Année 2021/2022 N°

Thèse

Pour le 19/10/2022

DOCTORAT EN MEDECINE

Diplôme d'État

par

Laura BOUT

Née le 23/03/1995 à Fontainebleau (77)

TITRE

Facteurs influençant les doses de diurétiques par voie IV chez les patients de 75 ans ou plus présentant une insuffisance cardiaque aiguë

Présentée et soutenue publiquement le 19/10/2022 devant un jury composé de :

Président du Jury :

Professeur Bertrand FOUGERE, Gériatrie, Faculté de Médecine –CHU Tours

Membres du Jury :

Professeur Laurent FAUCHIER, Cardiologie, Faculté de Médecine Tours

Docteur Fanny POITAU, Gériatrie, Médecine interne, PH – CHU Tours

Docteur Patrick FRIOCOURT, Gériatrie, Médecine interne – CH Blois

Docteur Philippe VERNOCHET, Cardiologie – SSR Bois Gibert - Ballan Miré

UNIVERSITE DE TOURS
FACULTE DE MEDECINE DE TOURS

DOYEN
Pr Patrice DIOT

VICE-DOYEN
Pr Henri MARRET

ASSESSEURS
Pr Denis ANGOULVANT, *Pédagogie*
Pr Mathias BUCHLER, *Relations internationales*
Pr Theodora BEJAN-ANGOULVANT, *Moyens – relations avec l'Université*
Pr Clarisse DIBAO-DINA, *Médecine générale*
Pr François MAILLOT, *Formation Médicale Continue*
Pr Patrick VOURC'H, *Recherche*

RESPONSABLE ADMINISTRATIVE
Mme Carole ACCOLAS

****

DOYENS HONORAIRES
Pr Emile ARON (†) – *1962-1966*
Directeur de l'Ecole de Médecine - 1947-1962
Pr Georges DESBUQUOIS (†) - *1966-1972*
Pr André GOUAZE (†) - *1972-1994*
Pr Jean-Claude ROLLAND – *1994-2004*
Pr Dominique PERROTIN – *2004-2014*

PROFESSEURS EMERITES
Pr Daniel ALISON
Pr Gilles BODY
Pr Philippe COLOMBAT
Pr Etienne DANQUECHIN-DORVAL
Pr Pascal DUMONT
Pr Bernard FOUQUET
Pr Yves GRUEL
Pr Gérard LORETTE
Pr Dominique PERROTIN
Pr Philippe ROSSET

PROFESSEURS HONORAIRES
P. ANTHONIOZ – P. ARBEILLE – A. AUDURIER – A. AUTRET – P. BAGROS – C. BARTHELEMY – J.L. BAULIEU – C. BERGER – JC. BESNARD – P. BEUTTER – C. BONNARD – P. BONNET – P. BOUGNOUX – P. BURDIN – L. CASTELLANI – J. CHANDENIER – A. CHANTEPIE – B. CHARBONNIER – P. CHOUTET – T. CONSTANS – C. COUET – L. DE LA LANDE DE CALAN – J.P. FAUCHIER – F. FETISSOF – J. FUSCIARDI – P. GAILLARD – G. GINIES – D. GOGA – A. GOUDEAU – J.L. GUILMOT – O. HAILLOT – N. HUTEN – M. JAN – J.P. LAMAGNERE – F. LAMISSE – Y. LANSON – O. LE FLOCH – Y. LEBRANCHU – E. LECA – P. LECOMTE – AM. LEHR-DRYLEWICZ – E. LEMARIE – G. LEROY – M. MARCHAND – C. MAURAGE – C. MERCIER – J. MOLINE – C. MORAINE – J.P. MUH – J. MURAT – H. NIVET – L. POURCELOT – R. QUENTIN – P. RAYNAUD – D. RICHARD-LENOBLE – A. ROBIER – J.C. ROLLAND – D. ROYERE - A. SAINDELLE – E. SALIBA – J.J. SANTINI – D. SAUVAGE – D. SIRINELLI – J. WEILL

PROFESSEURS DES UNIVERSITES - PRATICIENS HOSPITALIERS

ANDRES Christian.....Biochimie et biologie moléculaire
ANGOULVANT Denis .....Cardiologie
APETOH Lionel.....Immunologie
AUPART Michel.....Chirurgie thoracique et cardiovasculaire
BABUTY Dominique .....Cardiologie
BAKHOS David.....Oto-rhino-laryngologie
BALLON Nicolas.....Psychiatrie ; addictologie
BARBIER François.....Médecine intensive et réanimation
BARILLOT Isabelle.....Cancérologie ; radiothérapie
BARON Christophe .....Immunologie
BEJAN-ANGOULVANT Théodora.....Pharmacologie clinique
BERHOUET Julien.....Chirurgie orthopédique et traumatologique
BERNARD Anne .....Cardiologie
BERNARD Louis .....Maladies infectieuses et maladies tropicales
BLANCHARD-LAUMONNIER Emmanuelle ....Biologie cellulaire
BLASCO Hélène.....Biochimie et biologie moléculaire
BONNET-BRILHAULT Frédérique .....Physiologie
BOURGUIGNON Thierry .....Chirurgie thoracique et cardiovasculaire
BRILHAULT Jean.....Chirurgie orthopédique et traumatologique
BRUNEREAU Laurent .....Radiologie et imagerie médicale
BRUYERE Franck.....Urologie
BUCHLER Matthias.....Néphrologie
CALAIS Gilles.....Cancérologie, radiothérapie
CAMUS Vincent .....Psychiatrie d'adultes
CORCIA Philippe.....Neurologie
COTTIER Jean-Philippe .....Radiologie et imagerie médicale
DEQUIN Pierre-François.....Thérapeutique
DESMIDT Thomas .....Psychiatrie
DESOUBEAUX Guillaume.....Parasitologie et mycologie
DESTRIEUX Christophe .....Anatomie
DI GUISTO Caroline.....Gynécologie obstétrique
DIOT Patrice.....Pneumologie
DU BOUEXIC de PINIEUX Gonzague .....Anatomie & cytologie pathologiques
DUCLUZEAU Pierre-Henri.....Endocrinologie, diabétologie, et nutrition
EL HAGE Wissam.....Psychiatrie adultes
EHRMANN Stephan.....Médecine intensive – réanimation
FAUCHIER Laurent .....Cardiologie
FAVARD Luc.....Chirurgie orthopédique et traumatologique
FOUGERE Bertrand .....Gériatrie
FRANCOIS Patrick.....Neurochirurgie
FROMONT-HANKARD Gaëlle .....Anatomie & cytologie pathologiques
GATAULT Philippe.....Néphrologie
GAUDY-GRAFFIN Catherine.....Bactériologie-virologie, hygiène hospitalière
GOUPILLE Philippe .....Rhumatologie
GUERIF Fabrice .....Biologie et médecine du développement et de la reproduction
GUILLON Antoine.....Médecine intensive – réanimation
GUILLON-GRAMMATICO Leslie.....Epidémiologie, économie de la santé et prévention
GUYETANT Serge .....Anatomie et cytologie pathologiques
GYAN Emmanuel.....Hématologie, transfusion
HALIMI Jean-Michel.....Thérapeutique
HANKARD Régis.....Pédiatrie
HERAULT Olivier .....Hématologie, transfusion
HERBRETEAU Denis .....Radiologie et imagerie médicale
HOURIOUX Christophe.....Biologie cellulaire
IVANES Fabrice .....Physiologie
LABARTHE François .....Pédiatrie
LAFFON Marc .....Anesthésiologie et réanimation chirurgicale, médecine d'urgence
LARDY Hubert.....Chirurgie infantile
LARIBI Saïd.....Médecine d'urgence
LARTIGUE Marie-Frédérique.....Bactériologie-virologie
LAURE Boris.....Chirurgie maxillo-faciale et stomatologie
LECOMTE Thierry.....Gastroentérologie, hépatologie
LEGRAS Antoine.....Chirurgie thoracique
LESCANNE Emmanuel.....Oto-rhino-laryngologie
LINASSIER Claude .....Cancérologie, radiothérapie

MACHET Laurent .....Dermato-vénéréologie
MAILLOT François .....Médecine interne
MARCHAND-ADAM Sylvain .....Pneumologie
MARRET Henri .....Gynécologie-obstétrique
MARUANI Annabel .....Dermatologie-vénéréologie
MEREGHETTI Laurent .....Bactériologie-virologie ; hygiène hospitalière
MITANCHEZ Delphine .....Pédiatrie
MORINIERE Sylvain.....Oto-rhino-laryngologie
MOUSSATA Driffa .....Gastro-entérologie
MULLEMAN Denis.....Rhumatologie
ODENT Thierry.....Chirurgie infantile
OUAISSI Mehdi .....Chirurgie digestive
OULDAMER Lobna.....Gynécologie-obstétrique
PAINTAUD Gilles .....Pharmacologie fondamentale, pharmacologie clinique
PATAT Frédéric .....Biophysique et médecine nucléaire
PERROTIN Franck .....Gynécologie-obstétrique
PISELLA Pierre-Jean.....Ophtalmologie
PLANTIER Laurent.....Physiologie
REMERAND Francis.....Anesthésiologie et réanimation, médecine d'urgence
ROINGEARD Philippe.....Biologie cellulaire
RUSCH Emmanuel.....Epidémiologie, économie de la santé et prévention
SAINT-MARTIN Pauline.....Médecine légale et droit de la santé
SALAME Ephrem.....Chirurgie digestive
SAMIMI Mahtab .....Dermatologie-vénéréologie
SANTIAGO-RIBEIRO Maria .....Biophysique et médecine nucléaire
THOMAS-CASTELNAU Pierre .....Pédiatrie
TOUTAIN Annick.....Génétique
VAILLANT Loïc.....Dermato-vénéréologie
VELUT Stéphane.....Anatomie
VOURC'H Patrick.....Biochimie et biologie moléculaire
WATIER Hervé .....Immunologie
ZEMMOURA Ilyess .....Neurochirurgie

PROFESSEUR DES UNIVERSITES DE MEDECINE GENERALE

DIBAO-DINA Clarisse
LEBEAU Jean-Pierre

PROFESSEURS ASSOCIES

MALLET Donatien .....Soins palliatifs
ROBERT Jean.....Médecine Générale

PROFESSEUR CERTIFIE DU 2ND DEGRE

MC CARTHY Catherine.....Anglais

MAITRES DE CONFERENCES DES UNIVERSITES - PRATICIENS HOSPITALIERS

AUDEMARD-VERGER Alexandra.....Médecine interne
BARBIER Louise.....Chirurgie digestive
BINET Aurélien .....Chirurgie infantile
BISSON Arnaud .....Cardiologie (CHRO)
BRUNAULT Paul .....Psychiatrie d'adultes, addictologie
CAILLE Agnès .....Biostat., informatique médical et technologies de communication
CARVAJAL-ALLEGRIA Guillermo.....Rhumatologie (au 01/10/2021)
CLEMENTY Nicolas .....Cardiologie
DENIS Frédéric.....Odontologie
DOMELIER Anne-Sophie .....Bactériologie-virologie, hygiène hospitalière
DUFOUR Diane .....Biophysique et médecine nucléaire
ELKRIEF Laure.....Hépatologie – gastroentérologie
FOUQUET-BERGEMER Anne-Marie.....Anatomie et cytologie pathologiques
GOUILLEUX Valérie.....Immunologie
HOARAU Cyrille .....Immunologie

LE GUELLEC Chantal.....Pharmacologie fondamentale, pharmacologie clinique
LEFORT Bruno.....Pédiatrie
LEMAIGNEN Adrien.....Maladies infectieuses
MACHET Marie-Christine.....Anatomie et cytologie pathologiques
MOREL Baptiste.....Radiologie pédiatrique
PARE Arnaud.....Chirurgie maxillo-faciale et stomatologie
PIVER Éric.....Biochimie et biologie moléculaire
ROUMY Jérôme.....Biophysique et médecine nucléaire
SAUTENET Bénédicte.....Thérapeutique
STANDLEY-MIQUELESTORENA Elodie.....Anatomie et cytologie pathologiques
STEFIC Karl.....Bactériologie
TERNANT David.....Pharmacologie fondamentale, pharmacologie clinique
VAYNE Caroline.....Hématologie, transfusion
VUILLAUME-WINTER Marie-Laure.....Génétique

MAITRES DE CONFERENCES DES UNIVERSITES

AGUILLON-HERNANDEZ Nadia.....Neurosciences
NICOGLOU Antonine.....Philosophie – histoire des sciences et des techniques
PATIENT Romuald.....Biologie cellulaire
RENOUX-JACQUET Cécile.....Médecine Générale

MAITRES DE CONFERENCES ASSOCIES

AUMARECHAL Alain.....Médecine Générale
BARBEAU Ludivine.....Médecine Générale
CHAMANT Christelle.....Médecine Générale
ETTORI-AJASSE Isabelle.....Médecine Générale
PAUTRAT Maxime.....Médecine Générale
RUIZ Christophe.....Médecine Générale
SAMKO Boris.....Médecine Générale

CHERCHEURS INSERM - CNRS - INRAE

BECKER Jérôme.....Chargé de Recherche Inserm – UMR Inserm 1253
BOUAKAZ Ayache.....Directeur de Recherche Inserm – UMR Inserm 1253
BRIARD Benoit.....Chargé de Recherche Inserm – UMR Inserm 1100
CHALON Sylvie.....Directeur de Recherche Inserm – UMR Inserm 1253
DE ROCQUIGNY Hugues.....Chargé de Recherche Inserm – UMR Inserm 1259
ESCOFFRE Jean-Michel.....Chargé de Recherche Inserm – UMR Inserm 1253
GILOT Philippe.....Chargé de Recherche Inrae – UMR Inrae 1282
GOUILLEUX Fabrice.....Directeur de Recherche CNRS – EA 7501 - ERL CNRS 7001
GOMOT Marie.....Chargée de Recherche Inserm – UMR Inserm 1253
GUEGUINOU Maxime.....Chargé de Recherche Inserm – UMR Inserm 1069
HEUZE-VOURCH Nathalie.....Directrice de Recherche Inserm – UMR Inserm 1100
KORKMAZ Brice.....Chargé de Recherche Inserm – UMR Inserm 1100
LATINUS Marianne.....Chargée de Recherche Inserm – UMR Inserm 1253
LAUMONNIER Frédéric.....Chargé de Recherche Inserm - UMR Inserm 1253
LE MERREUR Julie.....Directrice de Recherche CNRS – UMR Inserm 1253
MAMMANO Fabrizio.....Directeur de Recherche Inserm – UMR Inserm 1259
MEUNIER Jean-Christophe.....Chargé de Recherche Inserm – UMR Inserm 1259
PAGET Christophe.....Chargé de Recherche Inserm – UMR Inserm 1100
RAOUL William.....Chargé de Recherche Inserm – UMR CNRS 1069
SI TAHAR Mustapha.....Directeur de Recherche Inserm – UMR Inserm 1100
SUREAU Camille.....Directrice de Recherche émérite CNRS – UMR Inserm 1259
WARDAK Claire.....Chargée de Recherche Inserm – UMR Inserm 1253

CHARGES D'ENSEIGNEMENT

Pour l'Ecole d'Orthophonie
DELORE Claire.....Orthophoniste
GOUIN Jean-Marie.....Praticien Hospitalier
Pour l'Ecole d'Orthoptie
BOULNOIS Sandrine.....Orthoptiste
Pour l'Ethique Médicale
BIRMELE Béatrice.....Praticien Hospitalier

Facteurs influençant les doses de diurétiques par voie IV chez les patients de 75 ans ou plus présentant une insuffisance cardiaque aigue

RESUME

Introduction : L'insuffisance cardiaque est une pathologie du sujet âgé : 75% des patients hospitalisés pour insuffisance cardiaque aigue ont plus de 75 ans. Le pronostic de cette pathologie est grave avec une moyenne de survie d'environ 4 ans. Les recommandations des sociétés savantes pour la prise en charge de l'insuffisance cardiaque sont robustes. Cependant, les preuves sont limitées pour guider la prescription des diurétiques.

L'objectif de cette étude était d'identifier les facteurs influençant les doses de diurétiques utilisées par voie intraveineuse chez les patients âgés présentant une insuffisance cardiaque aigue.

Méthodes : Il s'agit d'une étude observationnelle prospective bicentrique incluant les patients de 75 ans ou plus hospitalisés pour une insuffisance cardiaque aigue dans des services de médecine aigue gériatrique et de cardiologie. Les patients inclus ont été analysés en 2 groupes, l'un avec les patients ayant reçu de fortes doses de diurétiques IV par rapport à leur traitement habituel (HD) et l'autre avec ceux recevant de faibles doses de diurétiques IV par rapport à leur traitement habituel (LD).

Résultats : 110 patients ont été inclus. La moyenne d'âge était de 85 ans, avec une majorité de femmes (53,7%). 79% d'entre eux étaient fragiles selon les critères de Fried. L'indice de comorbidités moyen de Charlson était de 3,4. Les comorbidités et les paramètres de l'évaluation gériatrique étaient comparables entre les 2 groupes, sauf pour l'hospitalisation en gériatrie et les aides professionnelles à domicile, plus fréquent dans le groupe LD. Une étiologie infectieuse à la décompensation cardiaque, notamment urinaire ($p = 0,01$), était plus fréquemment retrouvée dans le groupe HD, avec un syndrome inflammatoire biologique plus marqué. A contrario, il y avait significativement plus de cas sans facteur déclenchant de décompensation dans le groupe LD ($p = 0,003$). Il n'y avait pas de différence significative entre les groupes pour la FEVG, les NT pro BNP, la troponinémie et la pathologie cardiaque sous-jacente. La dose habituelle de diurétique était plus élevée dans le groupe LD ($p = 0,0008$).

Conclusion : Cette étude ne retrouve finalement que peu de facteurs qui influencent la dose de diurétiques utilisées dans le traitement de l'insuffisance cardiaque aigue : cette dose dépend essentiellement de la dose habituelle de diurétiques du patient, et de la présence d'une infection sous-jacente, notamment urinaire. La fragilité du patient ne semble pas influencer les doses prescrites.

Factors influencing intravenous diuretic doses in patients aged of 75 years or older with acute decompensated heart failure

ABSTRACT

Introduction: Heart failure (HF) is a geriatric disease: 75% of hospitalized patients for acute heart failure have more than 75 years old. It has a poor prognosis with a mean survival at 4 years. Recommendations for heart failure are strong. Nevertheless, proofs about diuretic prescriptions are limited.

The purpose of this study was to identify factors influencing intravenous diuretic dose in patients aged of 75 years or older presenting an acute decompensated heart failure (ADHF).

Methods: This was a prospective, observational, descriptive and bicentric study. Enrollment was done for patient aged 75 and over hospitalized in geriatric and cardiologic department for ADHF. Included patients were analyzed in 2 groups. In one group, they received high intravenous diuretic dose compared to their daily diuretic dose (HD). In the other group, they received low intravenous diuretic dose compared to their daily diuretic dose (LD).

Results: 110 patients were involved. The mean age was 85 years old, there was a women majority (53.7%), 79% patients had 3 of the 5 components of the Fried phenotype patients. The mean Charlson Comorbidity Index was 3.4. Comorbidities and geriatric assessment were comparable in both groups except for hospitalization in geriatric department and assistance service, which were less frequent in HD group. An infectious etiology, notably urinary infection ($p = 0.001$) was more frequent in HD group with a higher biological inflammatory syndrome. However, there were more cases with unknown HF trigger in the LD group ($p=0.003$). There was no difference between groups for ejection fraction, NT pro BNP, troponin and cardiovascular disease. Daily diuretic dose was higher in LD group ($p = 0.0008$).

Conclusion: Finally, there were only few factors influencing intravenous diuretic dose in ADHF: dose depend essentially in the daily diuretic dose and a infection etiology, notably urinary etiology. Frailty doesn't seemed to influence diuretic dose.

Remerciements

A Mesdames et Messieurs les membres du jury,

A Monsieur le Professeur Bertrand Fougère, merci de m'avoir fait l'honneur de présider ce jury.

A Monsieur le Pr Laurent Fauchier, merci de m'avoir accueilli dès ma première année d'internat pour écouter mon projet professionnel en plus de ceux de vos élèves, et merci d'être présent au moment où l'internat se termine presque, pour juger mon travail.

A Monsieur le Dr Patrick Friocourt, merci de me faire l'honneur de juger mon travail de thèse, et surtout merci du compagnonnage dont vous avez fait preuve durant cette année bien chargée et merci pour les bons conseils.

A Monsieur le Dr Philippe Vernochet, merci de m'avoir montré un idéal de médecin chef, tu m'as laissé apprendre tout ce que pouvais pendant ces 6 mois, merci de ton soutien et surtout merci pour ton exemplarité.

A Madame le Dr Poitau Fanny, merci d'avoir dirigée ma thèse avec ce défi du temps, et merci pour ton perfectionnisme qui m'a permis de rendre un travail dont je suis fière. Soit assurée, Fanny, de ma reconnaissance.

Aux différents médecins et paramédicaux des services m'ayant accueillie lors de mes études,

A l'équipe des urgences de Tours, merci à l'équipe médicale et paramédicale (Dr Haouari, Dr Jeziorny, Dr Rousseau, Dr Dumouchel, Dr Truong, Charlotte, Anne, Victor et tous les autres), avec qui j'ai découvert l'internat et qui m'ont presque convaincu.

A l'équipe de gériatrie d'Orléans, merci à l'équipe médicale et paramédicale (Dr Colson, Dr Blanc, Dr Trinh, Dr Skowronski, Dr Pambet, Dr Biogeau, Sylvie et les autres), j'ai adoré travailler avec vous.

A l'équipe du SSR de l'Ermitage (Dr Dardaine, Dr Léger, Arwen, Amal et les autres), merci pour ce semestre, je reviens.

A l'équipe du SSR de Bois Gibert, merci à l'équipe médicale et paramédicale (Dr Vernochet, Dr Lecomte, Dr Gaborit-Roussel, Dr Triantafyllou, Dr Menard, Julie, Laurence, Julien, Elise et les autres), c'était un plaisir.

A l'équipe de cardiologie d'Orléans, merci à l'équipe médical et paramédical (Dr Nguyen, Dr Goralski, Dr Gamet, Dr Malmare, Dr Ramoul et les autres), j'ai tellement appris.

A l'équipe de gériatrie de Tours, merci à l'équipe médicale et paramédicale (Dr Mennecart, Dr Gana, Dr Lemoine, Dr Bleuet, Jacquelines, Lucie, Sophie et les autres), c'est avec vous que ce moment arrive.

A Madame le Dr Ben Sussan Hanna, Hanna, merci de m'avoir appris l'échocardiographie, j'ai adoré voir ta rigueur et ta passion mais aussi merci pour ta joie de vivre.

A Madame et Messieurs les Dr Dardaine, Dr Nguyen, Dr Blanc, Dr Vernochet, merci pour votre exemplarité qui donne envie aux plus jeunes générations de se dépasser pour faire de leur mieux.

Merci à tous les patients âgés que nous avons pu soigner et accompagner, prendre soin de vous est un honneur.

A ma famille et mes amis,

Merci à mes parents, vous êtes le ciment de ce que je suis. Merci de m'avoir rendu des mauvais moments surmontables, merci de me faire confiance. Merci à toi maman, de m'avoir montré que l'amour est la plus grande force qui existe dans ce monde. Merci à toi papa, de m'avoir appris à m'adapter tout le temps et devant tout.

Merci à ma sœur, Gigi et Loulou, je suis si fière de vous. Votre amour est tellement précieux.

Merci Bibi pour tous ce que tu m'as offert, ce que tu m'offres tous les jours et à tous ce que la vie va encore nous offrir (E.). Merci pour ta présence pendant chaque étape depuis qu'on se connait, merci pour tout cet amour, merci pour ta patience, tu es mon pilier, je t'aime.

Je m'estime chanceuse d'avoir notre famille. J'aime tous nos moments, à tous les prochains, vous le savez, je les attends toujours avec impatience. J'espère réussir à apporter ce que vous m'avez déjà donné.

Merci à Floc, je suis tellement contente de t'avoir rencontré, à toutes nos longues discussions et à nos prochaines. La distance n'a rien changé. Merci pour ta bienveillance.

Merci Roro d'amour, depuis le début on est ensemble, quel bonheur ce chemin ensemble.

Merci Alex, ta sincérité fait de toi un très bel Humain.

Merci Jaja, la vie a commencé bien avant la médecine et je l'aimais déjà beaucoup grâce à toi.

Merci Marie, Célclé, Soso, le temps passe mais on ne change pas. A chaque retrouvaille.

Merci Mel, une des plus belles rencontres de l'internat, je te souhaite les plus belles choses.

Merci Maelle pour cet internat de gériatrie, il n'aurait pas été pareil sans toi.

Merci à tous mes co internes (Yassine L, Romain B, Caro B, Julien L, Yacine S, Helene B, Antony D, Camille J, Chloé B, Othmane B, Wadi R, et tous les autres) j'ai aimé tous les moments au travail et en dehors. La vie est plus douce avec des humains comme vous.

Merci à ma famille médecine (Jib Jib, Guigui et mon parrain) on s'est si bien trouvé.

Pour finir, merci Avo. Je ne sais pas tellement comment j'ai choisi la gériatrie. Mais je te portais un amour inconditionnel et j'ai toujours voulu faire mieux avec les personnes âgées, peut-être pour toi.

Il n'y a pas plus prestigieux pour que prendre soins des ainés et de protéger leur dignité.

SERMENT D'HIPPOCRATE

En présence des Maîtres de cette Faculté,

de mes chers condisciples
et selon la tradition d'Hippocrate,
je promets et je jure d'être fidèle aux lois de l'honneur
et de la probité dans l'exercice de la Médecine.

Je donnerai mes soins gratuits à l'indigent,
et n'exigerai jamais un salaire au-dessus de mon travail.

Admis dans l'intérieur des maisons, mes yeux
ne verront pas ce qui s'y passe, ma langue taira
les secrets qui me seront confiés et mon état ne servira
pas à corrompre les mœurs ni à favoriser le crime.

Respectueux et reconnaissant envers mes Maîtres, je rendrai à leurs enfants l'instruction que j'ai reçue de leurs pères.

Que les hommes m'accordent leur estime si je suis
fidèle à mes promesses. Que je sois couvert d'opprobre
et méprisé de mes confrères
si j'y manque.

Table of contents

I. INTRODUCTION

Heart failure (HF) prevalence is estimated at 2.3% and >10% among persons aged 70 and over. About 70 000 deaths are linked to HF each year (1). According to the French National Hospitalization Database (PMSI), mean age of hospitalized patients for HF is 78 years old. Thus, we can see the geriatric implication. Moreover 21% of this patients were hospitalized at least twice for HF during that same year, and 7.8% died during hospitalization (2). More specifically, the poor prognostic of HF may be illustrate by this American national cohort of 170 239 patients aged of 67 years old and older, where one third died within the first year (3).

Euro Heart Failure Survey (EHFS) II confirms that the contemporary management of very elderly patients with HF remains suboptimal, even if comparatively at EHSF I, the situation is improving (4)(5).

The complexity of this heterogeneous population may explain this finding. More specifically, a part of this issue may be explained by frailty. Frailty is a geriatric syndrome which lead to vulnerability when patients are faced to stress. Vulnerability is made by cumulative declines across different physiological systems. Frailty phenotype defined by Fried criteria is independently predictive of incident falls, worsening mobility or ADL disability, hospitalization, and death (6). In HF, independently of age, co-morbidity and HF prognostic factors, frailty phenotype is associated with an increased risk of mortality and readmission during the first year. Moreover, its effect is “dose-dependent” when measured quantitatively (7). Finally, frailty is an important biological syndrome, which is not included in most HF prognostic models.

The mean age, the prognosis and the estimated hospitalization cost lead to one question: how can we improve management of HF?

Fortunately, with several therapeutic strategy (preventive and in the management of HF), a study with a cohort of 2.5 million patients suggest a slightly decrease of the incidence of HF in elderly persons since the 1990s. Incidence declined most noticeably among patient aged 80 to 84 years in this study (8). Nevertheless, even if it had improved little with time, hospital readmission rates and long-term all-cause mortality remain high in elderly persons (9). These findings suggest that recent innovations in heart failure management have not yet translated into better outcomes in this population (10). The need to identify optimal management strategies for these clinically complex patients is urgent.

There is a real therapeutic arsenal to treat, prevent and manage HF. Indeed, guidelines for management of HF are strong. However, the limited evidence to guide diuretic use in heart failure is

reflected in contemporary practice guidelines, which give diuretics a class I recommendation (expert consensus) but based on C evidence (low-level evidence) (11). In acute decompensated heart failure (ADHF), ESC guidelines suggest doses of IV diuretics, depending on the dose used before admission (11). Nevertheless, DOSE trial, which evaluate various strategy diuretic treatment in ADHF doesn't show significant difference in patients' global assessment of symptoms or in the change in renal function with a high dose diuretic therapy (2.5 times the previous oral dose) as compared with a low dose (equivalent to the patient's previous oral dose). Furthermore, the high-dose strategy was associated with greater diuresis and more favorable outcomes in some secondary measures but also with transient worsening renal function (12).

We therefore wondered what were the IV diuretic doses used in elderly patients, and if frailty, comorbidities, type of heart failure, etiology influenced these doses.

The main objective of our study was to evaluate the factors influencing IV diuretic dose in elderly patient ($\geqslant$ 75ans) presenting an ADHF. The second objective was to study the compliance of the doses used with the existing protocol (13).

II. PATIENTS AND METHODS

A) STUDY DESIGN

This was a prospective, observational, descriptive and bicentric study. We recruited in Cardiology (cardiac care units and intensive care units) and Geriatric department of two large hospitals centers of France (University Hospital of Tours and Regional Hospital of Orléans). Patients were enrolled between September 2021 and July 2022. The patients and/or their relatives were orally informed of the study. The French Data Protection Agency (n° F20211202103902) and ethics committee in human research approved the study protocol.

B) INCLUSION CRITERIA

Patient over age 75 were screened if they met diagnostic criteria:

- Presence of symptoms (dyspnea, orthopnea, major asthenia, paroxysmal nocturnal dyspnea) or signs (lung congestion, bilateral infiltrates in chest Xray, peripheral oedema, ascites, jugular turgidity) (13).
- NT pro BNP and BNP greater than or equal >350 and >100 pg/mL respectively (14,15).
- ≥ 1 intravenous diuretic injection.

C) EXCLUSION CRITERIA

Patients were excluded if they not talked French to prevent miss standardized geriatric assessment.

D) CLINICAL AND PARACLINICAL ASSESSMENT

Baseline data were collected by a physician. Demographic data (gender, age, walking difficulties, dwelling, and admission department) and comorbidities (HTA, diabetes, cardiovascular diseases, neurologic disease, oncology history…) were collected at admission. Their vaccination status was reported by themselves if possible or their family, likewise for medical history (number of falls, number of hospitalization…).

Biological values were recorded at the admission. If it was not available at the first test results, the first analysis during hospitalization was considered. According to the FAIR HF study, we transcript ferritin when it was collected (16). Liver function test was also recorded to evaluate occurrence of ischemic hepatitis (shock liver) in elderly patient (17), as well as troponin, an independent risk factor for in-hospital mortality (18).

All patients underwent a standardized geriatric assessment, after clinical stabilization and during hospitalization (Annex 2 – 3 – 4 – 5 - 6) (19–24). Frailty was defined using Fried criteria (6) studied in HF

(11). Frailty characterized by 3 or more of 5 components: 1) physical exhaustion, 2) slowness, 3) low physical activity, 4) unintentional weight loss and 5) weak grip strength.

The following data were also collected: HF characteristics prior to the admission (HF etiology and echocardiographic parameters), concomitant acute diseases, delirium, prior treatment, date of admission and date of discharge.

E) EXPOSURE

The exposure of interest was dose of diuretics. Intravenous diuretic prescription was made by physicians working in the two departments. The intravenous dose delivered in emergency department prior the hospitalization was identified and count if applicable. According to the DOSE-trial, two groups were created: high dose and low dose. High dose was defined by intravenous dose per day >2.5 times previous oral dose, or more than 80mg IV per day if previous oral dose was <60mg per day. Low dose was defined by intravenous dose per day <2.5 times previous oral dose or less than 80 mg IV per day if previous dose was < 60 mg per day.

Cumulative dose of IV diuretic during hospitalization was collected, as well as the highest dose per 24 hours. The association between cumulative dose of IV diuretic and data collected was investigated using a bivariate and multivariate analysis. Finally, diuretic doses were compared to the existing protocol.

F) STATISTICAL ANALYSIS

Statistical analysis were performed using R software version 3.1 (R: A language and environment for statistical computing; R Foundation for Statistical Computing, Vienna, Austria). Data were described by groups using the appropriate statistical parameters (Chi square test for categorical variables, non-parametric method of Kruskal-Wallis for ordinal or continuous variables). The bivariate and multivariate analysis were performed using a linear regression model. Statistical significance was defined by an acceptable alpha-risk of 5%.

III. RESULTS

A) TWO GROUPS ANALYSIS

1) BASELINE CHARACTERISTICS

110 patients were included. Main demographic data on the two age groups are given in *table 1*. Mean age was 84.8 ± 5.9 years old with no difference between HD and LD groups (p=0.11). 54.8% and 50% of these patients were males in respectively HD and LD group (p=0.61). LD group patients were less commonly referred to a cardiology department than HD group patient (75% in LD VS 91.9% in HD, p=0.01). There was no substantial difference about comorbidities (cardiovascular disease (coronary heart disease, hypertension), diabetes, oncology history and confirmed severe cognitive impairment in particular). There was no difference between groups for vaccination status. The median Charlson Comorbidity Index was 3 in both cases (3 (2-5) in HD vs. 3 (2-4) in LD, p=0.65).

The clinical picture (dyspnea, orthopnea, major asthenia, paroxysmal nocturnal dyspnea, lung congestion, edema of the lower limbs, ascites, jugular turgidity) wasn't significantly different between the HD group and the LD group. Bilateral infiltrates in chest Xray was less common in the HD group than in the LD group (48.3 vs. 72.9% respectively, p=0.009).

Concerning life style, almost all patients lived in home (91.8%) (Table 2). There was no significant difference for Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) in two groups (respectively 6 (5.5-6) and 7 (4.25-8) in HD group; and 5.75 (4-6) and 7 (2.25-8) in LD group, p=0.11 and p=0.95). 54.8% had walking disorders in the HD group and 58.3% in the LD group with no significant difference.

Table 1 - Baseline characteristics by dose group

	Total (n=110)	HD group (n=62)	LD group (n=48)	P-value
Age (years) [a]	85 (80-89)	85 (80-87)	87 (80-90)	0.11
Male Gender [b]	52.7% (58/110)	54.8% (34/62)	50 (24/48)	0.61
Body mass index (kg/m²)[a]	26.4 (23.6-29.6)	26.6 (23.5-29.4)	26.2 (24.0 – 30.2)	0.52
Enrolment				
Cardiology departement [b]	84. 5% (93/110)	91.9% (57/62)	75% (36/48)	**0.01**
Geriatric departement [b]	15.5% (17/110)	8.1% (5/62)	25% (12/48)	**0.01**
Symptoms				
Dyspnea [b]	97.2% (107/110)	98.4% (61/62)	95.8% (46/48)	0.22
Orthopnea [b]	17.2% (19/110)	12.9% (8/62)	22.9% (11/48)	0.41
Major asthenia [b]	24.5% (27/110)	27.4% (17/62)	20.8% (10/48)	0.17
Paroxysmal nocturnal dyspnea [b]	11.8% (13/110)	16.1% (10/62)	6.3% (3/48)	0.19
Signs				
Lung congestion [b]	93.6% (103/110)	93.6% (58/62)	93.8% (45/48)	0.76
Bilateral infiltrates in chest Xray [b]	59.3% (65/110)	48.4% (30/62)	72.9% (35/48)	**<0.01**
Peripheral oedema [b]	56.3% (62/110)	53.2% (33/62)	60.4% (29/48)	0.45
Jugular turgidity [b]	8.1% (9/110)	11.3% (7/62)	4.2% (2/48)	0.17
Cardiovascular disease				
Coronary heart disease [b]	23.6% (26/110)	24.2% (15/62)	18.7% (9/48)	0.49
Atrial fibrillation [b]	54.5% (60/110)	50% (31/62)	60.4% (29/48)	0.68
History of HTA [b]	73.6% (81/110)	77.4% (48/62)	68.9% (33/48)	0.31
Comorbidities				
Charlson [a]	3 (2-5)	3 (2-5)	3 (2-4)	0.65
Diabetes [b]	35.5% (39/110)	40.3%(25/62)	12.9% (14/48)	0.23
Peripheral arterial disease [b]	20% (22/110)	22.5% (14/62)	16.6% (8/48)	0.42
Oncology history [b]	18.2% (20/110)	21% (13/62)	14.6% (7/48)	0.39
Confirmed severe cognitive impairment [b]	4.4% (5/110)	4.8% (3/62)	4.1% (2/48)	0.87
Vaccination				
Covid vaccine [b]	88.2% (97/110)	85.5% (53/62)	91.7% (44/48)	0.67
Influenza vaccine [b]	67.3% (74/110)	64.5% (46/62)	70.8% (34/48)	0.71
Pneumococcal vaccine [b]	7.2% (8/110)	6.5% (4/62)	8.3% (4/48)	0.53

[a] *Median and quartiles, Wilcoxon test.*

[b] *Chi 2 test.*

Table 2 - Baseline lifestyle measures by dose group

	Total (n=110)	HD group (n=62)	LD group (n=48)	p-value
Living in own home [b]	91.8% (101/110)	91.9% (57/62)	91.7% (44/48)	0.98
Living alone [b]	46.4% (51/110)	45.1% (28/62)	47.9% (23/48)	0.77
Living with spouse or equal [b]	44.5% (49/110)	48.4% (30/62)	39.6% (19/48)	0.70
Assistance service [b]	50% (55/110)	41.6% (26/62)	60.42% (29/48)	**0.05**
ADL (selfs care problems) [a]	6 (5-6)	6 (5.5-6)	5.75 (4-6)	0.11
IADL (difficulties to perform usual activities) [a]	7 (3-8)	7 (4.25-8)	7 (2.25-8)	0.95
Quality of life				
Walking disorders [b]	56.4%(62/110)	54.8% (34/62)	58.3% (28/48)	0.71

[a] *Median and quartiles, Wilcoxon test.*
[b] *Chi 2 test.*

2) GERIATRIC ASSESSMENT

Table 3 - Geriatric assessment by group

	Total (n=110)	HD group (n=62)	LD group (n=48)	p-value
Fried frailty criteria (/5) [a]	4 (3-4)	4 (3-4)	4 (3-4)	0.57
Gait speed [b]	81.8% (90/110)	77.4% (48/62)	87.5% (42/48)	0.14
Handgrip strength [b]	81.8% (90/110)	85.5% (53/62)	77.1% (37/48)	0.36
≥ 1 hospitalisation past year [b]	54.5% (60/110)	56.5% (35/62)	52.1% (25/48)	0.41
≥ 1 fall past year [b]	39.1% (43/110)	35.5% (22/62)	43.8% (21/48)	0.59
PHQ2 [ca]	(0-5)	1.5 (0-5)	1 (0-5)	0.99
SPMSQ [da]	(0-3)	2 (1-3.3)	1(0-2)	**0.06**
Minicog [b]	56.3% (62/110)	59.7% (37/62)	52.1% (25/48)	0.43
MNA SF [ea]	10 (7-11)	9.5 (7-11)	10 (8-11)	0.67
MNA [fa]	22 (20-25)	22 (19.5-22.3)	22.5 (20-24.5)	0.95
Polymedication (≥ 10 drugs) [b]	26.4% (29/110)	30.6% (19/62)	20.8% (10/48)	0.22

[a] *Median and quartiles, Wilcoxon test.*
[b] *Chi 2 test.*
[C] *Patient Health Questionnaire-2 (19,20)* [d] *The Short Portable Mental Status Questionnaire (SPMSQ) (21,22)* [e] *Mini Nutritional Assessment Short Form (23)* [f] *Mini Nutritional Assessment (24)*

79% of patients were frail according to Fried criteria and there was no significant difference between groups for the Fried frailty criteria (4 vs. 4 p=0.57). Even with detailed Fried frailty criteria, there was no significant difference for gait speed and handgrip strength (table 3). ≥1 fall happened last year in 35.5% and 43.8% in the HD and LD group respectively with no substantial difference (p=0.59). Likewise, 56.5%

HD group's patients were hospitalized ≥1 times last year against 52.1% for LD group (p=0.41). In both cases, median's Mini Nutritional Assessment Short Form® (MNA SF) is range in "risk of malnutrition" (9. 5 vs. 10 p=0.67) as in the MNA® (22 vs. 22.5 p=0.95). There was a lot of patients presenting polymedication (≥10 drugs) with no significant difference between groups (30.6% in HD vs. 20.8% in LD, p=0.22). There was a statistical trend concerning the Short Portable Mental Status Questionnaire (2 in HD vs. 1 in LD, p =0.06) with reduce errors in the LD group.

3) BASELINE TREATMENT

Number of patients with furosemide prescription or equivalent before inclusion was higher in the LD group (68.8 in LD vs 43.5% in HD, p 0.008) and daily diuretic dose was higher in the LD group (median 0 in HD vs. 40mg in LD, mean 30 mg in HD vs 111 mg in LD p<0.001). There was no difference concerning heart failure medication between the two groups (hydrochlorothiazide, Angiotensin-converting enzyme inhibitors (ACE-I), angiotensin receptor blocker (ARB) and beta-blocker). Equally, prescriptions of calcic inhibitor, amiodarone and anticoagulation therapy were similar in both groups (table 4).

Table 4 - Usual Cardiovascular medication by dose group

	Total (n=110)	**HD group (n=62)**	**LD group (n=48)**	**P-value**
Diuretics : furosemide or equivalent [b]	54.5% (60/110)	43.5% (27/62)	68.8% (33/48)	**0.008**
Dose of oral furosemide or equivalent [a]	0 (0-0)	0 (0-40)	40 (0-120)	**<0.001**
Hydrochlorothiazide [b]	11.8% (13/110)	14.5% (9/62)	12.5% (4/48)	0.79
ACE-I [cb]	25.4% (28/110)	22.6% (14/62)	25.2% (14/48)	0.43
ARB [db]	24.5% (27/110)	25.8% (16/62)	22.9% (11/48)	0.72
Beta-blockers [b]	53.6% (59/110)	56.5% (35/62)	50.0% (24/48)	0.50
Anticoagulation therapy [b]	49.1% (54/110)	46.8% (29/62)	52.1% (25/48)	0.58
Amiodarone [b]	11.8% (13/110)	14.5% (9/62)	8.3% (4/48)	0.31
Calcic inhibitor [b]	32.7% (36/110)	33.9% (21/62)	31.2% (15/48)	0.38

[a] Median and quartiles, Wilcoxon test.

[b] Chi 2 test.

[c] ACE-I Angiotensin-converting enzyme inhibitors [d] ARB Angiotensin receptor blocker

4) INVESTIGATIONS: BIOLOGICAL FINDINGS AND CARDIAC INVESTIGATIONS

Table 5 - Biological findings and cardiac investigations by dose group

	Total (n=110)	HD group (n=62)	LD group (n=48)	P-value
Laboratory parameters				
Hemoglobin (g/l) [a]	115 (102.5-131.75)	117 (106-132.3)	112.5 (99.8 -131.3)	0.23
Creatinine (µmol/L) [a]	107 (82-154)	115 (82.3-154)	100 (81.8-141.3)	0.55
GFR (mL/min) [ac]	47.5 (31-67.25)	48 (31.5-71.8)	46.5 (30.75-65.6)	0.89
Natremia (mmol/L) [a]	138 (135-141)	137 (135-141)	139 (137-140.3)	0.34
Troponin (ng/L) [a]	60 (26-132)	61 (24.5-396.8)	56.4 (28.5-115.7)	0.42
BNP (pg/mL) [ad]	879 (635.3-1918.3)	926 (644-2278)	807 (635.25-1459)	0.31
NT pro BNP (pg/mL) [ae]	6496 (3358-15114)	5896 (329.5-12605)	8538 (3807.5-16570.5)	0.60
C-reactive protein (mg/L) [a]	15.1 (6.9-46.5)	19.1 (6.6-50.8)	12.3 (7.2-35.2)	0.40
Leucocytes (G/L) [a]	8.54 (6.7-11.3)	9.5 (7.6-12.7)	7.6 (6.2-9.1)	**<0.01**
Neutrophils (G/L) [a]	6.24 (4.8-8.9)	7.8 (5.16-10.2)	5.5 (4.3-7.2)	**<0.01**
12-lead electrocardiogram				
Heart frequency (bpm) [a]	83 (71-100)	82 (71-103)	85 (67-97)	0.63
Sinus rhythm [b]	51.8% (57/110)	53.2% (33/62)	50.0% (24/48)	0.73
Atrial fibrillation/SVT [bf]	47.3% (52/110)	45.2% (28/62)	50.0% (24/48)	0.61
Narrow QRS [b]	56.4% (62/110)	62.9% (39/62)	47.9% (23/48)	0.29
Echocardiography				
Echocardiography done [b]	88.2% (97/110)	95% (59/62)	79% (38/48)	**0.01**
Ejection Fraction (%) [a]	45% (30-60)	40% (30-60)	52% (31-60)	0.30
Left ventricular hypertrophy (LVH) [b]	30% (33/110)	29.0% (18/62)	31.2% (15/48)	0.48
Elevated LVEDP [bg]	44.5% (49/110)	48.4% (30/62)	39.6% (19/48)	0.35
Left atrial enlargement [b]	54.5 (60/110)	54.8% (34/62)	54.2% (26/48)	0.23
Moderate/severe aortic valve stenosis [b]	24.5% (27/110)	21.0% (13/62)	29.2% (14/48)	**0.08**
Mitral regurgitation [b]	48.2% (53/110)	54.8% (34/62)	39.5% (19/48)	0.34
Aortic regurgitation [b]	20.9% (23/110)	22.6% (14/62)	18.8% (9/48)	0.92
Tricuspid regurgitation [b]	22.7% (25/110)	22.6% (14/62)	22.9% (11/48)	0.45
Systolic pulmonary pressure (mmHg) [a]	50 (45-56.5)	50.5 (44.3-58)	50 (45-52.8)	0.86
Altered right ventricular (RV) function [b]	27.3% (30/110)	24.2% (15/62)	31.2% (15/48)	0.21

[a] Median and quartiles, Wilcoxon test.

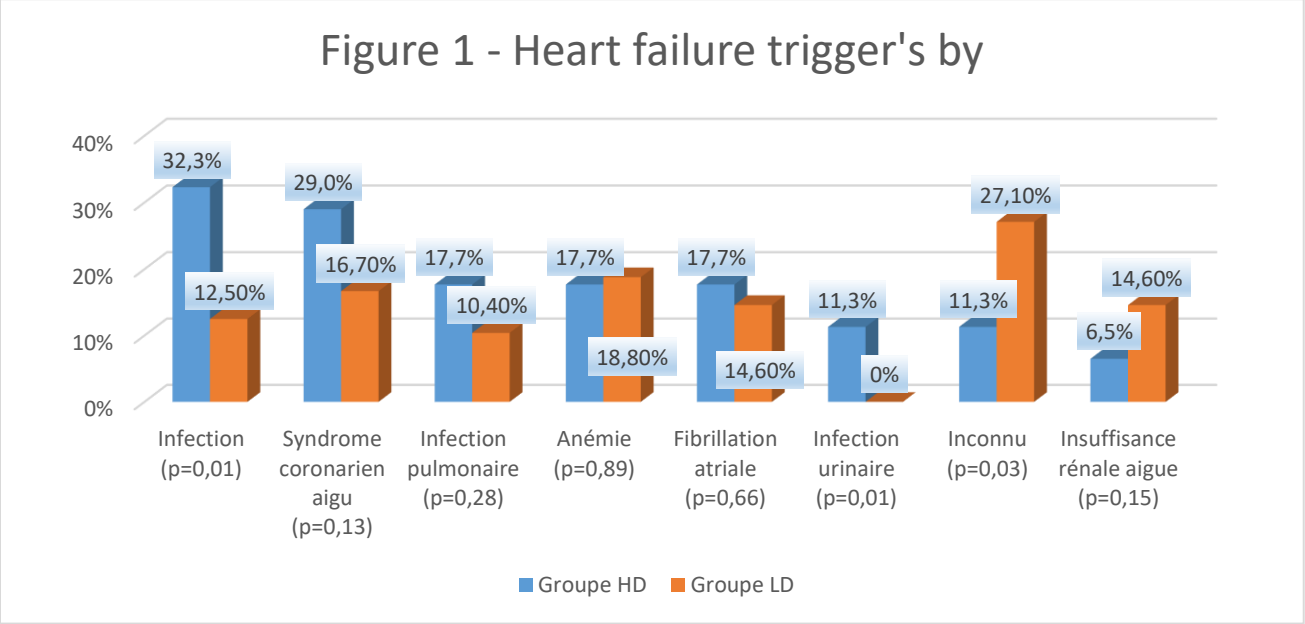
[b] Chi 2 test.

[C] GFR : glomerular filtration rate ; [d] BNP : B-type natriuretic peptide NT; [e] pro BNP : n-terminal pro-brain natriuretic peptide type B ; [f] SVT : supraventricular tachycardia ; [g] Elevated Left Ventricular End Diastolic Pressure LVEDP

Leukocytes and neutrophils was significantly higher in the HD group (respectively 9.5 G/L (7.6-12.7) in HD vs 7.6 G/L (6.2-9.1) in LD p= 0.001 and 7.8G/L (5.16-10.2) in HD vs.5.5 G/L (4.3-7,2) in LD p=0.002). No difference was observed among groups concerning hemoglobin, natremia, renal function, hepatic function as well as troponin , ferritin, B-type natriuretic peptid (BNP and NT-pro-BNP) (table 5).

95% and 79% underwent a echocardiography in the HD and LD group respectively (p=0.01). 42% of all patients had heart failure with reduced ejection fraction. There was not significantly different between groups for systolic function (40% (30-60) vs. 52% (31-60) p=0.31) as well as diastolic function parameters like left atrial enrollment, LVEDP, left ventricular hypertrophy and systolic pulmonary pressure. Altered right ventricular function was higher in the LD group but remains comparable (p = 0.21). Valvular disease was represented in both groups with no significant difference. There was a statistical trend between low dose group and aortic valve stenosis (29.2% (14/48) in LD vs 21.0% (13/62) in HD p 0.08).

5) HF ETIOLOGY



The infection rate was higher in the HD group than in the LD group (32.3% vs. 12.5% respectively p=0.01), Figure 1. It was the same for urinary infection in particular (11.3% in HD vs. 0% in LD p=0.01). On the other hand, it was more frequent not to find etiology in the LD group (27.1% in LD vs. 11.3% in HD p=0.03). There was no significant difference between groups for acute coronary syndrome, acute renal failure, anemia, atrial fibrillation/supra ventricular tachycardia and pulmonary infection in particular (Figure 1)

6) ADHF TREATMENT

Table 6 - Heart failure treatment

	Total (n=110)	HD group (n=62)	LD group (n=48)	p-value
Cumulative intravenous doses (mg) [a]	285 (125-560)	420 (280-847.5)	142.5 (80-257.5)	**<0.01**
Length of intravenous diuretic treatment (days) [a]	3 (2-5)	4 (3-5)	2 (1-4)	**<0.01**
Maximum dose (mg/24h) [a]	120 (80-240)	160 (120-240)	80 (55-120)	**<0.01**
Risordan (ISOSORBIDE) [b]	8.2% (9/110)	11.3% (7/62)	4.2% (2/48)	0.17
Hydrochlorthiazide [b]	2.7% (3/110)	3.2% (2/62)	2.1% (1/48)	
Inotrope [b]	3.6% (4/110)	6.5% (4/62)	0% (0/48)	**0.07**
Oxygenotherapy [b]	77.3% (85/110)	82.3% (51/62)	70.8% (34/48)	0.16
Non invasive ventilation [b]	13.6% (15/110)	19.4% (12/62)	6.3% (3/48)	0.05
Length of stay (days) [a]	10 (7-14)	10 (7.3-14)	10 (7-14)	0.23
Dose at discharge (mg/24h) [a]	40 (40-120)	40 (40-80)	50 (40-125)	0.38

[a] *Median and quartiles, Wilcoxon test.*
[b] *Chi 2 test.*

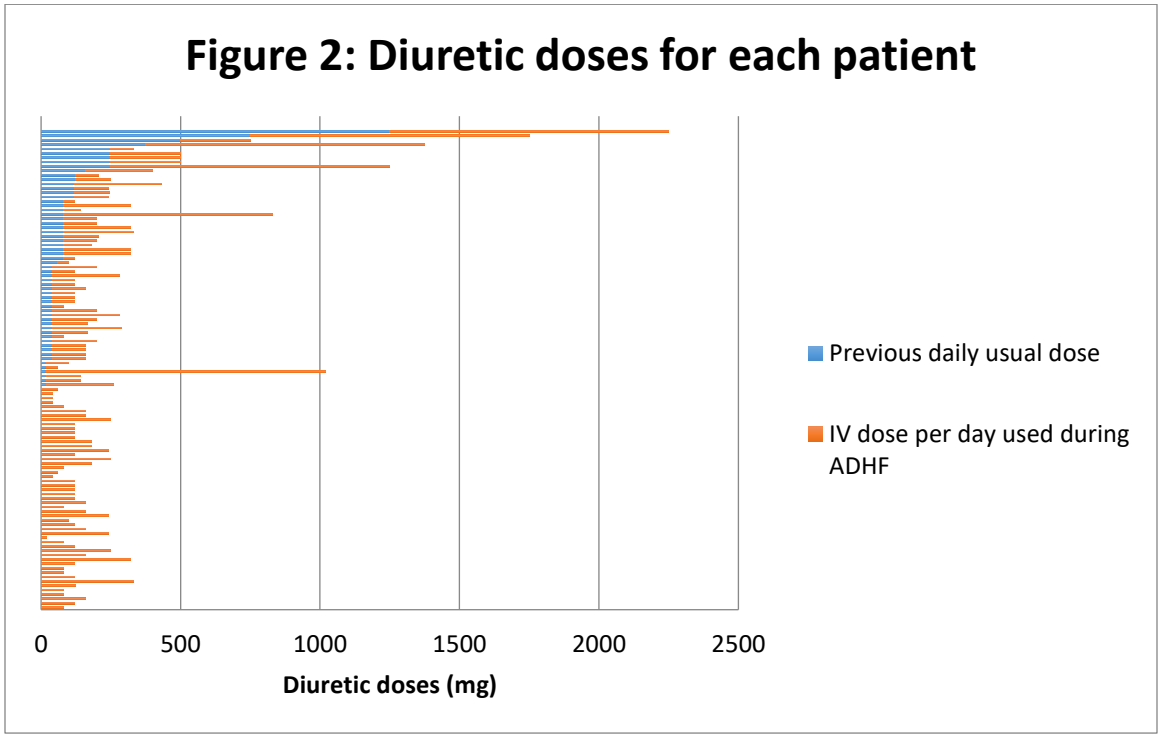
As expected, cumulative intravenous diuretic dose was higher in the HD group (420mg vs. 142.5mg in LD, p<0.001). Equally, the maximal intravenous dose per day was higher in the HD group (160mg vs. 80mg in LD p<0.001). The length of intravenous treatment was higher in the HD group (4days vs. 2 days in LD p<0.001). There was no significant difference for using ISOSORBIDE and HYDROCHLOROTHIAZIDE. Using conventional oxygen therapy in the HD group was higher but remains similar to the LD group (82.3% in HD vs. 70.8% in LD, p=0.157). Noninvasive ventilation utilization was higher in the HD group than in the LD group (19.4% vs. 6.3% respectively, p=0.047). There was no difference for length of stay and diuretic dose at discharge in the two groups.

B) BIVARIATE AND MULTIVARIATE ANALYSIS

In bivariate analysis, higher cumulative IV diuretic dose during hospitalization was significantly associated with using a walker. About comorbidities, there was a significant association between higher cumulative IV diuretic dose and Chronic Obstructive Pulmonary Disease history, renal failure stage 5 (including high usual creatinine values), hospitalization past year. It was the same for high diuretic dose at baseline and anticoagulation therapy by FLUINDIONE. Regarding ADHF, it was a significant association between higher cumulative IV diuretic dose and a renal or an infection trigger, a high creatinine and urea rate during ADHF, a non-sinus rhythm or a left bundle branch block at the admission electrocardiogram, ISOSORBIDE and

HYDROCHLORTHIAZIDE utilization in ADHF treatment. At last, higher diuretic dose was significantly associated with high diuretic dose at discharge.

In multivariate analysis, higher cumulative IV diuretic dose was significantly associated with usual diuretic doses (p=0.001) (figure 2) and isosorbide (p=0.04) or hydrochlorothiazide prescription (p<0.001) during acute cardiac failure. There was a statistical trend with a renal failure trigger (p=0.007).



C) COMPARISON WITH THE EXISTING PROTOCOL

84 prescriptions (76.4%) were conformed to the protocol. In the other prescriptions, diuretic doses were lower than the protocol. IV diuretics doses were lower than the usual oral dose for 7 patients.

IV. DISCUSSION

First of all, we choose to analyze data in two groups (LD and HD) because it was one of the only diuretic dose definition in our initial literature review. Nevertheless, there wasn't geriatric data. In fact, in DOSE-Trial study (12), the mean age was 66 years old. Moreover, the purpose of this study was the diuretic effectiveness while our study was based in the available baseline characteristic for the physician to pilot initial management. However, using this diuretic definition with two groups (HD and LD group) seemed to be useful because it integrated usual daily diuretic dose. It was one of the only values which influenced intra venous diuretic dose in the multivariate analysis.

The aim of this study was to identify features associated with diuretic doses used during ADHF. Finally, there were only few factors influencing this intravenous diuretic: the daily diuretic dose and an infection etiology. Frailty doesn't seem to influence diuretic dose. There was a link between renal function and IV diuretic dose in bivariate analysis, but not in multivariate analysis, probably because of confounding factors.

In overall population, mean age was 84.7 years old; the median Charlson Comorbidity was 3, 79% patients of the overall study had frail. These results are comparable to the other studies including elderly patients with heart failure: mean age 74.9 to 85 years old, Charlson between 3 and 4 and frailty in 57.5% to 76% of patients (25). EHFS I and II had a comparable mean age too with respectively 85.3 and 83.7 years old in geriatric groups (4-5). Thus, our population seemed to be representative but there are only few studies in this field. However, there is no study to our knowledge that included geriatric population and studied diuretic doses.

Association between cardiologic department and high dose group can be explain by several points. In the cardiologic department, patient was enrolled in intensive unit and classic hospitalization unit. Thus, we may imagine that patients in intensive unit needed higher dose because of the severity of the ADHF. However, baseline clinical outcomes and investigations outcomes (biological findings and cardiac investigations) are similar in both groups. Limitation was that only 15.5% from overall population was enrolled from a geriatric department. The reason was the limited time for physician-investigator in geriatric department comparatively to the cardiologic department. Exploration in geriatric department had to be continued.

We can't establish difference between groups for clinical profile. Two reasons can explain our fail: one, because there really no difference between population receiving high diuretic dose than low dose; second, because of the lack of power to find this statistical association. Our hypothesis is that clinical HF signs and symptoms are not sufficient to show HF severity and lead HF management. Typically, in this JAMA study, signs of congestion (rales, edema, and elevated mean jugular venous pressure) were absent in 18 of 43 patients (42%) with pulmonary capillary wedge pressures greater than or equal to 22 mm Hg (26).

On the other hand, we find a significant association between bilateral infiltrates in chest X ray and the LD group. In this 85 376 patients cohort study, approximately 1 of every 5 patients admitted from the emergency department (ED) with ADHF had no signs of congestion on chest radiography (27). One hypothesis may be that chest X ray in HD group was done after a clinical stabilization because of the ADHF severity and it could had a better diuretic effectiveness in patients with an acute pulmonary oedema picture. We didn't find paper to answer this question.

There wasn't a lot of pulmonary infection (14% in the overall population). However, only 67% received an influenza vaccine and 7% a Pneumococcal vaccine. The French Health Authority recommend a target of at least 75% vaccination coverage for all groups for which vaccination is recommended (28). Ideally, all patients of this study should receive influenza and Pneumococcal vaccine (29). Maybe, the vaccination coverage was better in our study. In fact, to obtain the vaccination status, we consult the medical files and we ask to the patient if possible or his family.

Only infection (in particular urinary infection) was statistically associated with high diuretic dose. This relation wasn't describe to our knowledge. Nevertherless, treatment and physiopathology of ADHF and sepsis are opposing. In fact, International Guidelines for Management of Sepsis and Septic Shock suggest fluid therapies (like crystalloids or saline fluid) for sepsis treatment(30). It may appear antithetical to conventional HF management that promotes preload and afterload reduction (31). Overlap exists between the hemodynamic effects of sepsis and HF, but whether this necessitates treatment variation remains unknown.

23% had acute coronary syndrome, 16% had tachyarrhythmia, and 18% anemia. Myocardial revascularization, rhythm control and blood therapy transfusion are treatment which can are quickly

delivered (almost in the emergency department or soon after). It could explain why we didn't find substantial difference between dose groups.

Time to reduce drugs and to discharge is unclear. For example, in the DOSE AHF trial, after decongestive therapy during 3 days, only 15% of patients were assessed to be euvolaemic by their treating physician (13). Moreover, in a ESC study, absent or minimal signs and symptoms of congestion did not portend a good post-discharge prognosis, raising the hypothesis that clinical 'decongestion' may be insufficient(32). Consequently, it can explain why we didn't find statistical association between intravenous diuretic dose, length of stay and diuretic dose at discharge.

More than three-quarters of the overall population had intravenous diuretics dose which are conformed to the existing protocol (annex 1). About a quarter had lower intravenous dose than the existing protocol. A more detailed geriatric assessment of this quarter could be studied.

The strength of this study was the prospective design which permit to carry out the geriatric assessment (not always done in cardiology department) and had a well descriptions of the sample. On the other hand, by the observational nature of this study, we can't assure the complete management of the hospitalization until discharge. For example, some patients even in cardiologic department didn't have echocardiography. This study didn't enroll enough patients and lake of power for many results.

V. CONCLUSION

This study highlights the association between intravenous diuretic doses during ADHF and baseline daily diuretic dose. In geriatric population, intravenous diuretic dose is sometime lower than the existing protocol that calls for caution in this population. Other studies are needed to specify diuretic utilization in cardio geriatric management.

Bibliography

1. Insuffisance cardiaque [Internet]. [cited 7th July 2022]. Available in : https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-cardiovasculaires-et-accident-vasculaire-cerebral/insuffisance-cardiaque

2. Gabet A, Juillière Y, Lamarche-Vadel A, Vernay M, Olié V. National trends in rate of patients hospitalized for heart failure and heart failure mortality in France, 2000–2012. Eur J Heart Fail. 2015;17(6):583-90.

3. Heart Failure Survival Among Older Adults in the United States: A Poor Prognosis for an Emerging Epidemic in the Medicare Population | Cardiology | JAMA Internal Medicine | JAMA Network [Internet]. [cited 11th Mai 2022]. Available in: https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/484969

4. Komajda M, Hanon O, Hochadel M, Follath F, Swedberg K, Gitt A, et al. Management of octogenarians hospitalized for heart failure in Euro Heart Failure Survey I. Eur Heart J. 2007;28(11):1310-8.

5. Contemporary management of octogenarians hospitalized for heart failure in Europe: Euro Heart Failure Survey II | European Heart Journal | Oxford Academic [Internet]. [cited 11th mai 2022]. Available in : https://academic.oup.com/eurheartj/article/30/4/478/412936?login=true

6. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in Older Adults: Evidence for a Phenotype. J Gerontol Ser A. 2001;56(3):M146-57.

7. Vidán MT, Blaya-Novakova V, Sánchez E, Ortiz J, Serra-Rexach JA, Bueno H. Prevalence and prognostic impact of frailty and its components in non-dependent elderly patients with heart failure. Eur J Heart Fail. 2016;18(7):869-75.

8. Incidence and Prevalence of Heart Failure in Elderly Persons, 1994-2003 | Cardiology | JAMA Internal Medicine | JAMA Network [Internet]. [cited 11th mai 2022]. Available in: https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/413997

9. Early and Long-term Outcomes of Heart Failure in Elderly Persons, 2001-2005 | Cardiology | JAMA Internal Medicine | JAMA Network [Internet]. [cited 11th mai 2022]. Available in: https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/773461

10. Kosiborod M, Lichtman JH, Heidenreich PA, Normand SLT, Wang Y, Brass LM, et al. National Trends in Outcomes Among Elderly Patients with Heart Failure. Am J Med. 2006;119(7):616.e1-616.e7.

11. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J. 2021;42(36):3599-726.

12. Cox ZL, Hung R, Lenihan DJ, Testani JM. Diuretic Strategies for Loop Diuretic Resistance in Acute Heart Failure: The 3T trial. JACC Heart Fail. 2020;8(3):157-68.

13. Felker GM, Lee KL, Bull DA, Redfield MM, Stevenson LW, Goldsmith SR, et al. Diuretic Strategies in Patients with Acute Decompensated Heart Failure. N Engl J Med. 3 mars 2011;364(9):797-805.

14. Cowie MR, Struthers AD, Wood DA, Coats AJ, Thompson SG, Poole-Wilson PA, et al. Value of natriuretic peptides in assessment of patients with possible new heart failure in primary care. The Lancet. 1997;350(9088):1349-53.

15. Zaphiriou A, Robb S, Murray-Thomas T, Mendez G, Fox K, McDonagh T, et al. The diagnostic accuracy of plasma BNP and NTproBNP in patients referred from primary care with suspected heart failure: Results of the UK natriuretic peptide study. Eur J Heart Fail. 2005;7(4):537-41.

16. Anker SD, Colet JC, Filippatos G, Willenheimer R, Dickstein K, Drexler H, et al. Rationale and design of Ferinject assessment in patients with IRon deficiency and chronic Heart Failure (FAIR-HF) study: a randomized, placebo-controlled study of intravenous iron supplementation in patients with and without anaemia. Eur J Heart Fail. 2009;11(11):1084-91.

17. Giallourakis CC, Rosenberg PM, Friedman LS. The liver in heart failure. Clin Liver Dis. 2002;6(4):947-67, viii-ix.

18. Peacock WF, De Marco T, Fonarow GC, Diercks D, Wynne J, Apple FS, et al. Cardiac Troponin and Outcome in Acute Heart Failure. N Engl J Med. 2008;358(20):2117-26.

19. Li C, Friedman B, Conwell Y, Fiscella K. Validity of the Patient Health Questionnaire 2 (PHQ-2) in Identifying Major Depression in Older People. J Am Geriatr Soc. 2007;55(4):596-602.

20. Depression: Screening and Diagnosis | AAFP [Internet]. [cited 3rd oct 2022]. Available in: https://www.aafp.org/pubs/afp/issues/2018/1015/p508.html

21. Erkinjuntti T, Sulkava R, Wikström J, Autio L. Short Portable Mental Status Questionnaire as a Screening Test for Dementia and Delirium Among the Elderly. J Am Geriatr Soc. 1987;35(5):412-6.

22. Pfeiffer E. A Short Portable Mental Status Questionnaire for the Assessment of Organic Brain Deficit in Elderly Patients†. J Am Geriatr Soc. 1975;23(10):433-41.

23. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, et al. Validation of the Mini Nutritional Assessment short-form (MNA®-SF): A practical tool for identification of nutritional status. JNHA - J Nutr Health Aging. 2009;13(9):782.

24. Guigoz Y, Vellas BJ. [Malnutrition in the elderly: the Mini Nutritional Assessment (MNA)]. Ther Umsch Rev Ther. 1997;54(6):345-50.

25. Madan SA, Fida N, Barman P, Sims D, Shin J, Verghese J, et al. Frailty Assessment in Advanced Heart Failure. J Card Fail. 2016;22(10):840-4.

26. Stevenson LW, Perloff JK. The limited reliability of physical signs for estimating hemodynamics in chronic heart failure. JAMA. 1989;261(6):884-8.

27. Collins SP, Lindsell CJ, Storrow AB, Abraham WT. Prevalence of Negative Chest Radiography Results in the Emergency Department Patient With Decompensated Heart Failure. Ann Emerg Med. 2006;47(1):13-8.

28. Grippe saisonnière : quand démarrer la campagne de vaccination ? [Internet]. Haute Autorité de Santé. [cited 14th sept 2022]. Available in: https://www.has-sante.fr/jcms/p_3345171/fr/grippe-saisonniere-quand-demarrer-la-campagne-de-vaccination

29. Delphine C. [Internet] Haute Autorité de santé. 2017;15. [cited 14th sept 2022] Available in: https://www.has-sante.fr/upload/docs/application/pdf/2018-01/penurie_vaccin_pneumococcique_23-valent_pneumovax_-_recommandation_vaccinale.pdf

30. Rhodes A, Evans LE, Alhazzani W, Levy MM, Antonelli M, Ferrer R, et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. Intensive Care Med. 1 2017;43(3):304-77.

31. Jones TW, Smith SE, Van Tuyl JS, Newsome AS. Sepsis With Preexisting Heart Failure: Management of Confounding Clinical Features. J Intensive Care Med. sept 2021;36(9):989-1012.

32. Ambrosy AP, Pang PS, Khan S, Konstam MA, Fonarow GC, Traver B, et al. Clinical course and predictive value of congestion during hospitalization in patients admitted for worsening signs and symptoms of heart failure with reduced ejection fraction: findings from the EVEREST trial. Eur Heart J. 2013;34(11):835-43.

Annex 1

PATIENT GERIATRIQUE EN DECOMPENSATION D'INSUFFISANCE CARDIAQUE

GESTION DES DIURETIQUES

Traitement décongestionnant : Dès la première heure d'admission : Furosémide IV

- Si naïf de diurétique antérieur : 0.5mg/kg de furosémide IV (bolus)
- Si diurétiques de l'anse antérieur :

Management des diurétiques chez les patients déjà sous diurétiques de l'anse				
PALIER	**Furosémide en place**	**Furosémide à prescrire IV et PSE**	**SI PSE impossible: bolus**	**[HCZ] à prescrire**
A	< 80 mg	40 mg IV bolus ET 5 mg/h	40 mg / 8h	0
B	81 – 160 mg	80 mg IV bolus ET 10 mg/h	80 mg / 8h	0
C	161 – 240 mg	80 mg IV bolus ET 20 mg/h	120 mg / 8h	12,5 mg
D	> 240mg	80 mg IV bolus ET 30 mg/h	160 mg / 6 à 8h	25 mg

Evaluation précoce du traitement, si possible à H6 :
Diurèse < 100ml/H ET Natriurèse sur échantillon < 50 meq/L
=> Augmenter au palier supérieur

Puis évaluation de la dose de diurétiques toutes les 24h

	24 heures	48 heures	72 heures	96 heures
Diurèse < 2 L OU Natriurèse sur échantillon < 70 meq/L	Palier supérieur	Palier supérieur	Palier supérieur	Palier supérieur
Diurèse 2 - 4 L	Maintien de la prescription	Maintien de la prescription	Maintien de la prescription	Maintien de la prescription
Diurèse > 4 L	Diminution des doses	Diminution des doses	Diminution des doses	Diminution des doses

- En cas de résistance au diurétique et en l'absence d'hyperkaliémie, considérer l'ajout de Soludactone IV 100 à 200 mg/jour.
- Surveillance rapprochée clinique et biologique (Ionogramme et fonction rénale)
- Relais PO après la phase de congestion : aux doses antérieures si facteur déclenchant identifié et corrigé, envisager une dose supérieure au long cours dans le cas inverse.

Poitau.F / Fougère.B - version du 11/10/2021

Annex 2

TABLE 2

PHQ-2 Screening Instrument for Depression

Over the past two weeks, how often have you been bothered by any of the following problems?	Not at all	Several days	More than half the days	Nearly every day
Little interest or pleasure in doing things	0	1	2	3
Feeling down, depressed, or hopeless	0	1	2	3

Scoring: A score of 3 or more is considered a positive result. The PHQ-9 (Table 3) or a clinical interview should be completed for patients who screen positive.

PHQ = Patient Health Questionnaire.

Adapted from Patient Health Questionnaire (PHQ) screeners. http://www.phqscreeners.com. Accessed February 8, 2018.

Annex 3

Eric Pfeiffer, M.D.

Instructions: Ask questions 1-10 in this list and record all answers. Ask question 4A only if patient does not have a telephone. Record total number of errors based on ten questions.

+	-

1. What is the date today? _____ (Month / Day / Year)
2. What day of the week is it? _____
3. What is the name of this place? _____
4. What is your telephone number? _____
4A. What is your street address? _____ (Ask only if patient does not have a telephone)
5. How old are you? _____
6. When were you born? _____
7. Who is the President of the U.S. now? _____
8. What was President just before him? _____
9. What was your mother's maiden name? _____
10. Subtract 3 from 20 and keep subtracting 3 from each new number, all the way down.

_____ Total Number of Errors

To Be Completed by Interviewer

Patient's Name: _____ Date _____

Sex: 1. Male 2. Female

Race: 1. White 2. Black 3. Other

Years of Education: _____

1. Grade School
2. High School
3. Beyond High School

Interviewer's Name: _____

Annex 4

Mini-Cog©

Instructions for Administration & Scoring

ID:_____ Date: _____

Step 1: Three Word Registration

Look directly at person and say, "Please listen carefully. I am going to say three words that I want you to repeat back to me now and try to remember. The words are [select a list of words from the versions below]. Please say them for me now." If the person is unable to repeat the words after three attempts, move on to Step 2 (clock drawing).

The following and other word lists have been used in one or more clinical studies.[1-3] For repeated administrations, use of an alternative word list is recommended.

Version 1	Version 2	Version 3	Version 4	Version 5	Version 6
Banana	Leader	Village	River	Captain	Daughter
Sunrise	Season	Kitchen	Nation	Garden	Heaven
Chair	Table	Baby	Finger	Picture	Mountain

Step 2: Clock Drawing

Say: "Next, I want you to draw a clock for me. First, put in all of the numbers where they go." When that is completed, say: "Now, set the hands to 10 past 11."

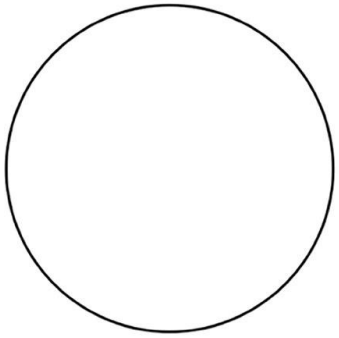
Use preprinted circle (see next page) for this exercise. Repeat instructions as needed as this is not a memory test. Move to Step 3 if the clock is not complete within three minutes.

Step 3: Three Word Recall

Ask the person to recall the three words you stated in Step 1. Say: "What were the three words I asked you to remember?" Record the word list version number and the person's answers below.

Clock Drawing

ID:_____ Date:_____



Mini-Cog Test	Possible Points	Scoring	Interpretation
Normal Clock Drawing	2	0-2	Higher likelihood of dementia
Word Recall	1 for each word	3-5	Lower likelihood of dementia

Annex 5

Mini Nutritional Assessment

MNA®

Nestlé Nutrition Institute

Last name: First name:

Sex: Age: Weight, kg: Height, cm: Date:

Complete the screen by filling in the boxes with the appropriate numbers. Total the numbers for the final screening score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe decrease in food intake
1 = moderate decrease in food intake
2 = no decrease in food intake ☐

B Weight loss during the last 3 months
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss ☐

C Mobility
0 = bed or chair bound
1 = able to get out of bed / chair but does not go out
2 = goes out ☐

D Has suffered psychological stress or acute disease in the past 3 months?
0 = yes 2 = no ☐

E Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems ☐

F1 Body Mass Index (BMI) (weight in kg) / (height in m^2) ☐
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater ☐

IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2.
DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.

F2 Calf circumference (CC) in cm
0 = CC less than 31
3 = CC 31 or greater ☐

Screening score ☐☐
(max. 14 points)

12-14 points: ☐ Normal nutritional status
8-11 points: ☐ At risk of malnutrition
0-7 points: ☐ Malnourished

Save Print Reset

Ref. Vellas B, Villars H, Abellan G, et al. *Overview of the MNA® - Its History and Challenges*. J Nutr Health Aging 2006;10:456-465.
Rubenstein LZ, Harker JO, Salva A, Guigoz Y, Vellas B. *Screening for Undernutrition in Geriatric Practice: Developing the Short-Form Mini Nutritional Assessment (MNA-SF)*. J. Geront 2001;56A: M366-377.
Guigoz Y. *The Mini-Nutritional Assessment (MNA®) Review of the Literature - What does it tell us?* J Nutr Health Aging 2006; 10:466-487.
Kaiser MJ, Bauer JM, Ramsch C, et al. *Validation of the Mini Nutritional Assessment Short-Form (MNA®-SF): A practical tool for identification of nutritional status.* J Nutr Health Aging 2009; 13:782-788.

For more information: www.mna-elderly.com

Annex 6

Mini Nutritional Assessment MNA®

Nestlé Nutrition Institute

Last name: B. First name: A.

Sex: M Age: 68 Weight, kg: 60kgs Height, cm: 1.60m Date: July 19, 2021

Complete the screen by filling in the boxes with the appropriate numbers.
Add the numbers for the screen. If score is 11 or less, continue with the assessment to gain a Malnutrition Indicator Score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe decrease in food intake
1 = moderate decrease in food intake
2 = no decrease in food intake → [1]

B Weight loss during the last 3 months
0 = weight loss greater than 3kg (6.6lbs)
1 = does not know
2 = weight loss between 1 and 3kg (2.2 and 6.6 lbs)
3 = no weight loss → [0]

C Mobility
0 = bed or chair bound
1 = able to get out of bed / chair but does not go out
2 = goes out → [1]

D Has suffered psychological stress or acute disease in the past 3 months?
0 = yes 2 = no → [0]

E Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems → [2]

F Body Mass Index (BMI) (weight in kg) / (height in m²)
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater → [2]

Screening score (subtotal max. 14 points) → [ ][6]
12-14 points: Normal nutritional status
8-11 points: At risk of malnutrition
0-7 points: Malnourished
For a more in-depth assessment, continue with questions G-R

Assessment

G Lives independently (not in nursing home or hospital)
1 = yes 0 = no → [1]

H Takes more than 3 prescription drugs per day
0 = yes 1 = no → [0]

I Pressure sores or skin ulcers
0 = yes 1 = no → [1]

J How many full meals does the patient eat daily?
0 = 1 meal
1 = 2 meals
2 = 3 meals → [2]

K Selected consumption markers for protein intake
- At least one serving of dairy products (milk, cheese, yoghurt) per day — yes [ ] no [X]
- Two or more servings of legumes or eggs per week — yes [X] no [ ]
- Meat, fish or poultry every day — yes [ ] no [X]

0.0 = if 0 or 1 yes
0.5 = if 2 yes
1.0 = if 3 yes → [0][0]

L Consumes two or more servings of fruit or vegetables per day?
0 = no 1 = yes → [0]

M How much fluid (water, juice, coffee, tea, milk...) is consumed per day?
0.0 = less than 3 cups
0.5 = 3 to 5 cups
1.0 = more than 5 cups → [0][0]

N Mode of feeding
0 = unable to eat without assistance
1 = self-fed with some difficulty
2 = self-fed without any problem → [1]

O Self view of nutritional status
0 = views self as being malnourished
1 = is uncertain of nutritional state
2 = views self as having no nutritional problem → [0]

P In comparison with other people of the same age, how does the patient consider his / her health status?
0.0 = not as good
0.5 = does not know
1.0 = as good
2.0 = better → [0][5]

Q Mid-arm circumference (MAC) in cm
0.0 = MAC less than 21
0.5 = MAC 21 to 22
1.0 = MAC 22 or greater → [0][5]

R Calf circumference (CC) in cm
0 = CC less than 31
1 = CC 31 or greater → [1]

Assessment (max. 16 points) → [ ][7][ ]
Screening score → [ ][6][ ]
Total Assessment (max. 30 points) → [1][3][ ]

Malnutrition Indicator Score

24 to 30 points	[ ]	Normal nutritional status
17 to 23.5 points	[ ]	At risk of malnutrition
Less than 17 points	[X]	Malnourished

References
1. Vellas B, Villars H, Abellan G, *et al*. Overview of the MNA® - Its History and Challenges. *J Nutr Health Aging*. 2006; **10**:456-465.
2. Rubenstein LZ, Harker JO, Salva A, Guigoz Y, Vellas B. Screening for Undernutrition in Geriatric Practice: Developing the Short-Form Mini Nutritional Assessment (MNA-SF). *J Geront*. 2001; **56A**: M366-377
3. Guigoz Y. The Mini-Nutritional Assessment (MNA®) Review of the Literature - What does it tell us? *J Nutr Health Aging*. 2006; **10**:466-487.

For more information: www.mna-elderly.com

Vu, le Directeur de Thèse

Vu, le Doyen
De la Faculté de Médecine de Tours
Tours, le

BOUT Laura

41 Pages – 6 tableaux – 2 graphiques.

Résumé : *Introduction* : L'insuffisance cardiaque est une pathologie du sujet âgé : 75% des patients hospitalisés pour insuffisance cardiaque aigue ont plus de 75 ans. Le pronostic de cette pathologie est grave avec une moyenne de survie d'environ 4 ans. Les recommandations des sociétés savantes pour la prise en charge de l'insuffisance cardiaque sont robustes. Cependant, les preuves sont limitées pour guider la prescription des diurétiques.
L'objectif de cette étude était d'identifier les facteurs influençant les doses de diurétiques utilisées par voie intraveineuse chez les patients âgés présentant une insuffisance cardiaque aigue.

Méthodes : Il s'agit d'une étude observationnelle prospective bicentrique incluant les patients de 75 ans ou plus hospitalisés pour une insuffisance cardiaque aigue dans des services de médecine aigue gériatrique et de cardiologie. Les patients inclus ont été analysés en 2 groupes, l'un avec les patients ayant reçu de fortes doses de diurétiques IV par rapport à leur traitement habituel (HD) et l'autre avec ceux recevant de faibles doses de diurétiques IV par rapport à leur traitement habituel (LD).

Résultats : 110 patients ont été inclus. La moyenne d'âge était de 85 ans, avec une majorité de femmes (53,7%). 79% d'entre eux étaient fragiles selon les critères de Fried. L'indice de comorbidités moyen de Charlson était de 3,4. Les comorbidités et les paramètres de l'évaluation gériatrique étaient comparables entre les 2 groupes, sauf pour l'hospitalisation en gériatrie et les aides professionnelles à domicile, plus fréquent dans le groupe LD. Une étiologie infectieuse à la décompensation cardiaque, notamment urinaire ($p = 0,01$), était plus fréquemment retrouvée dans le groupe HD, avec un syndrome inflammatoire biologique plus marqué. A contrario, il y avait significativement plus de cas sans facteur déclenchant de décompensation dans le groupe LD ($p = 0,003$). Il n'y avait pas de différence significative entre les groupes pour la FEVG, les NT pro BNP, la troponinémie et la pathologie cardiaque sous-jacente. La dose habituelle de diurétique était plus élevée dans le groupe LD ($p = 0,0008$).

Conclusion : Cette étude ne retrouve finalement que peu de facteurs qui influencent la dose de diurétiques utilisées dans le traitement de l'insuffisance cardiaque aigue : cette dose dépend essentiellement de la dose habituelle de diurétiques du patient, et de la présence d'une infection sous-jacente, notamment urinaire. La fragilité du patient ne semble pas influencer les doses prescrites.

Mots clés : insuffisance cardiaque, diurétique, personne âgée

Jury :

Président du Jury : Professeur Bertrand FOUGERE
Directeur de thèse : Docteur Fanny POITAU
Membres du Jury : Professeur Laurent FAUCHIER
Docteur Patrick FRIOCOURT
Docteur Philippe VERNOCHET
Date de soutenance : 19/10/2022