E.A.U. Mars 2016

ECHOGRAPHIE PLEURO-PULMONAIRE Approche de l'étude parenchymateuse

Dr BONNEC J.M.(1) (2) Dr BOBBIA X. (1) – Dr CLARET P.G. - Pr DE LA COUSSAYE J.E. (1) (1) Pôle Anesthésie Réanimation Douleur Urgence - GHU Carémeau-Nîmes (2) Pôle Urgences – SAMU – SMUR – CH Perpignan



Echographie pleuro-pulmonaire et condensation alvéolaire



- « Hépatisation » pulmonaire
- Se 90% Spe 98%
- Accolé à la plèvre dans 98 % des cas.
- Perte du glissement pleural dans la majorité des cas
- Bronchogramme visible Lichtenstein, I C M 2004

Echographie pleuro-pulmonaire et condensation alvéolaire

Intensive Care Med (2004) 30:276–281 DOI 10.1007/s00134-003-2075-6 ORIGINAL

Daniel A. Lichtenstein Nathalie Lascols Gilbert Mezière Agnès Gepner Ultrasound diagnosis of alveolar consolidation in the critically ill

- Aspects échographiques:
- Traduction échographique de l'hépatisation parenchymateuse
- > Limites:
- ✓ Superficielle: régulière : épanchement ou plèvre
- Profonde: régulière en cas de consolidation lobaire complète ou irrégulière à la jonction parenchyme consolidé et aéré

Echographie pleuro-pulmonaire et condensation alvéolaire





Moins le poumon est aéré, plus il est visible en échographie ...

Echographie pleuro-pulmonaire et condensation alvéolaire

- Aspects échographiques:
- Echostructure:
- The Dynamic Air Bronchogram. Lichtenstein D, Mezière G, Seitz J. Chest. 2009 Feb 18.
- Bronchogramme aérien: images hyperéchogènes punctiformes ou linéaires sans ombres acoustiques postérieures
- Bronchogramme aérien dynamique: plutôt en faveur d'un sd alvéolaire non rétractile ?
- Bronchogramme aérien statique: plutôt en faveur d'une atélectasie ?

Echographie pleuro-pulmonaire et condensation alvéolaire





Aspect « hépatisé » du parenchyme pulmonaire sans bronchogramme aérien

Echographie pleuro-pulmonaire et condensation alvéolaire



Consolidation alvéolaire massive avec bronchogramme aérien

Echographie pleuro-pulmonaire et condensation alvéolaire



Echographie pleuro-pulmonaire et syndrome alvéolo-interstitiel

• Bedside ultrasound of the lung for the monitoring of acute decompensated heart failure.

Volpicelli G et al. Am J Emerg Med. 2008

• The comet-tail artifact: an ultrasound sign of alveolarinterstitial syndrome.

Lichtenstein et al. Am J Respir Crit Care Med 1997

- Caractérisé par la présence d'un artéfact: ligne B
- Ligne B: air-eau=impédances acoustiques éloignées mêlées à un même endroit
- Ligne B: constantes dans l'œdème pulmonaire (mais pas que ...)

Echographie pleuro-pulmonaire et condensation alvéolaire



Echographie pleuro-pulmonaire et syndrome alvéolo-interstitiel

- Caractéristiques des lignes B:
- Artéfact en queue de comètes
- Nombreuses (>2) sur une même coupe
- Naissant de la ligne pleurale
- Bien définie
- ➢ Hyperéchogène
- Descendant jusqu'au bas du champ d'exploration échographique
- Effaçant les lignes A
- Assujettie au glissement pleural





Echographie pleuro-pulmonaire et syndrome alvéolo-interstitiel



Echographie pleuro-pulmonaire et syndrome alvéolo-interstitiel



« Queues de comète »

<u>DYSPNEE AIGUE: OAP vs BPCO décompensée:</u> Queues de comète présentes chez 40/40 OAP Queues de comète absentes chez 24/26 BPCO décompensée Queue de comète absentes chez 79/80 patients non dyspnéïques Lichtenstein et al Intensive Care Med 1998

Echographie pleuro-pulmonaire et approche de l'étude parenchymateuse

CLINICAL INVESTIGATIONS



Comparative Diagnostic Performances of Auscultation, Chest Radiography, and Lung Ultrasonography in Acute Respiratory Distress Syndrome Daniel Lichnsnein, M.D., * Am Goldstein, M.D., + Thisper Classel, M.D., Ph.D., ± Philper Chemie, M.D., * Jan-Goldstein, M.D., * Philippe Classel, M.D., Ph.D., ± Philper Chemie, M.D., * Jana Course Rody, M.D., * Ph.D., *

Lignes « B3 » = verre dépoli (type OAP)

Lignes « B7 » = épaississement des septa (type fibrose) Lichtenstein et al Anesthesiology 2004 Echographie pleuro-pulmonaire et approche de l'étude parenchymateuse

• PERSPECTIVES: Orientation diagnostique étiologique de la détresse respiratoire en pré-hospitalier:

RESEARCH



Open Access

ESEARCH

rosen et al. Critical Care 2011, 15:R11

Combination of lung ultrasound (a comet-tail sign) and N-terminal pro-brain natriuretic peptide in differentiating acute heart failure from chronic obstructive pulmonary disease and asthma as cause of acute dyspnea in prehospital emergency setting Gregor Prosen¹², Petra Klemen¹²³, Matej Stmad¹² and Stefek Grmec^{123,4*}

Echographie pleuro-pulmonaire et approche de l'étude parenchymateuse

• PERSPECTIVES: Orientation diagnostique étiologique de la détresse respiratoire en pré-hospitalier:

Table 4 Test characteristics of ultrasound examination, modified Boston examination, NT-proBNP and combination of ultrasound examination and NT-proBNP^a

Characteristic	Ultrasound examination ^b	Modified Boston criteria scoring	NT-proBNP	Ultrasound examination + NT-proBNP ^c	P value ^d
Sensitivity	100% (95% Cl 98 to 100)	85% (95% Cl 79 to 89)	92% (95% CI 88 to 95)	100% (95% CI 98 to 100)	< 0.01
Specificity	95% (95% Cl 91 to 100)	86% (95% Cl 82 to 90)	89% (95% CI 84 to 92)	100% (95% CI 97 to 100)	< 0.01
NPV	100% (95% Cl 98 to 100)	80% (95% Cl 77 to 85)	86% (95% CI 82 to 90)	100% (95% CI 98 to 100)	< 0.01
PPV	96% (95% Cl 93 to 100)	90% (95% Cl 86 to 93)	90% (95% CI 85 to 94)	100% (95% CI 96 to 100)	< 0.01
LR ⁺	20 (95% Cl 1.98 to 89.94)	6.1 (95% Cl 1.65 to 18.48)	8.36 (95% Cl 1.72 to 33.86)	Infinite	< 0.01
LR'	0	0.18 (95% CI 0.07 to 0.52)	0.09 (95% Cl 0.02 to 0.23)	0	< 0.01
AUROC	0.94 (95% Cl: 0.90 to 0.97)	0.86 (95% Cl 0.80 to 0.91)	0.90 (95% Cl 0.84 to 0.94)	0.99 (95% CI 0.98 to 1.00)	< 0.01

The combination of ultrasound examination and NTproBNP was statistically significantly different from the use of single methods. It had values of 100% sensitivity, 100% specificity, 100% NPV, 100% PPV, LR⁺ infinite, LR⁻ zero, and AUROC 0.99.

Echographie pleuro-pulmonaire et approche de l'étude parenchymateuse



E.A.U. Mars 2016

ECHOGRAPHIE PLEURO-PULMONAIRE B.L.U.E. Protocol Synthèse et intégration clinique

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B.L.U.E. Protocol Chest 2008;134;117-125 Decide publication of the American College of Chest Physicians Micro of Lung Ultrasound in the Designosis of Acute Respiratory Failure *: The BLUE Protocol Date A. Lichtenstein and Gilbert A. Meziere

METHODOLOGIE:

- Etude échographique de 401 patients consécutifs admis pour détresse respiratoire
- 2 Opérateurs: Gilles Mezière et Daniel Lichtenstein
- Confrontation des données de l'échographie pleuro-pulmonaire aux données diagnostiques « conventionnelles »
- Echographie dans les 20 premières minutes d'admission et durée U.S. < 3 minutes

B.L.U.E. Protocol

Eléments de sémiologie échographique recueillis:









* PLAPS: Posterolateral alveolar and/ or pleural syndrome = aspect de consolidation +/- épanchement pleural en regard



B.L.U.E. Protocol

Disease	Ultrasound Signs Used	Sensitivity, %	Specificity, %	Positive Predictive Value, %	Negative Predictive Value, %
Cardiogenic pulmonary edema	Diffuse bilateral anterior B+ lines associated with lung sliding (B profile)	97 (62/64)	95 (187/196)	87 (62/71)	99 (187/189)
COPD or asthma	Predominant anterior A lines without PLAPS and with lung sliding (normal profile), or with absent lung sliding without lung point	89 (74/83)	97 (172/177)	93 (74/79)	95 (172/181)
ulmonary embolism	Predominant anterior bilateral A lines plus venous thrombosis	81 (17/21)	99 (238/239)	94 (17/18)	98 (238/242)
neumothorax	Absent anterior lung sliding, absent anterior B lines and present lung point	88 (8/9)	$100\ (251/251)$	100 (8/8)	$99\ (251/252)$
Pneumonia	Diffuse bilateral anterior B+ lines associated with abolished lung sliding (B' profile)	11 (9/83)	100 (177/177)	100 (9/9)	70 (177/251)
	Predominant anterior B+ lines on one side, predominant anterior A lines on the other (A/B profile)	14.5 (12/83)	100 (177/177)	100 (12/12)	71.5 (177/248)
	Anterior alveolar consolidation (C profile)	21.5 (18/83)	99 (175/177)	90 (18/20)	73 (175/240)
	A profile plus PLAPS	42 (35/83)	96 (170/177)	83 (35/42)	78 (170/218)
	A profile plus PLAPS, B', A/B or C profile	89 (74/83)	94 (167/177)	88 (74/84)	95 (167/176)



B profil

B.L.U.E. Protocol

Disease	Ultrasound Signs Used	Sensitivity, %	Specificity, %	Positive Predictive Value, %	Negative Predictive Value, %
Cardiogenic pulmonary edema	Diffuse bilateral anterior B+ lines associated with lung sliding (B profile)	97~(62/64)	95 (187/196)	87 (62/71)	99 (187/189)
COPD or asthma	Predominant anterior A lines without PLAPS and with lung sliding (normal profile), or with absent lung sliding without lung point	89 (74/83)	97 (172/177)	93 (74/79)	95 (172/181)
Pulmonary embolism	Predominant anterior bilateral A lines plus venous thrombosis	81 (17/21)	99 (238/239)	94 (17/18)	98 (238/242)
Pneumothorax	Absent anterior lung sliding, absent anterior B lines and present lung point	88 (8/9)	$100\ (251/251)$	100 (8/8)	99(251/252)
Pneumonia	Diffuse bilateral anterior B+ lines associated with abolished lung sliding (B' profile)	11 (9/83)	100 (177/177)	100 (9/9)	70 (177/251)
	Predominant anterior B+ lines on one side, predominant anterior A lines on the other (A/B profile)	14.5 (12/83)	100 (177/177)	100 (12/12)	71.5 (177/248)
	Anterior alveolar consolidation (C profile)	21.5 (18/83)	99 (175/177)	90 (18/20)	73 (175/240)
	A profile plus PLAPS	42 (35/83)	96 (170/177)	83 (35/42)	78 (170/218)
	A profile plus PLAPS, B', A/B or C profile	89 (74/83)	94 (167/177)	88 (74/84)	95 (167/176)





A profil

B.L.U.E. Protocol

Disease	Ultrasound Signs Used	Sensitivity, %	Specificity, %	Positive Predictive Value, %	Negative Predictive Value, %
Cardiogenic pulmonary edema	Diffuse bilateral anterior B+ lines associated with lung sliding (B profile)	97~(62/64)	95 (187/196)	87 (62/71)	99~(187/189)
COPD or asthma	Predominant anterior A lines without PLAPS and with lung sliding (normal profile), or with absent lung sliding	89 (74/83)	97 (172/177)	93 (74/79)	$95\ (172/181)$
Pulmonary embolism	without lung point Predominant anterior bilateral A lines plus venous thrombotis	81 (17/21)	99 (238/239)	94 (17/18)	98 (238/242)
Pneumothorax	Absent anterior lung sliding, absent anterior B lines and present lung point	88 (8/9)	$100\ (251/251)$	100 (8/8)	$99\ (251/252)$
Pneumonia	Diffuse bilateral anterior B+ lines associated with abolished lung sliding (B' profile)	11 (9/83)	100 (177/177)	100 (9/9)	70(177/251)
	Predominant anterior B+ lines on one side, predominant anterior A lines on the other (A/B profile)	14.5 (12/83)	100 (177/177)	100 (12/12)	71.5 (177/248)
	Anterior alveolar consolidation (C profile)	21.5 (18/83)	99 (175/177)	90 (18/20)	73 (175/240)
	A profile plus PLAPS	42 (35/83)	96 (170/177)	83 (35/42)	78 (170/218)
	A profile plus PLAPS, B', A/B or C profile	89 (74/83)	94 (167/177)	88 (74/84)	95 (167/176)



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EP Profil

B.L.U.E. Protocol

Disease	Ultrasound Signs Used	Sensitivity, %	Specificity, %	Positive Predictive Value, %	Negative Predictive Value, %
Cardiogenic pulmonary edema	Diffuse bilateral anterior B+ lines associated with lung sliding (B profile)	97 (62/64)	95 (187/196)	87(62/71)	99 (187/189)
COPD or asthma	Predominant anterior A lines without PLAPS and with lung sliding (normal profile), or with absent lung sliding without lung point	89 (74/83)	97 (17 <u>2</u> /177)	93 (74/79)	95 (172/181)
Pulmonary embolism	Predominant anterior bilateral A lines plus venous thrombosis	81 (17/21)	99(238/239)	94 (17/18)	98 (238/242)
Pneumothorax	Absent anterior lung sliding, absent anterior B lines and present lung point	88 (8/9)	100 (251/251)	100 (8/8)	99 (251/252)
Pneumonia	Diffuse bilateral anterior B+ lines associated with abolished lung sliding (B' profile)	11 (9/83)	100 (177/177)	100 (9/9)	70 (177/251)
	Predominant anterior B+ lines on one side, predominant anterior A lines on the other (A/B profile)	14.5 (12/83)	100 (177/177)	100 (12/12)	71.5 (177/248)
	Anterior alveolar consolidation (C profile)	21.5 (18/83)	99 (175/177)	90 (18/20)	73 (175/240)
	A profile plus PLAPS	42 (35/83)	96 (170/177)	83 (35/42)	78 (170/218)
	A profile plus PLAPS, B', A/B or C profile	89 (74/83)	94 (167/177)	88 (74/84)	95 (167/176)



PNT profil

B.L.U.E. Protocol

Disease	Ultrasound Signs Used	Sensitivity, %	Specificity, %	Positive Predictive Value, %	Negative Predictive Value, %
Cardiogenic pulmonary edema	Diffuse bilateral anterior B+ lines associated with lung sliding (B profile)	97~(62/64)	95 (187/196)	87 (62/71)	99 (187/189)
COPD or asthma	Predominant anterior A lines without PLAPS and with lung sliding (normal profile), or with absent lung sliding without lung point	89 (74/83)	97 (172/177)	93 (74/79)	95 (172/181)
Pulmonary embolism	Predominant anterior bilateral A lines plus venous thrombosis	81 (17/21)	99 (238/239)	94 (17/18)	98 (238/242)
Pneumothorax	Absent anterior lung sliding, absent anterior B lines and present lung point	88 (8/9)	$100\ (251/251)$	100 (8/8)	$99\ (251/252)$
Pneumonia	Diffuse bilateral anterior B+ lines associated with abolished lung sliding (B' profile)	11 (9/83)	100 (177/177)	100 (9/9)	70(177/251)
	Predominant anterior B+ lines on one side, predominant anterior A lines on the other (A/B profile)	14.5 (12/83)	100 (177/177)	100 (12/12)	71.5 (177/248)
	Anterior alveolar consolidation (C profile)	21.5 (18/83)	99 (175/177)	90 (18/20)	73 (175/240)
	A profile plus PLAPS	42 (35/83)	96 (170/177)	83 (35/42)	78 (170/218)
	A profile plus PLAPS, B', A/B or C profile	89 (74/83)	94 (167/177)	88 (74/84)	95 (167/176)



A/B profil

B.L.U.E. Protocol

Ultrasound Signs Used	Sensitivity, %	Specificity, %	Positive Predictive Value, %	Negative Predictive Value, %
Diffuse bilateral anterior B+ lines associated with lung sliding (B profile)	97 (62/64)	95 (187/196)	87 (62/71)	99 (187/189)
redominant anterior A lines without PLAPS and with lung sliding (normal profile), or with absent lung sliding without lung point	89 (74/83)	97 (172/177)	93 (74/79)	95 (172/181)
redominant anterior bilateral A lines plus venous thrombosis	$81\ (17/21)$	99(238/239)	94 (17/18)	98 (238/242)
bsent anterior lung sliding, absent anterior B lines and present lung point	88 (8/9)	$100\ (251/251)$	100 (8/8)	99 (251/252)
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profile plus PLAPS	42 (35/83)	96 (170/177)	83 (35/42)	78 (170/218)
profile plus PLAPS, B', A/B or C profile	89 (74/83)	94 (167/177)	88 (74/84)	95 (167/176)
	Wifuse blatteral anterior B+ lines associated with lung skiding (B profile) redominant anterior A lines without PLAPS and with lung skiding (normal profile), or with absent lung skiding without hung point redominant anterior blatteral A lines plus venous thrombosis bsent anterior blatteral A lines plus venous thrombosis associated with abolished lung shiding associated with abolished lung shiding (B profile) redominant anterior B+ lines on one side, profile) relaters anterior A lines on the other (AB profile) netiors absectars consolidation (C profile) profile plus PLAPS, B', A'B or C profile	uffinse blatteral anterior B + lines 97 (62)64) associated with lung sking (normal predominant anterior A lines without 89 (74)83) PLAPS and with lung sking (normal predominant anterior blateral A lines 81 (17)(21) Pais venous thrombosis 85 (89) anatoria B lines and present lung paint 85 (89) anatoria B lines and present lung sking associated with abolished lung sking (B profile) 11 (983) exdense B + lines on one side, protoinniant anterior B + lines on the other (AB profile) 145 (12)(3) netfore B + Lines one the other (AB profile) 215 (15)(3) profile plus PLAPS 82 (35)(3) profile plus PLAPS 82 (35)(3) profile plus PLAPS 89 (74)(3)	uffinse blatteral anterior B+ lines 97 (62:64) 95 (187/196) associated with lung skiding (B profile) 89 (74:83) 97 (172177) PIAPS and with lung skiding (I normal profile), or with absent lung sliding without hung point 89 (74:83) 97 (172177) Piak venous thrombosis 88 (89) 100 (251/251) ansterior Bines and present lung point State and reserve lung point 11 (98:3) 100 (177/177) associated with absidished lung skiding (B profile) 100 (177/177) Minuse blatteral anterior B+ lines on one side, predominant anterior B+ lines on the other (AB profile) 11 (58:33) 100 (177/177) profile plus PLAPS 42 (35:33) 96 (170/177) profile plus PLAPS, B', AB or C profile 21.5 (18:83) 99 (176/177)	$ \begin{array}{llll} \label{eq:resonance} \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$



C Profil

B.L.U.E. Protocol



FIGURE 7. A decision tree utilizing lung ultrasonography to guide diagnosis of severe dyspnea.

APPLICATION PRATIQUE AUX URGENCES



Lung ultrasound is an accurate diagnostic tool for the diagnosis of pneumonia in the emergency department. Cortellaro et al. *Emerg Med J*, Janvier 2012

- 120 patients admis pour suspicion de PNP: 81 diagnostic retenu (67,5%)
 - RT à l'admission: VP: 54/81 (Se 67%) et VN: 33/39 (Sp 85%)
- US à l'admission: VP: 80/81 (Se 98 %) et VN: 37/39 (Sp 95%)
 - Faisabilité 100 % et durée examen US < 5 minutes
- Remarques:
- Opérateur entrainé
- Méthode diagnostique de référence discutable

APPLICATION PRATIQUE AUX URGENCES

A comparison of different diagnostic tests in the bedside evaluation of pleuritic pain in the ED. Volpicelli et al. Am J Emerg Med, Février 2012

- 49 patients en rétrospectif et 41 en prospectif => 90 patients se présentant au SAU avec une « douleur de type pleurale » et RT jugée normale
- 57 diagnostics de douleur pariétale, 22 PNP, 2 pleurésies, 7 EP, 1 K Pulm et 1 PNT
 US au SAU: Se 97 % et Sp 96 %
 - AUC pour la prédiction de lésion radio-occulte: 0,967 (IC: 0,929-1,00)

LE « TOUT » ÉCHOGRAPHIE PULMONAIRE ???

Probablement pas... Les stratégies diagnostiques combinées= démarche « écho-clinique »



Conclusion : échographie pleuro-pulmonaire (et plus...) La démarche « Echographie Clinique »

Une réflexion échographique « clinicienne » intégrée

Rapid evaluation by lung-cardiac-inferior vena cava (LCI) integrated ultrasound for differentiating heart failure from pulmonary disease as the cause of acute dyspnea in the emergency setting

Katsuya Kajimoto^{1*}, Keiko Madeen¹, Tomoko Nakayama², Hiroki Tsudo³, Tadahide Kuroda¹ and Takashi Abe³









Conclusion : échographie pleuro-pulmonaire (et plus...) La démarche « Echographie Clinique »

Table 2 Plasma BNP, lung ultrasound alone or combined with BNP, cardiac findings, and the LCI integrated ultrasound for diagnosis of AHFS Sensitivity Specificity NPV PPV Accuracy (%) (%) (%) (%) (%) BNP ≥100 pg/ml 76.4 67.1 68.8 92.4 35.1 Framingham 79.2 56.7 65.6 64.6 70.0 criteria* Lung ultrasound 96.2 54.0 90.9 75.0 78.8 alone Both Lung ultrasound and BNP (≥100 pg/ml) 88.6 67.6 80.6 79.8 80.0 Reduced EF (LVEF <40%) 26.4 86.5 45.1 73.7 51.1 MR or TR > 92.4 81.0 88.2 87.5 87.7 moderate IVC collapsibility 83.0 <50% 81.1 76.9 86.3 82.2 Both preserved EF 56.7 100.0 61.6 100.0 67.0 and MR ≥ moderate Both reduced EF 30.1 94.5 48.6 88.9 56.7 and either MR or TR ≥ moderate Lung-cardiac-inferior 94.3 vena cava (LCI) integrated 91.9 91.9 94.3 93.3 * Two major or one major and two minor criteria. BNP = brain natriuretic peptide; ICI = lung-cardiac-inferior vena cava; AHFS = actue heart failure syndromes; NPV = negative perdictive value; PVP = positive perdictive value; LVEF = left ventricular ejection fraction; NC = inferior vena cava; MR = mitral regurgitation; The =tricupid regurgitation.

