two reviewers (SGJ and SJ). In case a disagreement appeared, a third reviewer made a deci-

sion (JAN). The records screened were exported to Rayyan, where decisions were recorded.

Data Extraction and Quality Assessment

Extracting data from reports using titles and abstracts was done by two independent reviewers (YA and SJ) and if a disagreement appeared a third reviewer made a decision (JAN). If there is unreported data, investigators tried to contact the study author. Biases were evaluated according to the type of studies by one author (SGJ or SJ). In case series or case reports, the criteria of Murad MH, et al. [11] were followed; in observational studies the The Risk Of Bias In Non-randomized Studies (ROBINS-I) scale [12] was used and for randomized studies the Cochrane risk-of-bias tool was used.

Data Synthesis

From the selected studies the following were extracted: number of patients, patient age, country of study/case, complication observed using POCUS, operator's specialty, presence of lupus activity and setting where the POCUS was used. Information was synthesized and proportion and distribution trends were calculated.

Role of the Funding Source

There was no funding source for this research.

Results

The literature search returned 1036 records, after deleting duplicates 880 were screened, and finally, 736 were ruled out following exclusion criteria. From the reports assessed for eligibility 96 were excluded. Additionally, 34 records were included by other methods. A PRISMA flow diagram was created (Figure 1).

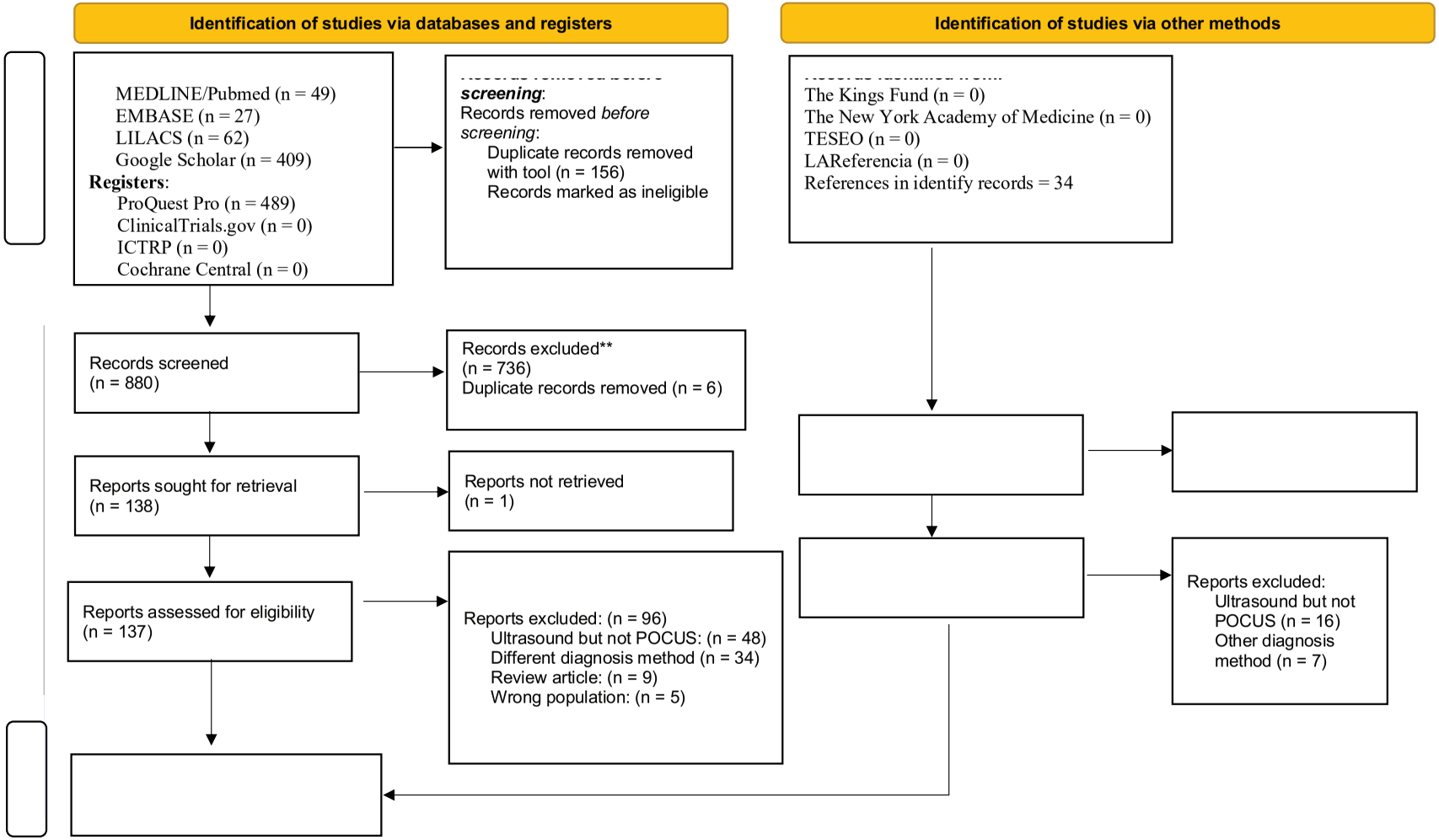
Finally, in this systematic review 52 reports regarding the use of POCUS while assessing a patient with SLE were included (Table 2). The total number of patients from all reports was 1262 subjects. Most of the reports came from Europe representing 44%; primarily from Italy (27%), followed by North America with 37%; mainly from the United States (33%), Asia with 15%, and Latin America with 4%. There were no reports from Oceania or Africa (Fig. 2). The most common types of studies were clinical cases representing 54% (n = 28), followed by cross-sectional studies 40% (n = 21) and prospective studies just 6% (n = 3). It must be noted that 92% of the reports from the USA were case reports. All the reports from Italy addressed the musculo-skeletal system involvement and had a cross-sectional or prospective methodology.

Musculoskeletal affection was present in 44%, serosal in 35%, cardiac in 15%, veins in 10%, and pulmonary in 6% of the studies. The musculoskeletal system accounted for most of the total of 1262 patients, representing 96.2% of patients (1214 patients); serositis represented 2.7% of patients and all the remaining represented just 1.6% of the patients. This is mainly affected by the method used in musculoskeletal reports and the high frequency of serositis. Regarding the number of systems evaluated, 92% of the reports POCUS only assessed one system and 8% of reports describe its use in more than one system. If used for other complications, the most reported was serositis or cardiac abnormality. However, there was no protocol established for multiorgan assessment, and only the cross-sectional or prospective studies used an established one-system protocol.

Rheumatologists performed the POCUS in 38% of the reports, but only to evaluate musculoskeletal pathology. It was followed by emergency physicians in 12% of reports, but only to evaluate pericardial or cardiac abnormality. The primary location where POCUS was used was the emergency room (45%), followed by the rheumatology unit (20%), and it was not mentioned in 22% of reports.

There were 23 reports (44%) that evaluated musculoskeletal compromise. These studies assessed synovitis, bone erosions, enthesitis, and tenosynovitis [13-34]. Regarding synovitis, it was the most common finding, reported in 19 of the 23 reports. Upper limbs synovitis was present in 31% of musculoskeletal reports (n = 16) and lower limbs synovitis in 17% (n = 9). The most common joint involvement was the wrist and metacarpophalangeal (MCP) joints, followed by proximal interphalangeal (PIP), knee, and ankle, and less reported the metatarsophalangeal (MTP), elbow, shoulders, and hips, represented in figure 4. The highest incidence of synovitis was 87% in a population of 67 patients in one of the reports [23]. The relationship between synovitis identification by POCUS and the disease activity usually defined by Systemic Lupus Erythematosus Disease Activity Index 2000 (SLEDAI-2K) was identified in nine reports; three of them were found a statistically significant relationship ($p < 0,05$) [19, 20, 22] and 6 of them no relationship ($p > 0,05$) [23-25, 27, 29, 31].In two reports, it was found a relationship with serological markers such as erythrocyte sedimentation rate or anti-dsDNA antibodies ($p < 0,05$) [24, 27]. From prospective studies, one demonstrated that baseline power Doppler

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Fig. 1. PRISMA 2020 flow diagram for systematic reviews

Table 2. Systematic review data

#	Author	Year	Country	Type of research	Number of patients (n)	Complication or differential diagnostic observed	Other organs evaluated or ruled-out with POCUS	Lupus status (Active or non active)	Operator	POCUS Setting
1	Yu M. et al. 41	2023	China	Case report	1	Pericardial tamponade	NR	Active	NR	Emergency room
2	Li W. et al. 42	2017	USA	Case report	1	Pericardial effusion and plethoric inferior vena cava	NR	Active	NR	Emergency room
3	Walsh BM. et al 71	2015	USA	Case report	1	Right ventricle: dilated, with akinesis of the free wall, McConnell's sign, augmented end-diastolic diameter. Septal bowing during systole.	Left ventricular function, no pericardial effusion, no aortic root dilatation.	Non-active	Emergency physician	Emergency room
4	Palkar A. et al. 43	2017	USA	Case report	1	Bilateral B-lines, mitral jet of mitral regurgitation in long-axis and 4-chamber, pericardial effusion	Normal smooth pleural line, normal left ventricular function, normal right/ left size ratio, normal aortic and mitral valves,	Non-active	NR	NR
5	Shokoohi H. et al. 44	2016	USA	Case report	1	Rupture of a left ventricular apical pseudoaneurys	NR	Not-reported	Emergency physician	Emergency room
6	Nunes G. et al. 45	2016	Brazil	Case report	1	Pericardial effusion, reduced ejection fraction and hypocontractility of the left ventricle.	NR	Active	NR	Emergency room
7	Ayat P. et al. X cita	2023	USA	Case report	1	Pericardial effusion	NR	Active	NR	Emergency room
8	Botros M. et al. 46	2022	USA	Case report	1	Inferior vena cava larger than 2 cm, ratio E/e' of 15.6 (elevated filling pressure).	NR	Non-active	NR	Emergency room
9	Lee HJ. et al. 70	2019	USA	Case report	1	Pleural effusion and pericardial effusion.	Normal cardiac contractility. The leg ventricular ejection fraction.	Active	NR	Emergency room
10	Argaiz E. Et al. 47	2022	Mexico	Case report	1 of 2	Dilated inferior vena cava, portal vein pulsatility of 77% (severe) and decreased to 33% after compressing arterio-venus fistula.	NR	NR	NR	NR
11	Zhao Y. et al. 101	2021	China	Case report	1	Left perirenal fluid collection.	NR	Active	Not reported	Nephrology Unit
12	Kahl N. et al. 90	2021	USA	Case report	1	D sign, Right ventricular dilation. Flattening of the septum indicating decreased left ventricular systolic function. Non compressive right femoral vein	NR	NR	NR	Emergency room
13	Larson N. et al. 48	2018	USA	Case report	1	Large pericardial effusion with evidence of right ventricular collapse.	NR	Active	NR	Emergency room
14	Noorvash D. et al. 113	2018	USA	Case report	1 of 2	Free fluid in the peritoneum	NR	NR	NR	Emergency room

#	Author	Year	Country	Type of research	Number of patients (n)	Complication or differential diagnostic observed	Other organs evaluated or ruled-out with POCUS	Lupus status (Active or non active)	Operator	POCUS Setting
15	Gomez-Casanovas J. et al. 49	2023	USA	Case report	1	Pericardial effusion, bilateral pleural effusions, and hyperdynamic heart with enlarged right ventricle	showed a normal left ventricular cavity with ejection fraction of around 55%	Active	NR	NR
16	Buda N. et al. 85	2017	Poland	Case report	2	hypoechoic sub-pleural consolidation and bilateral B-lines (alveolar hemorrhage)	NR	Active	NR	Emergency room
17	Goswami RP. 84	2016	Switzerland	Case report	1	Shrinking lung syndrome	NR	Active	NR	Emergency room
18	Ma Z. et al. 50	2013	USA	Case report	1	Cardiac Tamponade	NR	Active	NR	Emergency room
19	Aljasmi R. et al. 51	2023	United Arab Emirates	Case report	1	Cardiac Tamponade	NR	Active	NR	Emergency room
20	Jimenez W. et al. 52	2023	Colombia	Case report	1	Cardiac Tamponade, Bilateral pleural effusion, ascites	NR	Active	Emergency physician	Emergency room
21	Tio M. et al. 53	2022	Indonesia	Case report	1	Pericardial effusion, and ascites	NR	Active	NR	Emergency room
22	Farkouh F. Et al 54 (Abstract)	2023	USA	Case report	1	Pericardial effusion	NR	Active	NR	NR
23	Ch Rahul. et al. 109	2021	India	Case report	1	Hepatic portal venous gas (HPVG) suggestive of necrotizing enterocolitis (NEC)	NR	Active	NR	NR
24	Cho G. et al 77	2022	USA	Case report	1	Pleural effusion	NR	NR	Untrained physician and expert physician	NR
25.	Mantovani Cardoso et al. 55	2020	USA	Case report	1	Pericardial effusion	NR	Active	NR	Emergency room
26.	Yousif P. et al. 56	2022	USA	Case report	1	Pericardial effusion	NR	Active	Emergency physician	Emergency room
27	Puticiu M (Conference Abstract) 57	2012	Romania	Case report	1	Pleural and pericardial effusion, free abdominal fluid. Optic nerve evaluation.	Pleural and pericardial effusion, free abdominal fluid	Active	NR	Emergency room
28	Mandavia et al. 58	2001	USA	Prospective cohort study	19 of 478	Pericardial effusion: 42% (n = 8)	NR	Active	Emergency physician	Emergency room
29.	Hans P et al. 114	2020	Canada	Case report	1	Rhabdomyolysis (hypoechoic areas of muscle, disorganization of the fascicular architecture, irregularity of the muscle fibers, and some hyperechogenicity in the muscle)	NR	Active	Emergency physician	Emergency room
30.	Marozzi et al. 82	2024	Italy	Cross-sectional	1 of 33	Interstitial lung disease (B-lines)	NR	Active	NR	NR

#	Author	Year	Country	Type of research	Number of patients (n)	Complication or differential diagnostic observed	Other organs evaluated or ruled-out with POCUS	Lupus status (Active or non active)	Operator	POCUS Setting
31.	Ogura T. et al. 80	2016	Japon	Cross-Sectional	15 of 55	Synovitis: 80%. In: wrist, MCP, PIP, thumb IP Tenosynovitis: 93%	NR	Both	Rheumatologist	Rheumatology Unit
32.	Ceccarelli F. et al. 16	2017	Italy	Cross-Sectional	17	Synovitis: effusion: 88.2%, synovial hypertrophy: 76,5%, PD: 29,4%. In: wrist, MCP, PIP Bone erosions: 58,8%	NR	Both	Rheumatologist	Inpatient clinic
33.	Di Matteo A. et al. 17	2017	Italy	Cross-Sectional	25	Synovitis: effusion: 9.5%, synovial hypertrophy: 11,5%, both: 14%. PD: 30% of 85 joints. In: wrist, MCP, PIP, knees, feet, ankles, elbows, shoulders, hips. Tenosynovitis: 17.7%. Enthesitis: 24.2% entheses. Bone erosion: 2,1%.	NR	Both	Rheumatologist	Rheumatology Unit
34.	Piga M. et al. 18	2022	Italy	Cross sectional	26	Bone erosions: 5,9% areas	NR	Both	Rheumatologist	NR
35.	Fagni et al. 19	2023	Italy	Cross-sectional	106 of 400	Enthesitis: 29,2%. In: Shoulder, DIP, Elbow, greater trochanter, knee, ankle, plantar fascia and achilles tendon	NR	Active	Rheumatologist	NR
36.	Di Matteo A. et al 20	2018	Italy and Czech Republic	Cross-Sectional	65	Enthesitis: 67.7%. In: patella, Achilles, quadriceps and plantar fascia	NR	Both	Rheumatologist	Inpatient clinic
37.	Ceccarelli et al. 21	2019	Italy	Cross-sectional	106	Synovitis. In: wrist, MCP, PIP and knees	NR	Both	Rheumatologist	NR
38.	Smiljanic Tomicevic L. et al. 22	2022	Croatia	Cross-Sectional	60	Synovitis: 53,3%. In: ankle. Tendinitis or enthesitis: 21,7% Bone erosion: 1,6%	NR	Both	Rheumatologist	Rheumatology Unit
39.	Gabba A. et al. 23	2012	Italy	Cross - sectional	108	Synovitis: 25%. PD: 12%. In: wrist and MCP. Tendon abnormality: 40%. Bone erosions: 25,9%	NR	Both	Rheumatologist	Rheumatology Unit
40.	Torrent-Segarra V. et al. 24	2012	Spain	Cross-sectional	58	Synovitis: hypertrophy or effusion: 25%, wrist synovitis: 14,2%. In: wrist, MCP, PIP. Tenosynovitis: 39.2%	NR	Both	Rheumatologist	Rheumatology Unit
41.	Lagnocco A. et al 25	2014	Italy	Cross-Sectional	62	Synovitis: 87.1%. In: wrist, MCP, PIP, MTP,	NR	Both	Rheumatologist	Rheumatology Unit
42.	Ho-Shung Y. et al. 26	2014	South Korea	Cross-Sectional	48	Synovitis: 58.3%. In: wrist, MCP. Tenosynovitis: 4.2%	NR	Both	Rheumatologist	Rheumatology Unit
43	Ossandon A. et al. 27	2009	Italy	Cross Sectional	26 of 66	Synovitis: 58%. PD: 10%. In: knee	NR	Non-active	Rheumatologist	Rheumatology Unit

#	Author	Year	Country	Type of research	Number of patients (n)	Complication or differential diagnostic observed	Other organs evaluated or ruled-out with POCUS	Lupus status (Active or non active)	Operator	POCUS Setting
44.	Delle-Sedie A et al. 28	2009	Italy	Cross Sectional	50 of 100	Synovitis: wrist: 80%, MCP/PIP: 50%. In: wrist, MCP, PIP. Tenosynovitis: 22%. Bone erosion: 0.5%.	NR	Non-active	Rheumatologist	Rheumatology Unit
45.	Mosca M. et al. 29	2015	Italy	Cross Sectional	102	Synovitis: 42.2% PD: 10,7%. In: wrist, MCP, PIP Tenosynovitis: 38.2%. Bone erosion: 31.4%,	NR	Non-active	Rheumatologist	NR
46.	Demirkaya E. et al 30	2009	Turkey	Cross-sectional	30	Synovitis: 60% (knee) – 10.3% (elbow). In: wrist, MCP, elbow, knee, ankle Tenosynovitis: 23,3%	NR	Active	Physiatrist	Rheumatology unit
47.	Morales-Lozano R. et al. 31	2016	Spain	Cross-Sectional	54 of 114	Synovitis. In: MTP, ankle.	NR	Both	Podologist	Outpatient clinic
48.	Dreyer L et al 32	2014	Denmark	Cross-Sectional	33	Synovitis: 48% (wrist) and 21% (MCP). Tenosynovitis: 18%. Bone erosion: 6%.	NR	Both	Rheumatologist	Not reported
49.	Iagnocco A. et al. 36	2004	Italy	Cross-Sectional	26	Synovitis: 42.3%. PD: 9.6%. In: wrist. Bone erosion: 3.8%. Tenosynovitis: 3.8%	NR	Both	Rheumatologist	Rheumatology unit
50	Mukherjee S. et al. 34	2016	England	Cross-Sectional	20	Synovitis: 80% (MTP) - 60% (MCP).	NR	Both	Rheumatologist	Rheumatology unit
51.	Piga M. et al. 35	2016	Italy	Prospective (5-year)	80	Baseline: effusion or hypertrophy: 18,8%, PD: 10% In: wrist, MCP, PIP, elbows, knee, ankle, MTP Bone erosions: Baseline = 5%. Final visit = 16.3%. Tenosynovitis: baseline = 37%.	NR	Both	Rheumatologist	Outpatient clinic
52.	Guillén-Astete et al. 36	2024	Spain	Longitudinal prospective 10-year	96	Synovitis: baseline = 74.9%. In: wrist, MCP, PIP.	NR	NR	Rheumatologist	Inpatient clinic

Unless otherwise indicated, percentage values are patients. In synovitis data, unless otherwise indicated, it represents the total percentage of synovitis presented.

JE: Joint Effusion, MCP: Metacarpo-phalangeal, MTP: Metatarso-phalangeal, NR: Not Reported, PIP: proximal interphalangeal, PD: Power-Doppler, ST: subtalar, TT: Tibio talar,

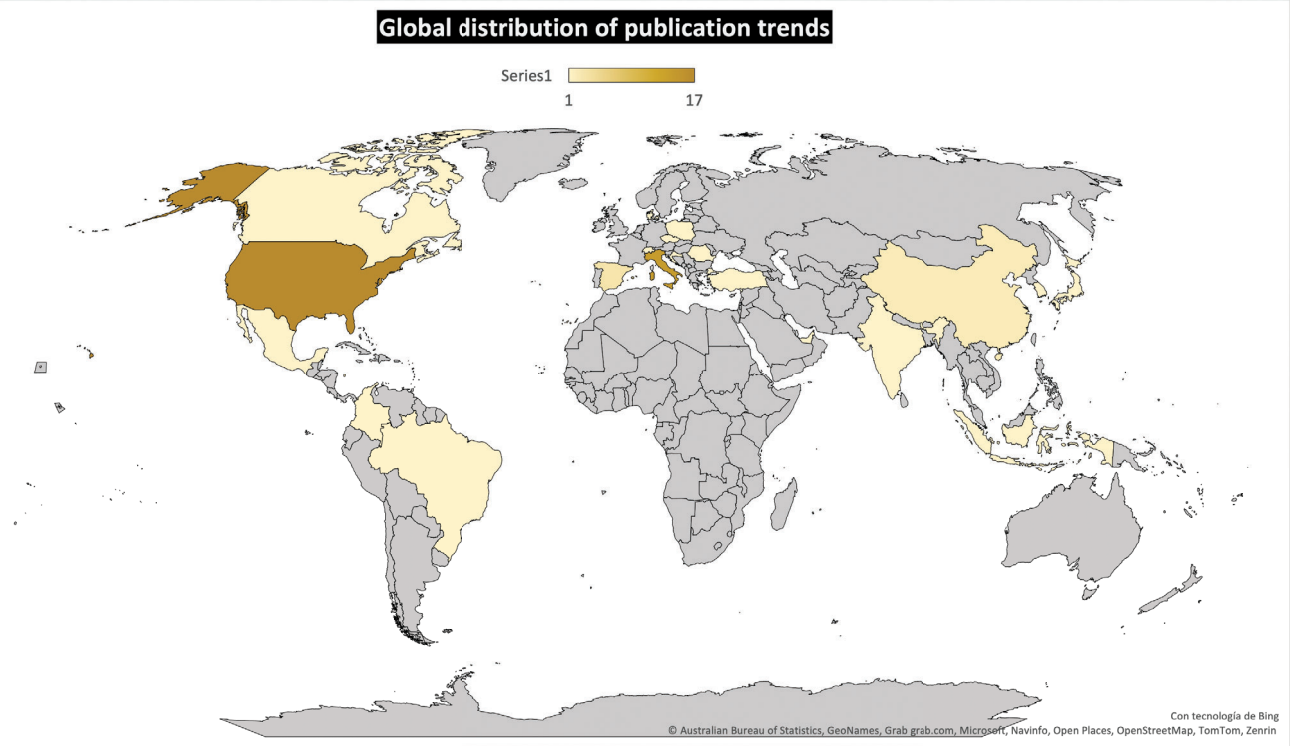


Fig. 2. Global distribution of publication trends of POCUS utilization in SLE patients included in the systematic review (Graphic created using Microsoft Excel)

synovitis was an independent predictor factor for a 2-year SLE flare ($p < 0,05$) [33]. Baseline subclinical synovitis is associated with joint compromise progression in less time than patients without this baseline abnormality [34].

Other musculoskeletal findings included one report of rhabdomyolysis evaluation using POCUS [35]. Also, enthesitis was reported in four studies, with a frequency between 5.9% to 67.7% [15, 17, 18, 20]. Bone erosions were described in 19% (n = 10) of reports with frequencies between 0.5% and 24.1% [15, 16, 21, 26, 33]. It must be noted that regarding the musculoskeletal system, there was no evaluation by internal or emergency medicine, and no reports from North or South America were identified.

Concerning serosal involvement, pericardial affection was reported in 33% of reports, making it the most common report of extra-articular SLE complication [36-52].Frequently, pericardial involvement was described at the same time as pleural effusion or ascites. Pleural effusion was present in 10% of reports [41, 43, 46, 51, 53]. Ascites were described in 4% of reports [47, 52].

There were six studies evaluating the cardiovascular system. In two reports the authors exposed any abnormality in the left ventricle (LV), reporting hypocontractility with reduced ejection fraction, and abnormal E wave/e' wave ratio (E/e') [39, 54]. It must be highlighted that in another 8% of reports, there was a description of normal ventricular function evaluation through POCUS [41, 43, 54, 55]. Evaluation of the right ventricle for pulmonary hypertension signs was described in 4% of reports and with thromboembolic disease final diagnosis in only one of those [55, 56].

Lung findings were present only in 6% of reports describing interstitial lung disease, alveolar hemorrhage, and shrinking lung syndrome respectively [57-59]. In three reports, fluid overload was evaluated through inferior vena cava diameter dilatation and in one of the hepatic vein [37, 60, 61]. As for abdominal findings, intra-abdominal bleeding was documented in two reports, and in one report necrotizing enterocolitis was described [62-64]. Finally, in one report the optic nerve was evaluated, but the findings were ruled out to be pathological [51].

The risk of bias was evaluated using the proposed tools (Table 3, appendix).

Appendix. Table 3. Risk of Bias of Included Studies

Case reports Studies. Murad et al. tool

	Selection	Ascertainment		Causality				Reporting	Overall Risk of Bias (1-8)
Yu M. et al. 36	1	1	1	1	0	1	1	1	7
Li W. et al. 37	1	1	1	1	0	1	1	1	7
Walsh BM. et al 55	1	1	1	1	0	1	1	1	7
Palkar A. et al. 54	1	1	1	0	0	1	0	1	5
Shokoohi H. et al. 38	1	1	1	0	0	1	1	1	6
Nunes G. et al. 39	1	1	1	0	1	1	1	1	7
Ayat P. et al. 40	1	1	1	1	0	1	0	1	6
Botros M. et al. 60	1	1	1	0	0	1	1	0	5
Lee HJ. et al. 41	1	1	1	1	0	1	1	1	7
Argaiz E. et al. 61	1	1	1	0	0	1	0	1	5
Zhao Y. et al. 62	1	1	1	1	0	1	1	1	7
Kahl N. et al. 56	1	1	1	1	0	1	0	1	6
Larson N. et al. 42	1	1	1	1	0	1	1	1	7
Noorvash D. et al. 63	1	1	1	1	0	1	1	1	7
Gomez-Casanovas J. et al. 43	1	1	1	1	0	1	1	1	7
Buda N. et al. 59	1	1	1	1	0	1	1	1	7
Goswami RP. 58	1	1	1	0	0	1	1	1	6
Ma Z. et al. 44	1	1	1	1	0	1	1	1	7
Aljasmi R. et al. 45	1	1	1	1	0	1	1	1	7
Jimenez W. et al.46	1	1	1	1	0	1	1	1	7
Tio M. et al. 47	1	1	1	1	0	1	1	1	7
Farkouh F. Et al 48	1	1	1	1	0	1	1	1	7
Ch Rahul. et al. 64	1	1	1	1	0	0	1	1	6
Cho G. et al. 53	1	1	1	1	0	1	1	1	7
Mantovani Cardoso et al. 49	1	1	1	1	0	1	1	1	7
Yousif P. et al. 50	1	1	1	1	0	1	1	1	7
Puticiu M 51	1	1	1	0	0	1	1	0	5
Hans P et al. 35	1	1	1	1	0	1	1	1	7

As the study evaluated the use of POCUS; the original question included in the Murad et al. tool “Was there a challenge/rechallenge phenomenon?” was not taken into account. The scores of 4 or less points indicate high risk of bias.

Cross Sectional studies – ROBBIN I tool

Bias domain		Mandavia et al. 52	Marozzi et al. 57	Ogura T. et al. 13	Ceccarelli F. et al. 14	Di Matteo A. et al. 15	Piga M. et al. 16	Fagni et al. 17	Di Matteo A. et al 18	Ceccarelli et al. 19	Smiljanic Tomicevic L. et al 20	Gabba A. et al. 21	Torrent-Segarra V. et al. 22	Lagnocco A. et al 23	Ho-Shung Y. et al. 24	Ossandon A. et al. 25	Delle-Sedie A et al 26	Mosca M. et al.27	Demirkaya E. et al. 28	Morales-Lozano R. et al.. 29	Dreyer L et al. 30	Iagnocco A. et al. 31	Mukherjee S. et al 32	Piga M. et al. 33	Guillén-Astete et al. 34
Bias due to confounding factors	1.1	N	N	N	N	N	N	PN	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	RoB judgment	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Bias in the selection of study participants	2.1	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	2.2	NA	NA	NA	NA	NA	NA	PY	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2.3	NA	NA	NA	NA	NA	NA	PY	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2.4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	PY	Y	Y	Y	Y	PY	PY	PY
	2.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	RoB judgment	Low	Low	Low	Low	Low	Low	Critical	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Bias in the classification of interventions	3.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	PY	PY	Y	Y	Y	PY	Y	Y
	3.2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	3.3	N	PN	PN	N	N	PN	PN	N	PN	N	PN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	RoB judgment	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Bias due to deviations from planned interventions	4.1	N	N	N	N	N	N	N	N	N	N	N	N	N	PN	N	PN	N	PN	N	N	PN	N	N	N	N
	4.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4.3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	4.4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	4.5	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	4.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	RoB judgment	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Bias domain		Mandavia et al. 52	Marozzi et al. 57	Ogura T. et al. 13	Ceccarelli F. et al. 14	Di Matteo A. et al. 15	Piga M. et al. 16	Fagni et al. 17	Di Matteo A. et al 18	Ceccarelli et al. 19	Smiljanic Tomicevic L. et al 20	Gabba A. et al. 21	Torrent-Segarra V. et al. 22	Lagnocco A. et al 23	Ho-Shung Y. et al. 24	Ossandon A. et al. 25	Delle-Sedie A et al 26	Mosca M. et al.27	Demirkaya E. et al. 28	Morales-Lozano R. et al.. 29	Dreyer L et al. 30	Iagnocco A. et al. 31	Mukherjee S. et al 32	Piga M. et al. 33	Guillén-Astete et al. 34
Bias due to missing data	5.1	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	PY	Y	Y	PY	Y	Y	PY	Y	Y	PY	PY	Y	Y	Y
	5.2	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	5.3	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	5.4	NA	NA	NA	NA	NA	NA	PN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5.5	NA	NA	NA	NA	NA	NA	PY	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	RoB judgment	Low	Low	Low	Low	Low	Low	Critical	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Bias in measuring results	6.1	N	N	N	PN	PN	N	PN	N	PN	PN	N	N	N	PN	N	N	N	N	N	N	N	N	N	N
	6.2	PN	N	N	PN	N	N	Y	PN	PN	PN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	6.3	Y	PY	Y	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	PY	PY	Y	PY	Y	Y	PY	Y	Y
	6.4	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	RoB judgment	Low	Low	Low	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Bias in the selection of reported results	7.1	PN	N	PN	N	N	N	PN	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	7.2	N	N	PN	N	N	N	PN	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	7.3	N	PN	PN	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	RoB judgment	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
General bias: Low/ moderate/ severe/ critical/NI		Low	Low	Low	Low	Low	Low	Severe	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Discussion

In this systematic review, we found 52 studies where POCUS had been used to evaluate systems such as the musculoskeletal or cardiovascular systems in patients with SLE (Table 2). There were cross-sectional studies for musculo-skeletal system, one prospective study for the respiratory system, one for pericardial involvement, and various case reports of isolated organ or system evaluation. These findings highlight that the use of POCUS for a structured multiorgan assessment of patients with SLE is none.

Systemic lupus erythematosus (SLE) complications may affect broad systems and organs, including joints, muscles, lungs, heart, pleura, pericardium, peritoneum, maxillary glands, kidneys, aorta, pancreas, liver, intestines, skin, and nervous system. Epidemiology exhibits a globally heterogeneous distribution shaped by regional differences [2] (Table 1). POCUS may improve the evaluation of the multiorgan involvement associated with SLE.

Musculoskeletal

Regarding the musculoskeletal system, joint involvement can be seen between 48% in the European cohort and 93% in the Latin American cohort [3, 4] (Table 1). A linear transducer can be used to assess joints as exposed by the European League Against Rheumatism (EULAR) procedure basis and wrist, hands, elbow, shoulder, hip, knee, ankle, and foot can be evaluated [65]. All of these joints were reported, although the elbow, shoulder, and hips were exposed only in one report [15]. As documented in this systematic review, POCUS can evaluate most joints, although its capabilities may be limited depending on the type of transducer used.

Most of the reports evaluated joint effusion, synovial hypertrophy, and power Doppler signal to evaluate joint synovitis (Table 2). In the OMERACT definition of 2005, the Doppler signal was not necessary, and this was used in ten studies [19-21, 23, 24, 26, 27, 29, 30, 33]. However, the OMERACT definition was revised in 2019, as a significant number of healthy individuals were found to have similar ultrasound abnormalities [66]. The presence of joint effusion which is now excluded in the new definition, and Doppler signal activity is now mandatory for defining synovitis [66]. Only one study refers to this new definition [34]. This may be mainly affected by the year of each report. Statistically significant relationships between synovitis and SLE activity or laboratory market were identified in some of the records. Consequently, it demonstrates the potential utility of POCUS on therapeutic and prognosis

Regarding the relationship between synovitis identification by POCUS and the disease activity usually defined by Systemic Lupus Erythematosus disease activity index 2000 (SLEDAI-2K) was identified in nine reports; three of them found a statistically significant relationship ($p < 0,05$) [19, 20, 22] and 6 of them no relationship ($p > 0,05$) [23-25, 27, 29, 31]. In two reports it was found a relationship with serological markers such as erythrocyte sedimentation rate or anti-dsDNA antibodies ($p < 0,05$) [24, 27]. From prospective studies, one demonstrated that baseline power Doppler synovitis was an independent predictor factor for a two-year SLE flare ($p < 0,05$) [33]. The other is that baseline subclinical synovitis is associated with joint compromise progression in a lesser time than patients without baseline abnormality [34].

Regarding bone erosions, it has been described that in autoimmune diseases such as rheumatoid arthritis, the presence of early bone erosions during the disease is a poor prognostic factor [67]. Clinical importance in patients with SLE has not been clearly studied, but in one report it appears their presence does not affect the patient's quality of life [33]. There was only one muscular assessment, reporting rhabdomyolysis [35].

Serosal: pericardial and pleural

Serositis was the most common diagnosis after synovitis. With an incidence of between 16 to 28% in the Latin America, Europe, China, and Spain cohorts [3-6] (Table 1). Approximately 25% of all patients with SLE develop symptomatic pericarditis at some point through the course of the disease [68]. The effusion can be identified in a parasternal of a four-chamber view, and additional related findings may consist of diastolic collapse of the right ventricle, systolic collapse of the right atrium, and plethoric inferior vena cava with respiratory variation [69]. In three reports was described hypocontractility of the left ventricle [39], right ventricular collapse [42], and enlarged right ventricle [43].

Pleural effusion has been reported in up to 22% of SLE patients [3]. The diagnosis using ultrasound, compared to radiography for pleural effusion, demonstrates a sensitivity of 94% and a specificity of 98% in a meta-analysis [70]. Moreover, it performs well when conducted by novices-to-POCUS residents after training [71].

Cardiovascular

Cardiovascular complications may account for as much as 42% as reported in the GLADEL cohort, and as low as 3.5% in China's CSTAR cohort (Table 1). Affection of this system includes valvular involve-

ment, Libman-Sacks endocarditis, left or right ventricular dysfunction and aortic aneurysm.

Mitral valve prolapse appears to occur more frequently in patients with SLE, estimated to occur in 21% of SLE cases versus 5.5% of controls in one study [72]. Long-axis, short-axis, and apical four-chamber, two-chamber, three-chamber, and five-chamber views could be obtained, allowing for a qualitative assessment of valvular appearance, calcification, and degree of dysfunction [73]. Studies report that POCUS has a sensitivity and specificity between 48 to 100% for valvular heart disease [74]. Only 1 study reported mitral regurgitation [54].

Libman-Sacks endocarditis has a prevalence between 6 and 11% in patients with SLE. An autopsy study reported the presence of this condition in 50% of lupus cases [75]. Initial evaluation by POCUS could include the presence of any mobile densities on the valves or valvular insufficiency [76], although reports in this systematic review did not identify this complication.

Left ventricular dysfunction in SLE can be multifactorial, including the presence of lupus myocarditis (prevalence of 8 to 25%) [77], ischemic heart disease (incidence 9.6 events per 1,000 person-years) [78], or antimalarial-induced cardiomyopathy, which may present as congestive heart failure in 77% of cases [79]. Evaluation includes assessing symmetric endocardial movement, myocardial thickening, and the movement of the mitral valve's maximal opening point (E-Point) [80]. Quantitative measures such as E-point Septal Separation (EPSS) could be employed; a measurement of less than 2 mm indicates a high level of certainty for normal left ventricular ejection fraction [81, 82]. In one report they report hypocontractility and reduced ejection fraction, but there is no information on the quantification method used [39]. Right ventricle evaluation is discussed in the pulmonary complications section.

Aortic aneurysms may also be identified using POCUS, although it is uncommon [83]. The POCUS examination could include exploration of the aorta from the epigastrium to the distal bifurcation, including differentiation of its shape and caliber, thrombus in the lumen or signs of dissection [84]. There was not a report exploring this.

Respiratory

Respiratory or lung findings in SLE are among the most affected system/organs and can vary significantly. The distribution of lung abnormalities includes interstitial lung disease, pulmonary embolism, and pulmonary hypertension reported in order of incidence [85]. Additional possible findings include infectious pneumonia, shrinking lung syndrome, and diffuse alveolar hemorrhage. Evaluating dyspnea assessment, POCUS reduces the-to-diagnosis by 63 minutes, and the time-to-treatment by 27 minutes and has a higher likelihood of receiving appropriate treatment compared to those cases not using POCUS [9].

Interstitial lung disease in SLE has a prevalence of 6% [86]. This complication may be observed in the POCUS assessment by the presence of irregular, fragmented, thickening, blurred, or coarse pleural line, bilateral or unilateral B-lines, and consolidations less than 5 mm [87, 88]. Even more, in connective tissue lung disease the diagnosis performance of B-lines, compared to high-resolution computer tomography scan, found a pooled sensitivity of 91,5% and specificity of 81,3% [89]. POCUS examination for this disease takes five to seven minutes and an additional three minutes for record registration using protocol [87]. There was a report evaluating interstitial lung and it showed a non-inferiority of the inclusion of the artificial intelligence algorithm: SenseUS Lung compared to expert-ultrasonography [57].

In shrinking lung syndrome, ultrasound provides real-time dynamic information and quantification of diaphragmatic contraction velocity, duration of the diaphragmatic cycle, and inspiratory time through M-mode [90]. In the only report included, it was suspected on the basis of reduced diaphragmatic movement compared to the patient's healthy sister [58]. Unfortunately, it was not used for follow-up after treatment with rituximab [58]. Diffuse alveolar hemorrhage can present as a hypoechoic subpleural consolidation along with B-lines as were described in one report identified [59].

Pulmonary hypertension has a prevalence of 8% among the SLE population and may progress to heart failure, often manifesting with right ventricular findings observed on POCUS [91]. Evaluating the tricuspid annular plane systolic excursion (TAPSE) which is a marker of right ventricle function. Although, most of the right ventricular evaluations are related to lung complications [92]. Studies suggest that visual TAPSE estimation is easy to learn and it may be a viable substitute for measurements by emergency physicians.

As a main cause, pulmonary thromboembolic disease has a prevalence in SLE of 1.29% [93]. Es-

pecially when antiphospholipid syndrome increases this risk. For detecting the presence of deep vein thrombosis in legs, compression ultrasonography must be performed, as the vein wall is weaker than the arterial wall, it will collapse in the absence of solid content in its interior, and when no solid content is present (thrombus) [94]. It offers high sensitivity (95%) and specificity (96%), a shorter examination time (<4 min), and a shorter learning period [95]. In one study, the presence of right heart findings with the POCUS that are commonly found in pulmonary embolism did not lead to that diagnosis, as the patient had normal angiotomography [55]. On the other hand, the other report that found this abnormality along with deep vein thrombosis POCUS's findings did lead to pulmonary embolism diagnosis [56].

Kidneys and overload

Highlighting that end-stage kidney disease may develop in 1.7-2.8% of cases [3-5]. POCUS can assess kidney size, echogenicity, and cortical thickness in cases of chronic disease [96]. Although two reports presented lupus nephritis, they did not describe kidney evaluation, and there was not a report of any acute kidney injury [60, 61]. Using this tool can also rule out hydronephrosis or any other anatomical urinary tract alteration in cases of hematuria or acute kidney injury [97]. Compared to tomography, POCUS has a sensitivity of 72% and specificity of 73% for hydronephrosis detection, and depending on the experience of the operator sensitivity can increase to 92 % [98]. As it may be necessary before adding some points to the SLEDAI 2K score. In patients with lupus nephritis, who are undergoing hemodialysis, POCUS plays an important role in evaluating fistula diameter, depth, maturity, and facilitating cannulation [96]. In one report for the evaluation of an arterio-venous fistula, they evaluated the portal vein pulsatility change after compression of the fistula [61].

Additionally, it is important to note that POCUS is useful for evaluating fluid overload. This includes chronic complications leading to congestion, such as lupus nephritis that could need renal replacement therapy. It may have increased utility in acute situations that require high-volume administration, such as sepsis or acute pancreatitis. Congestion can be assessed using the Venous Excess Ultrasound Score (VExUS). Evaluation utilizing power Doppler of the suprahepatic, portal, and renal veins highly correlated to venous congestion [99]. Although in the reports when evaluating the inferior vena cava, even if it was dilated, they did not describe the VExUS score to quantify congestion [37, 60, 61].

Gastrointestinal and Hepatobiliary

Manifestations of the gastrointestinal and hepatobiliary tract may be broad, it may include lupus enteritis, pancreatitis, intestinal pseudo-obstruction, vasculitis of small or large intestines, hepatitis, and acalculous cholecystitis [100, 101]. Intra-abdominal bleeding can also be detected, as the report of perirenal hemorrhage and abdominal aortic aneurysm rupture is included in this systematic review [62, 63]. Also, there was a rare case report of necrotizing enterocolitis identified by the presence of hepatic vein gas presence POCUS [64]. POCUS may have an important role in the right clinical scenario, especially in SLE patients with acute abdominal pain.

Activity: SLEDAI-2K score

The SLEDAI 2K is a score that evaluates clinical and paraclinical activity manifestation, and a mean score of ten points is associated with all-cause mortality [102]. For 24 different variables, POCUS may be used to assess pleural and pericardial effusion and arthritis by joint effusion, summing it may provide up to eight points. POCUS may provide faster calculation of the SLEDAI score. From most of the records, this score was reported to expose the activity, although none of them linked with the usage of POCUS to calculate it.

It must be remarked that POCUS may be used to evaluate many other possible systemic complications that may arise in SLE patients: for example, secondary Sjögren syndrome, cutaneous lesions, malnutrition, or central and peripheral nerve system affections. Alternatively, it could be used to document the improvement or worsening of affected organs after treatment initiation. Multiorgan Ultrasound Lupus Assessment possibilities are represented (Fig. 3).

Limitation

The main limitation of the study was that a considerable number of reports were case reports. This takes a higher amount of bias and less reproducible information. It is also important to note that in many reports the authors did not report who performed the POCUS, where it was done, if they evaluated other organs or if they used a protocol for assessment.

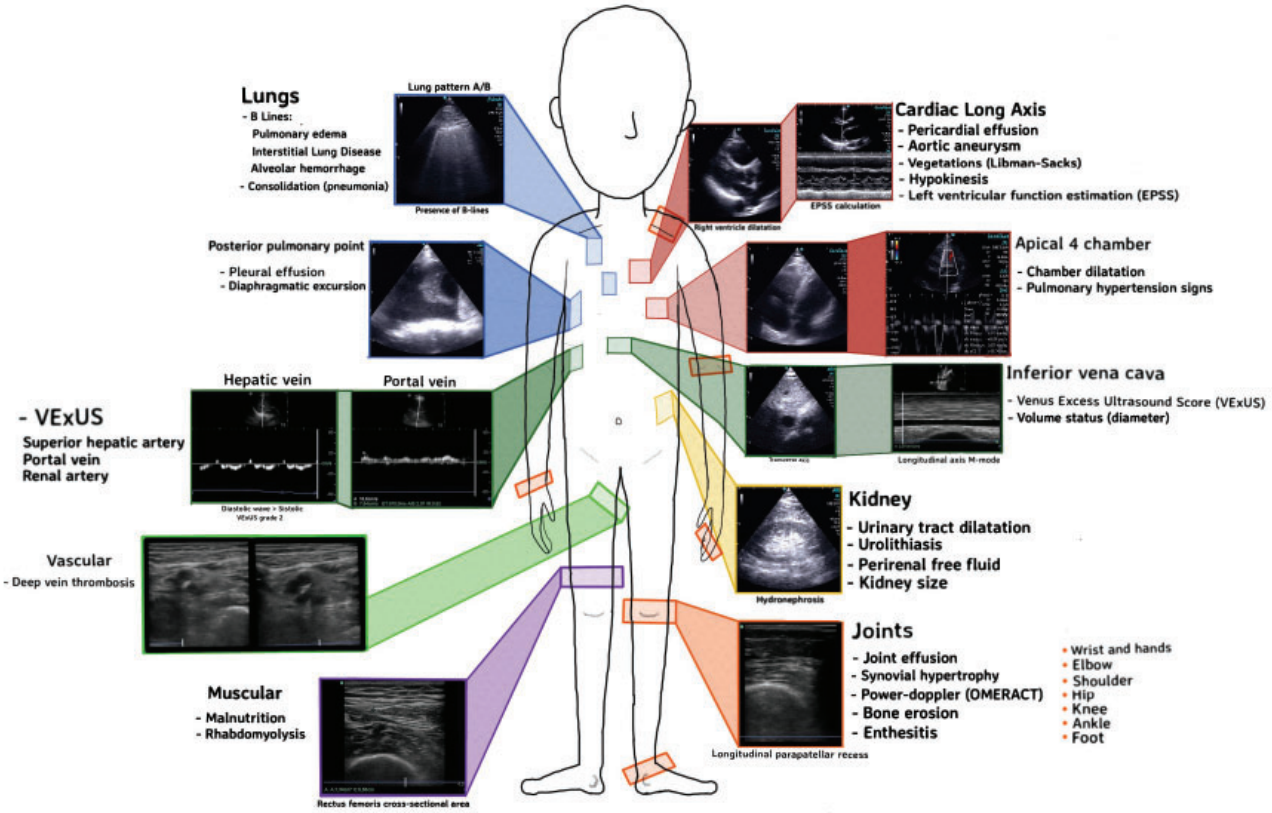


Fig. 3. Multiorgan Ultrasound Lupus Assessment (Image created using Takayasu Sketches)

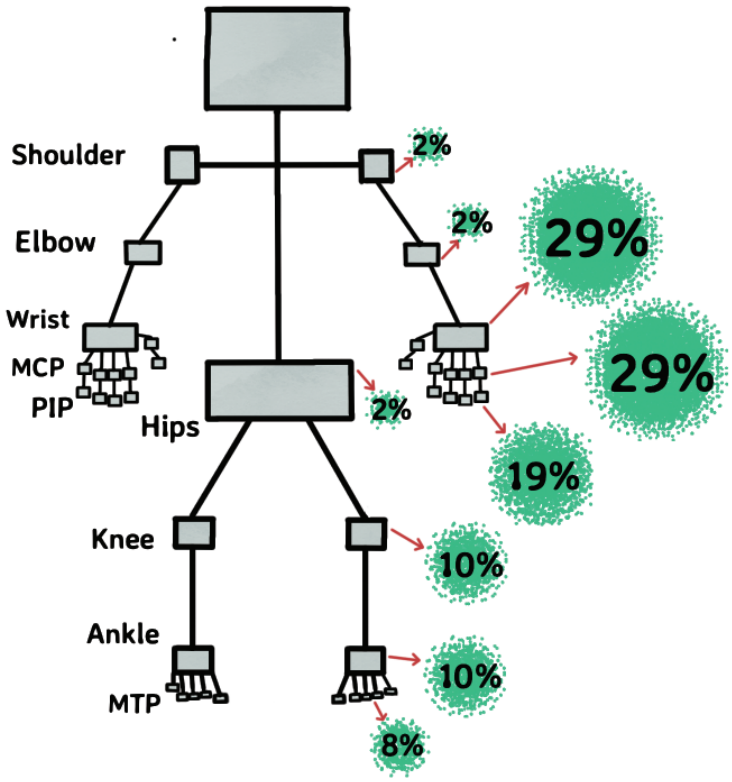


Fig. 4. Joint involvement distribution among the 23 records regarding the musculoskeletal system. (Image created using Takayasu Sketches)

Conclusions

This systematic review revealed that POCUS remains underutilized in evaluating SLE complications. These reports showed that POCUS was primarily used for the evaluation of one system or one organ. Notably, POCUS assessments mainly occur in emergency rooms under the purview of emergency physicians to evaluate the cardiovascular system or, in a rheumatology unit, to evaluate musculo-skeletal affection, overlooking other clinical settings and specialties. Addressing these gaps requires robust research to establish standardized protocols and explore their application.

Furthermore, taking into account the performance capacity and impact in diagnosis, follow-up, and treatment decisions in acute and chronic complications of POCUS in SLE, thus it may be more emphasized in practice. It is necessary to promote training and application of multiorgan assessment by POCUS in all clinical scenarios to systematically evaluate patients with SLE.

Author contributions: *All authors approve the final version of the manuscript, and all agree to be accountable for all aspects of the work.*

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Submitted: 04.01.2025

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