Learning process of ultrasound-guided ilio-fascial compartment block on a simulator: a feasibility study

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This publication URL: https://archive-ouverte.unige.ch/unige:166180
Publication DOI: 10.13097/archive-ouverte/unige:166180

Section de médecine Clinique

Département de médecine aiguë

Service des urgences

Thèse préparée sous la direction du Professeur François Sarasin

" Learning process of ultrasound-guided ilio-fascial compartment block on a simulator: a feasibility study "

Thèse

présentée à la Faculté de Médecine

de l'Université de Genève

pour obtenir le grade de Docteur en médecine

par

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de

Genthod (Genève, Suisse)

Thèse n° ___________

Genève (GE)

2020

Formulaire à joindre aux exemplaires
de la thèse à remettre pour le dépôt légal

THESE

Learning process of ultrasound-guided ilio-fascial compartment block on a simulator: a feasibility study

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Learning process of ultrasound-guided ilio-fascial compartment block on a simulator: a feasibility study

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Résumé :

Le bloc iliofascial échoguidé (US-BIF) est une alternative au traitement par opiacé dans le traitement antalgique pré-opératoire des fractures du fémur proximal. Habituellement réalisé par l'anesthésiste, il est démontré que cette technique peut être acquise par le non anesthésiste. Il n'existe toutefois pas de parcours d'apprentissage validant. A Genève cette procédure n'est pas réalisée par manque de disponibilité de l'anesthésiste.

L'objectif est de mettre en place un socle de formation validant la compétence pour la procédure d'un de l'US-BIF pour le non anesthésiste.

Notre étude sur mannequin de simulation comparant l'apprentissage de l'US-BIF entre deux populations de non spécialistes (médecins urgentistes et étudiants en médecine de 3ème année) montre la faisabilité de l'implémentation d'un parcours validant pour le non anesthésiste.

(120 mots)

Signature du doctorant : Visa du directeur de thèse :

Tables des matières

Remerciements

Je tiens à adresser mes sincères remerciements aux deux personnes m'ayant aidé à initier et développer ce projet : le Dr Olivier Rutschmann et le Dr Frederic Rouyer. Leur aide, leurs conseils, leur soutien et leur confiance ont été sans faille. Leur appui m'a permis de persévérer, et de trouver l'énergie nécessaire pour mener ce projet à bien, ce qui n'était pas acquis dès le départ.
Mes remerciements également au Dr Christophe Fehlmann dont le soutien, la motivation et la disponibilité sans borne ont été une source d'inspiration. Et aux co-auteurs, la Dre Roxane Fournier, la Dre Iris Pelieu ainsi que le Professeur Mathieu Nendaz, pour leur précieuse aide dans leur domaine d'expertise et pour leur relecture attentive et bienveillante à toutes les étapes.
Ma reconnaissance au Professeur François Sarasin pour son regard bienveillant et ses conseils avisés qui m'ont permis de prendre la bonne direction.
A ma famille dans son ensemble, et plus particulièrement à mon épouse Letizia et mes deux merveilleux enfants, Nora et Matteo, source d'amour, de soutien et de fierté.

Résumé

Le bloc iliofascial échoguidé (US-BIF) est une alternative au traitement par opiacé dans le traitement antalgique pré-opératoire des fractures du fémur proximal. Habituellement réalisé par l'anesthésiste, il est démontré que cette technique peut être acquise par le non anesthésiste. Il n'existe toutefois pas de parcours d'apprentissage validant. A Genève cette procédure n'est pas réalisée par manque de disponibilité de l'anesthésiste.

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Introduction

La fracture du fémur proximal (FFP) est une pathologie fréquente dans les services d'urgence et touche principalement les personnes âgées souffrant de comorbidités sévères[1] . En Suisse, 1,34 habitant sur 1000 sont hospitalisés chaque année pour ce motif, soit aux HUG près de 600 patients par an[2]. Cette pathologie est intrinsèquement grevée d'une mortalité et d'une morbidité non négligeable générant des coûts importants[3,4] estimés à un coût moyen de 28'487.- CHF par patient aux HUG[5], ceci sans compter les complications surajoutées durant l'hospitalisation.

Le contrôle de la douleur est un enjeu primordial dans la prise en charge de ces patients. Il existe deux approches pour gérer cette situation.

La méthode classique consiste à administrer des antalgiques essentiellement de palier 3 (opiacés type morphine – fentanyl – sufentanyl) par voie intra-veineuse. Cette approche comporte cependant un risque important d'effets secondaires majeurs (bradypnée - arrêt respiratoire, effets histamino-libérateur, vomissements, confusion, ralentissement du transit, risque de chute). La durée moyenne d'attente pré-opératoire à Genève étant de 47h (médiane 35h)[5], ce délai expose le patient à ces effets sur un laps de temps substantiel, et en conséquence à une oligoanalgésie (gestion suboptimale de la douleur).

La méthode alternative, ou conjuguée, est l'analgésie locorégionale (ALR). Technique reconnue et largement utilisée par les anesthésistes en per ou post-opératoire, comme par exemple pour l'antalgie post-opératoire des interventions de prothèse du genou[6], l'ALR pré-opératoire est peu ou pas utilisée aux HUG. Le bloc ilio-fascial (BIF) ou le bloc fémoral (BF) échoguidés sont des techniques ayant démontré leur efficacité/sécurité dans la diminution pré-opératoire de la douleur en cas de fracture du col fémoral, chez l'adulte comme chez l'enfant[7,8].

La non utilisation du BIF aux urgences en cas de FFP a deux explications. La première est logistique, et tient à la trajectoire des patients depuis le SU et à la présence de comorbidités objectivées par le score de MEWS (Modified Early Warning Score) mesuré à l'admission. Les patients avec un score bas entrent dans une filière rapide ou « fast-track » où, après la réalisation d'un bilan standard l'admission vers le service d'aval est accélérée. Ce « fast-track » est réalisé depuis la salle d'attente et ces locaux ne se prêtent ni en terme de matériel et de personnel soignant à la réalisation d'un geste technique comme le BIF. La deuxième est constituée par le manque de disponibilité de l'anesthésiste et l'absence de compétence et

d'autonomie de l'urgentiste pour réaliser ce geste.
Avec l'objectif de soulager les patients au prix d'un minimum d'effets secondaires, il est donc important qu'un transfert de compétence soit réalisé afin que le médecin urgentiste puisse être autonome dans la réalisation de cette procédure.
Le BIF est un bloc dit compartimental (dépôt d'anesthésique local dans un compartiment à distance du nerf, limitant le risque de lésion nerveuse). Il diffuse dans plus de 90% des cas vers le nerf fémoral, dans environ 30% des cas vers le nerf cutané latéral de la cuisse, et rarement vers le nerf obturateur[9,10]. Depuis 2002, la Société Française d'Anesthésie et de Réanimation (SFAR) reconnait la pratique du BIF par le non anesthésiste selon certaines recommandations[11].
Cette technique peut être réalisée en pré-hospitalier ou dans les salles d'urgence, avant même l'évaluation radiologique[12]. Rapide et sûre, elle peut être effectuée par des médecins relativement peu expérimentés et parfois même par des paramédicaux[13–15]. Son utilisation permet : 1) de mieux couvrir la période douloureuse (dépendant des molécules choisies) ; 2) de pallier aux douleurs induites par la mobilisation ;[16,17] 3) de limiter l'utilisation d'opiacés avant et après la chirurgie[18]de même que de diminuer le risque de délirium, et ce faisant de réduire la durée du séjour[19] et les coûts hospitaliers.
Historiquement réalisée "à l'aveugle" à l'aide de repères anatomiques, le BIF échoguidé est devenu un standard[20]. L'apport de l'échographie dans la diminution des complications péri-gestes n'est plus à démontrer. Par exemple pour la pose de cathéter veineux centraux.[21].
Le modèle traditionnel d'acquisition de compétences basé sur l'accompagnement au chevet du patient et qui se résume à «see one, do one, teach one» est aujourd'hui obsolète. Il n'est plus défendable et peut compromettre la sécurité des patients[22]. L'essor technologique a permis d'introduire l'apprentissage sur mannequin de simulation et conférer un cadre sécuritaire au médecin novice afin de lui permettre l'acquisition de compétences techniques et relationnelles (travail d'équipe, outil de communication). Les supports d'apprentissage permettent une immersion totale dans le rôle endossé par le médecin novice. L'apprentissage de l'ALR échoguidé sur mannequin est un standard dans le parcours de formation des anesthésistes et sa plus-value est indéniable[23]. Cependant, la littérature actuelle ne permet pas de statuer sur la capacité de transfert sur patient des compétences acquises en simulation.
Au-delà du support d'apprentissage, une question subsiste : comment définir qu'un médecin a acquis une compétence de manière autonome ? La courbe d'apprentissage basée sur un nombre de procédure réalisée n'est pas optimale et ne reflète pas clairement l'acquisition

globale d'un geste. Depuis les années 2000, l'académie suisse des sciences médicales (ASSM) a édité un document répertoriant l'ensemble des compétences qu'un étudiant en médecine devrait avoir acquis durant ses études, sous l'égide de l'acronyme PROFILES (Principal Relevant Objectives and a Framework for Integrative Learning and Education in Switzerland), subdivisé en 3 chapitres : 1) objectifs généraux de la fonction de médecin, 2) SSPs (Situations as Starting Points - catalogue de situations fréquentes en médecine que le médecin devrait être capable de gérer) et 3) EPA pour Entrusted Professional Activities, littéralement activité professionnelle confiée. L'EPA est définie comme une tâche ou une responsabilité à exécuter sans supervision une fois que la compétence a été considérée comme acquise. Il faut voir une compétence comme un éventail d'étapes et sa validation ne peut pas être limitée à un nombre de réalisation préalable. Le BIF échoguidé en est un exemple et c'est sur ce modèle que la formation de notre étude a été construite : reconnaissance de la pathologie, compétence relationnelle avec un patient simulé, explication d'une procédure, recherche de contre-indications, préparation du matériel et habillage stérile, critères de qualité de l'échoguidage du geste.

L'objectif principal de ce travail est de démontrer la faisabilité de l'implémentation d'un parcours de formation structuré. Elaboré avec les anesthésistes et fondé sur les recommandations d'apprentissage actuelles, sa mise en pratique par l'acquisition du BIF échoguidé et un socle à l'édifice de formation et à l'acquisition de compétences que sous souhaitons développer aux urgences.

Original Article

Learning process of ultrasound-guided ilio-fascial compartment block on a simulator: a feasibility study

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Key Words: ultrasound-guided fascia iliaca bock – learning process – emergency physician

Abstract word count: *260*

Main text word count: *2201*

Tables:

Figure:

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ABSTRACT

Background

Ultrasound-guided fascia iliaca block (US-FICB) do not be part of the learning curriculum of the emergency physicians (EP) and is usually performed by anesthesiologists. However, several studies promote EP to use this procedure.

The goal of this study was to assess the feasibility of a training concept for non-anesthesiologists for the US-FICB on a simulator based on a validating learning path.

Method

This was a feasibility study. Emergency physicians and medical students received a one-day training with a learning phase (theoretical and practical skills), followed by an assessment phase.

The primary outcome at the assessment phase was the number of attempts before successfully completing the procedure. The secondary outcomes were the success rate at first attempt, the length of procedure (LOP) and the stability of the probe, corresponding of the visualization of the needle tip (and its tracking) throughout the procedure, evaluated on a Likert scale.

Results

A total of 25 participants were included. The median number of attempts was 2.0 for emergency physicians and 2.5 for medical students, and this difference was not significant (p=0.140). Seven participants (28%) succeeded at the first attempt of the procedure; the difference between emergency physicians and medical students was not significant (37% versus 21%; p=0.409). The average LOP was 19.7 minutes with a significant difference

between emergency physicians and medical students (p=0.001). There was no significant difference regarding the stability of the probe between the two groups.

Conclusion

Our one-day training for non-anesthesiologists with or without previous skills in ultrasound seems to be feasible for learning the US-FICB procedure on a simulator.

MAIN TEXT

INTRODUCTION

Hip fracture is a common pathology in Emergency Departments (ED) and most often involves polymedicated elderly patients with frequent severe co-morbidities1,2.

Despite the fact that effective pain relief is a major challenge in this process, patients are at high risk for not receiving adequate analgesia in a crowded ED 3,4, especially if they suffer from cognitive disorders 5,6.

In response to suboptimal pain management that results in oligoanalgesia, various strategies have been developed to improve this situation, some beginning at the ED door, e.g., implementation of a medico-delegated analgesia protocol, campaigns on pain management, fast-track management and strategies for shortening the time to intervention. Opiate treatment is frequent in the acute phase. Therapeutic equilibrium is not obvious to achieve, wich can result in risk of under dosage for fear, secondary effects (delirium, fall, urinary globe) and potential respiratory repercussions. Regional analgesia is a widely recognized analgesia technique for pain analgesia. FICB is a compartmental block allowing excellent analgesia of the proximal part of the femur7. Historically performed "blindly" using anatomical landmarks, US-FICB has become a standard8,9. This technique, which is usually performed by anesthesiologists, can be performed by emergency physicians, nurses and paramedics with relatively little experience10,11. However, there is currently no structured and evidence-based training program for this procedure.

The aim of this project was to assess the feasibility and the effect of a training concept for non-anesthesiologists with or without prior ultrasound skills in the acquisition of technical skills for ultrasound-guided regional anesthesia (UGRA) using a high-fidelity simulator to learn US-FICB.

METHOD AND MATERIALS

Design and setting

This was a monocentric pilot study in the ED of a primary and tertiary urban teaching hospital in Geneva, Switzerland, that admits 73,000 patients per year.

Study population

Participants were enrolled on a voluntary basis. Inclusion criteria depended on the profile of the participants. Enrolled emergency physicians had a full position in an emergency division, at least five years of postgraduate training and daily experience in point-of-care ultrasound (group with previous experience in US but not in US-guided regional anesthesia). Enrolled medical students were in their third year of a 6-year medical school program and had not taken, except theoretical lessons, a practical ultrasound course or used an ultrasound machine before (group without previous experience in US).

Materials

The high-fidelity simulator used in this study was a Nysora MS2-FEM. This simulator allows hydro dissection and injection under ultrasound control, increasing the level of realism with a high degree of fidelity (Figure 1). The real-life FICB procedure usually consists of administering 30–40 ml of local anesthetic divided into two syringes. Due to limitations in volume injection on the simulator, it was decided that, for the study, 2 x 5 ml of saline serum would be injected to simulate the handling and changing of syringes. Syringes used were Stimuplex® Ultra 360® 22 Ga (B. Braun Melsungen AG). Linear array ultrasound probes (L12-4 for Philips-SPARQ® and HFL38x for SonoSite, Inc.) were used.

Teaching session

Four sessions were organized, each with six to eight participants. Each session was under the direct supervision of two instructors, either two attending emergency physicians or one attending emergency physician and one anesthesiologist physician.

A station checklist (Fig 2) was consensually established by the expert group, which included two senior anesthesiologists, who are experts in UGRA (RF, IP), and two senior emergency physicians (FR, JC).

The teaching session consisted of three parts: one 1-hour theoretical session, three 1-hour supervised practical sessions and the viewing of an institutional video showing “the perfect procedure: US-FICB on a high-fidelity simulator”. The participant-to-instructor ratio was 3:1 or 4:1 for practical sessions.

Assessment session

In the afternoon after training, each participant underwent an individual, timed evaluation on the simulator the participant used previously. Except for one session with only one expert (JC), all the individual assessment sessions were under the supervision of two experts (the same as in the teaching session). JC was present for all sessions. The assessment checklist included 5 steps with a total of 16 control items (Table 1) and was developed by the same expert group that developed the station checklist.

Participants had to perform steps 1–3 chronologically to continue the procedure. In case of error, the experts could interrupt the participant to provide verbal feedback, after which the participant had to repeat all the items of the steps that had been performed in error.

The points noted with an asterisk in Table 1 are those identified as critical as they can cause the needle to exit the skin to create a new puncture. Stability of the probe, the only item for which feedback was not given during the evaluation, was evaluated separately by the two experts at the end of the procedure. After comparing their own assessment, which was scored on a 5-level Likert scale from –2 (low stability) to +2 (high stability), a consensus was easily found.

Participants had to complete all the items to pass the evaluation (sufficient US-FICB skill acquired). They could not ask the instructors questions except for technical issues. Number of skin-breakthroughs was recorded by one of the reviewers. No physical feedback (taking control of the needle) was given.

Outcomes measure

The primary outcome at the assessment phase after the training was the number of attempts before successfully completing the procedure. An attempt was defined as a skin-breakthrough. Success was defined as the completion of every point of the checklist (Table 1) in less than 45 min. Secondary outcomes were success at first attempt, length of procedure (LOP) and stability of the probe. LOP was defined as the time needed to accomplish the 16 prespecified items listed in Table 2. The stability of the probe was evaluated by the two observers and scored on a scale from –2 (low stability) to +2 (high stability). Based on the maximum acceptable duration of a procedure, a procedure longer than 45 minutes was considered as failed.

Statistical analysis

Mann-Whitney-Wilcoxon test and Fischer's exact test were used for comparisons between groups. For all tests, a two-sided P value less than 0.05 was considered significant. Statistical analyses were performed using STATA version 14 (Stata Corporation, Texas, US).

Results

Twenty-five participants were included: 11 senior emergency physicians and 14 medical students, 64% of whom were male. Participant characteristics are presented in Table 2. All participants were right-handed and finished the procedure.

Outcome results are shown in Figure 3 and Table 3.

For the primary outcome, the median number of attempts was 2.0 (95%CI 1.0 – 2.9) for emergency physicians and 2.5 (95%CI 2.0 – 3.0) for medical students, and the difference between the groups was not statistically significant (p=0.140).

For the secondary outcome, the first attempts of seven participants (28%) were successful, and there was a clinically significant difference between emergency physicians and medical students (37% versus 21%; p=0.409).

The average LOP was 19.7 minutes, with a significantly shorter LOP for emergency physicians (15.3 min, 95%CI 13.4–17.2, versus 23.2 min, 95%CI 19.6–26.8, p=0.001).

Finally, the overall average stability of the probe was 0.9, with no significant difference between emergency physicians and medical students (1.5 versus 0.5, p=0.215).

No vascular or nervous puncture was performed.

DISCUSSION

This study demonstrates that a one-day structured, competence-based training seems sufficient for learning US-FICB with a simulator regardless of previous experience in US.

The use of locoregional anesthesia in acute pain management in the ED, particularly of FICB for fractures of the proximal femur, is well established12. The FICB practice is effective, safe and can be performed by non-anesthetiologist13,14. However, there are obstacles to transfer of competence, including the lack of training for emergency doctors in the performance of UGRA. However, this study indicates that providing sufficient training can easily be accomplished.

The observed difference in first attempt success rate between experienced practitioners and medical students, although not statistically significant, was 26% in favor of the experienced group. This is an important difference and the lack of statistical significance likely reflects that the study was seriously underpowered with respect to this outcome (see limitations).This difference can be explained by the previous experience of senior physician in US-guided procedures such a central line. As demonstrated in the study of Kim et al15, novice students in UGRA significantly improve their learning curve after five attempts for a simple nerve block (as the FICB) on a simulator; this observation reflects the learning curve of the students in our study (by adding up all the trainings of the day, the individual number of attempts exceeded five per participant). The median number of attempts in this study agrees well with those reported by Morse16 and Liu17. The acquisition of simple technical skills (low difficulty block, as with the FICB) does not seem to require a strong medical background, and this is likely due to the focus in the training on the acquisition of a specific procedural skill.

The stability of the probe was not significantly different between the two groups, even though there was a clear trend that the stability achieved by the students was inferior to that by the physicians. As described by Sites and al18, poor stability is among the most frequent errors made by novices in the acquisition of an ultrasound-based gesture in locoregional anesthesia. Note that, during the evaluation session, the instructors provided oral feedback freely on the conduct and monitoring of the probe, particularly to students, and it would have been interesting to measure the impact of such feedback on the performance and reliability of the results obtained. Although it was not addressed in this study, it would be interesting to assess whether the hand-eye coordination obtained by habitual playing of video games influences the learning curve of trainees using the simulator 19.

The LOP required by students was significantly longer than for physicians. This can be explained by the prior experience of the emergency physicians for the preparation of the material, the disinfection of the patient and the dressing of the probe — experience that the students had not yet gained. Observers had the impression that steps 1—3 (see Table 2) required considerably more time for students to complete. To ensure that the assessment provides realistic data for a competency-based curriculum, a total procedure time of maximum 45 min was chosen for this study.

The training curriculum developed in this study was based on the most recent evidence for technical learning in the medical field, on the contribution of simulation to learning UGRA and on expert recommendations in good practice of the FICB20–24. To our knowledge, this study is the first to compare the acquisition of skills by physicians and medical students for US-FICB using a simulator.

Some limitations should, however, be acknowledged. First, the most important limitation is the likely lack of statistical power of the study.

Secondly, the participants in each experience group were unbalanced in number and gender. Emergency physicians generally had a wide range of proficiency in US. With a larger number of participants, future studies should determine the skill level of physicians before training to meaningfully measure the impact of this program.

Thirdly, different co-examiners performed evaluation in the assessment sessions, potentially adding bias to the evaluations. This potential bias was limited as the main author acted as a co-examiner for all evaluations. Despite the fact that various studies have measured the positive impact of combining verbal and physical feedback on performance during skill learning25, we chose to only give verbal feedback in this study. We did not measure the number of times feedback was given; although such data could be interesting with a larger number of participants. Although the impact of simulation in the transfer of skills learned in clinical practice is clearly appreciated for most teaching models and undeniably provides added value with respect to the perception of the learners, the real impact of simulation is yet to be determined20,26. Another limitation of this study could be the extrapolation of the results to clinical practice, as single size of manikin was used and is not representative of all the actual sono-anatomical landmarks encountered in clinical practice. In addition, the assessment session took place on the same day as the teaching session, and, therefore, only the short-term effect of the training was evaluated. In future studies, a second assessment session one or three months later could be added to evaluate long-term effects, including a questionnaire evaluating the impact of the training in the implementation of the technique in the clinical practice of the physicians included in the study as well as their degree of satisfaction. Although the US-FICB is carried out autonomously by EPs in different countries, our EPs do not have the prerequisite to do so. We have therefore not been able to assess how many physicians have included this technique in their clinical practice or even assess the maintenance of competence. However, we hope that our study can be the starting point of the training for non-anesthesiologists in our hospital.

Finally, fatigability of participants, unmeasured in this study, could have influenced performance18.

CONCLUSION

This study demonstrates the feasibility of a training concept for non-anesthesiologists with or without prior US skills for the performance of US-FICB on a high-fidelity simulator. More studies involving real patients and long-term effect are needed to evaluate transfer of competence.

Tables and figures

Table 1 – Assessment checklist

<table>
<tr><th>Boxes</th><th>Steps</th><th>Acquired</th><th>Not acquired</th></tr>
<tr><td rowspan="2">1. Preoperative consult</td><td>Knowledge and compliance for contraindications</td><td></td><td></td></tr>
<tr><td>Explanation of the procedure and obtaining consent</td><td></td><td></td></tr>
<tr><td rowspan="2">2. Technical aspects</td><td>Choice of ultrasound probe</td><td></td><td></td></tr>
<tr><td>Correct preset selection (loco-regional anesthesia)</td><td></td><td></td></tr>
<tr><td rowspan="5">3. Asepsis</td><td>Physician's clothing</td><td></td><td></td></tr>
<tr><td>Preparation of syringes (2 x 5 ml saline serum)</td><td></td><td></td></tr>
<tr><td>Preparation of the probe</td><td></td><td></td></tr>
<tr><td>Correct cleaning of the site</td><td></td><td></td></tr>
<tr><td>Sterile gel for the puncture area</td><td></td><td></td></tr>
<tr><td rowspan="4">4. Ultrasound guidance and anatomical identification</td><td>Correct orientation of the probe</td><td></td><td></td></tr>
<tr><td>*Anatomical and sono-anatomical landmarks</td><td></td><td></td></tr>
<tr><td>*Ideal trajectory and in-plane progression</td><td></td><td></td></tr>
<tr><td>Stability of the probe throughout the procedure*

*–2 = low stability / +2 high stability</td><td colspan="2">–2 –1 0 +1 +2</td></tr>
<tr><td rowspan="3">5. Hydro-dissection procedure</td><td>Visualization of the needle tip throughout the procedure</td><td></td><td></td></tr>
<tr><td>Suction before injection</td><td></td><td></td></tr>
<tr><td>*Identification of the injection area, injection of 2 x 5 cc (syringe change) and visualization of fascia detachment</td><td></td><td></td></tr>
<tr><td colspan="2">Ultrasound-guided FICB</td><td></td><td></td></tr>
<tr><td colspan="2">Number of breakthroughs</td><td colspan="2"></td></tr>
<tr><td colspan="2">LOP</td><td colspan="2"></td></tr>
</table>

Table 2 – Participant characteristics

Level of expertise	Medical students (n=14)	Emergency physicians (n=11)
Age[1], years	24±1	34±2
Females, number (%)	5 (36)	4 (36)
Postgraduate experience[1], year	NA	7±2

[1] Means ±SD.

Table 3 – Primary and secondary outcomes

Level of expertise	Medical students (n=14)	Emergency physicians (n=11)	p-value
Number of attempts[1]	2.5 [2.0–3.0]	2.0 [1.0–2.9]	0.140
Success at first attempt, number (%)	3 (21)	4 (37)	0.409
Length of procedure[2], min	23.2±6.2	15.3±2.9	0.001
Stability of probe[2], points	0.5±1.7	1.5±0.8	0.215

[1] Median [95%CI]. [2] Means ±SD.

Figure 1 – Sono-anatomical landmarks for the simulator/target injection

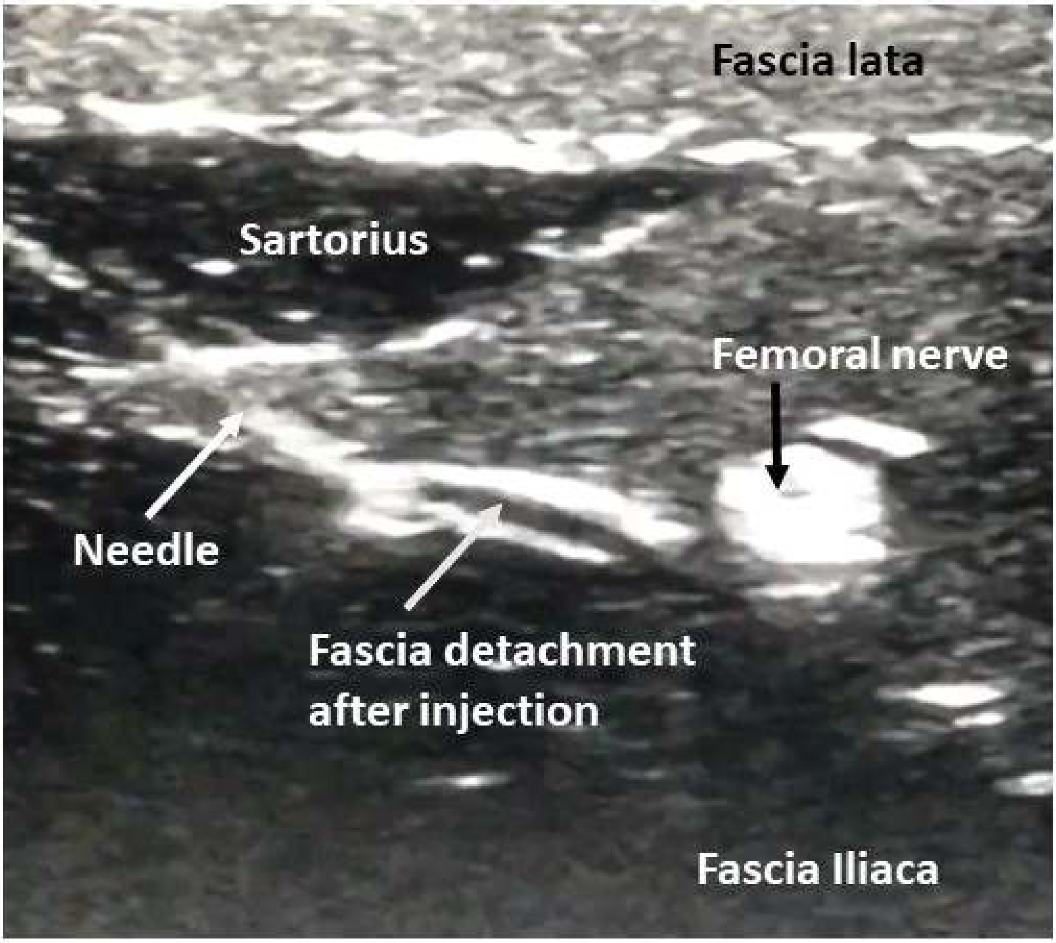


Figure 2 – Formative station checklist

Station 1

Preoperative consult :
- name, birthday date
- injured side
- announcement of the diagnosis
- explanation of the procedure
- search for contraindications
    - Anticoagulation
    - Hip prosthesis on the injured side
    - Local infection
    - Allergy to local anesthetics
    - Cognitive disorder
- search for consent

Station 2

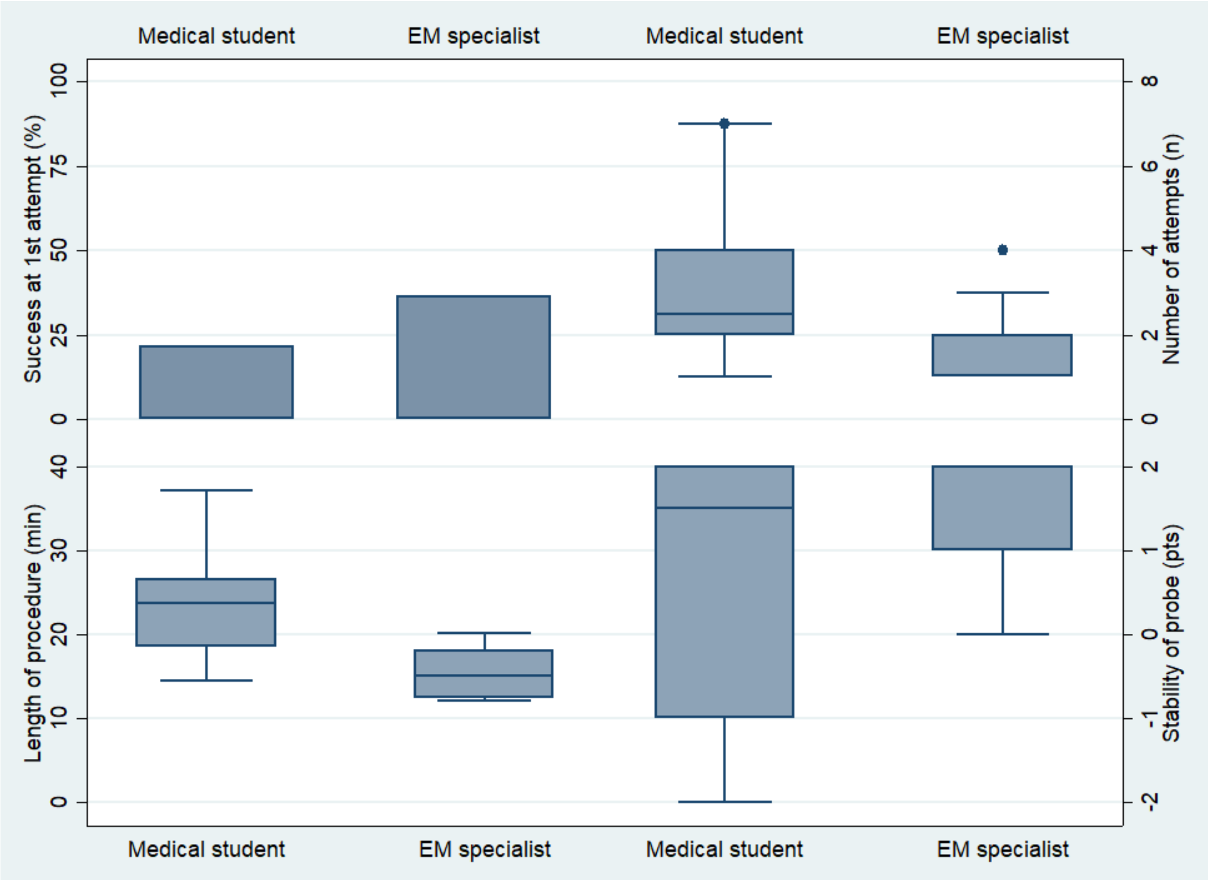
Technical aspects of ultrasound:
- basic settings, choice of the probe (linear) and the preset (ALR)
- matching the side of the probe and the screen to avoid errors between movement of the ultrasound probe on the screen and movements on the patient
- locating anatomical and sonoanatomical structures (human model and high fidelity simulator)
    - Pubic tubercule
    - Anterior iliac spine
    - Iliaca muscle
    - Sartorius muscle
    - Fascia lata
    - Fascia iliaca
    - Femoral artery
    - Femoral vein
    - Femoral nerve
    - Lateral cutaneous nerve of the thigh

Needling exercises with four specifics objectives:
- Locating target in a transverse axis
- Determining the needle trajectory before the procedure
- Keeping visualization of the needle throughout the procedure
- Using ultrasound-guidance to go as close as possible of the target

Station 3

- Sterile preparation of the work set
- Sterile dressing of the ultrasound probe
- Hand disinfection with hydro-alcoholic friction
- Wear sterile gloves
- Fill in two seringes with 5ml of saline serum
- Sterile field installation and clear puncture site (3 times)

Figure 3 – Primary and secondary outcomes at the end of training



DECLARATION

Ethics approval and consent to participate

The study was conducted at Geneva University Hospitals in accordance with Good Clinical Practice (Declaration of Helsinki 2002). After consultation with the institutional ethics committee (Geneva, Switzerland), a complete review of the study was waived.

Participants consent to participate was obtained.

Consent for publication

Not applicable

Availability of data and material

The data that support the findings of this study are publicly available upon request.

Competing interests

The authors declare that they have no competing interests

Funding

No funding was obtained for this study.

Authors' contributions

Conceptualization: J. Celi, O.T. Rutschmann, I. Pelieu, R. Fournier, M. Nendaz, F. Rouyer; data curation: C.A. Fehlmann; formal analysis: C.A. Fehlmann; funding acquisition : F. Sarasin; investigation: J. Celi, F. Rouyer; project administration : F. Sarasin, F. Rouyer; supervision: F. Sarasin, F. Rouyer; writing of original draft : J. Celi, C.A. Fehlmann; writing review and editing : J. Celi, O.T. Rutschmann, C.A. Fehlmann, R. Fournier, M. Nendaz, F. Sarasin, F. Rouyer.

Acknowledgements

Not applicable.

REFERENCES

1. Lippuner K, Grifone S, Schwenkglenks M, et al. Comparative trends in hospitalizations for osteoporotic fractures and other frequent diseases between 2000 and 2008. *Osteoporos Int*. 2012;23(3):829-839. doi:10.1007/s00198-011-1660-8

2. https://www.obsan.admin.ch/fr/indicateurs/taux-dhospitalisation-pour-fracture-de-la-hanche.

3. Gobet M, Rutschmann OT, Sarasin F, Villar A, Mugnier B RM. Oligoanalgesia in the emergency department waiting room: predictive factors. *EUSEM XI Eur Congr Emerg Med Athens2017*. 2017.

4. Hwang U, Richardson L, Livote E, Harris B, Spencer N, Morrison RS. Emergency department crowding and decreased quality of pain care. *Acad Emerg Med*. 2008;15(12):1248-1255. doi:10.1111/j.1553-2712.2008.00267.x

5. Morrison RS, Siu AL. A comparison of pain and its treatment in advanced dementia and cognitively intact patients with hip fracture. *J Pain Symptom Manage*. 2000. doi:10.1016/S0885-3924(00)00113-5

6. Markey G, Reilly N, Kelly P, Kelly C. Delayed Emergency Analgesia for Patients With Dementia and Hip Fracture. *Geriatr Orthop Surg Rehabil*. 2016. doi:10.1177/2151458516642581

7. Swenson JD, Davis JJ, Stream JO, Crim JR, Burks RT, Greis PE. Local anesthetic injection deep to the fascia iliaca at the level of the inguinal ligament: The pattern of distribution and effects on the obturator nerve. *J Clin Anesth*. 2015. doi:10.1016/j.jclinane.2015.07.001

8. Dolan J, Williams A, Murney E, Smith M, Kenny GNC. Ultrasound Guided Fascia Iliaca Block: A Comparison With the Loss of Resistance Technique. *Reg Anesth Pain Med*. 2008. doi:10.1016/j.rapm.2008.03.008

9. Desmet M, Balocco AL, Van Belleghem V. Fascia iliaca compartment blocks: Different techniques and review of the literature. *Best Pract Res Clin Anaesthesiol*. 2019;33(1):57-66. doi:10.1016/j.bpa.2019.03.004

10. McRae PJ, Bendall JC, Madigan V, Middleton PM. Paramedic-performed fascia iliaca compartment block for femoral fractures: A controlled trial. *J Emerg Med*. 2015. doi:10.1016/j.jemermed.2014.12.016

11. Scurrah A, Shiner CT, Stevens JA, Faux SG. Regional nerve blockade for early analgesic

management of elderly patients with hip fracture – a narrative review. *Anaesthesia*. 2018. doi:10.1111/anae.14178

12. Steenberg J, Møller AM. Systematic review of the effects of fascia iliaca compartment block on hip fracture patients before operation. *Br J Anaesth*. 2018. doi:10.1016/j.bja.2017.12.042

13. Ketelaars R, Stollman JT, Van Eeten E, Eikendal T, Bruhn J, Van Geffen G-J. Emergency physician-performed ultrasound-guided nerve blocks in proximal femoral fractures provide safe and effective pain relief: a prospective observational study in The Netherlands. doi:10.1186/s12245-018-0173-z

14. M.Freyz, F.Adnet, Y.Auroy PG et al. Pratique des anesthesies locales et locorégionales par des médecins non spécialisés en anesthésie réanimation dans le cadre des urgences. *Ann Fr Anesth Reanim*. 2004.

15. Kim SC, Hauser S, Staniek A, Weber S. Learning curve of medical students in ultrasound-guided simulated nerve block. *J Anesth*. 2014. doi:10.1007/s00540-013-1680-y

16. Morse J, Terrasini N, Wehbe M, et al. Comparison of success rates, learning curves, and inter-subject performance variability of robot-assisted and manual ultrasound-guided nerve block needle guidance in simulation. *Br J Anaesth*. 2014;112(6):1092-1097. doi:10.1093/bja/aet440

17. Liu Y, Glass NL, Glover CD, Power RW, Watcha MF. Comparison of the Development of Performance Skills in Ultrasound-Guided Regional Anesthesia Simulations With Different Phantom Models. doi:10.1097/SIH.0b013e318299dae2

18. Sites BD, Spence BC, Gallagher JD, Wiley CW, Bertrand ML, Blike GT. Characterizing Novice Behavior Associated With Learning Ultrasound-Guided Peripheral Regional Anesthesia. *Reg Anesth Pain Med*. 2007. doi:10.1016/j.rapm.2006.11.006

19. Harbin AC, Nadhan KS, Mooney JH, et al. Prior video game utilization is associated with improved performance on a robotic skills simulator. *J Robot Surg*. 2017;11(3):317-324. doi:10.1007/s11701-016-0657-x

20. Cook DA, Hamstra SJ, Brydges R, et al. Comparative effectiveness of instructional design features in simulation-based education: Systematic review and meta-analysis. *Med Teach*. 2013. doi:10.3109/0142159X.2012.714886

21. Chen XX, Trivedi V, AlSaflan AA, et al. Ultrasound-Guided Regional Anesthesia Simulation

Training. *Reg Anesth Pain Med*. 2017. doi:10.1097/AAP.0000000000000639

22. Aggarwal R, Grantcharov TP, Darzi A. Framework for Systematic Training and Assessment of Technical Skills. *J Am Coll Surg*. 2007. doi:10.1016/j.jamcollsurg.2007.01.016

23. Kim TE, Tsui BCH. Simulation-based ultrasound-guided regional anesthesia curriculum for anesthesiology residents. *Korean J Anesthesiol*. 2019;72(1):13-23. doi:10.4097/kja.d.18.00317

24. Tan JS, Chin KJ, Chan VWS. Developing a training program for peripheral nerve blockade: The "nuts and bolts." *Int Anesthesiol Clin*. 2010;48(4):1-11. doi:10.1097/AIA.0b013e3181f17a18

25. Lerman IR, Souzdalnitski D, Halaszynski T, Dai F, Guirguis M, Narouze SN. Ultrasound-guided regional anesthesia simulation and trainee performance. *Tech Reg Anesth Pain Manag*. 2014. doi:10.1053/j.trap.2015.10.008

26. Ziv A, Small SD, Wolpe PR. Patient safety and simulation-based medical education. *Med Teach*. 2000. doi:10.1080/01421590050110777

Conclusions et perspectives :

Ce travail montre la faisabilité d'implémenter un parcours de formation d'acquisition du bloc ilio-fémoral échoguidé sur mannequin pour le non anesthésiste à Genève.
Le changement de paradigme de la notion « d'attente », en visant une installation immédiate avec un « early medical diagnosis » offre la possibilité, notamment architecturale, de réaliser de l'analgésie loco-régionale, impensable dans une salle d'attente conventionnelle. La conjonction de la difficulté d'avoir un anesthésiste disponible 24/24 pour ce geste et le bas niveau de difficulté du BIF rend possible le transfert de cette compétence à l'urgentiste.
Il n'existe à ce jour aucun parcours de formation universel pour le BIF permettant de définir et délivrer une « compétence » hormis la reconnaissance par ses pairs. Ce travail a le mérite d'avoir créé l'architecture d'un parcours avec les pré-requis de sécurité technique, pharmacologique et d'aspesie, nécessaires à la mise en place d'un procédé dans les meilleures conditions possibles.
Avec l'aide des anesthésistes et des chirurgiens orthopédiques, nous visons à introduire cette technique de soin dans avec l'objectif de contribuer à une amélioration de la prise en charge des patients souffrant d'une fracture du fémur proximal durant leur séjour aux urgences des HUG.

Bibliographie :

1. Lippuner, K. *et al.* Comparative trends in hospitalizations for osteoporotic fractures and other frequent diseases between 2000 and 2008. *Osteoporos. Int.* **23**, 829–839 (2012).

2. https://www.obsan.admin.ch/fr/indicateurs/taux-dhospitalisation-pour-fracture-de-la-hanche.

3. Keene, G. S., Parker, M. J. & Pryor, G. A. Mortality and morbidity after hip fractures. *Bmj* **307**, 1248–50 (1993).

4. Pugely, A. J. *et al.* A risk calculator for short-term morbidity and mortality after hip fracture surgery. *J. Orthop. Trauma* **28**, 63–69 (2014).

5. Belaieff, W. thèse de doctorat : les fractures du fémur proximal chez les seniors aux hôpitaux universitaire de Genève. (2019).

6. Terkawi, A. S. *et al.* Pain Management Modalities after Total Knee Arthroplasty. *Anesthesiology* **126**, 923–937 (2017).

7. Guay, J., Parker, M. J., Griffiths, R. & Kopp, S. Peripheral nerve blocks for hip fractures. *Cochrane Database of Systematic Reviews* (2017). doi:10.1002/14651858.CD001159.pub2

8. Dalens, B., Vanneuville, G. & Tanguy, A. Comparison of the fascia iliaca compartment block with the 3-in-1 block in children. *Anesth. Analg.* (1989). doi:10.1213/00000539-198912000-00003

9. Parkinson, S. K., Mueller, J. B., Little, W. L. & Bailey, S. L. Extent of blockade with various approaches to the lumbar plexus. *Anesth. Analg.* **68**, 243–248 (1989).

10. Capdevila, X., Bouregba, M., Barthelet, Y., Rubenovitch, J. & D ’athis, F. Comparison of the Three-in-One and Fascia lliaca Compartment Blocks in Adults:

Clinical and Radiographic Analysis. *Anesth Analg* **86**, (1998).

11. Société française d'anesthésie et de réanimation Pratique des anesthésies locales et locorégionales par des médecins non spécialisés en anesthésie–réanimation, dans le cadre des urgences. (2002).

12. Gozlan, C. *et al.* [Fascia iliaca block for femoral bone fractures in prehospital medicine]. *Ann. Fr. d'anesthèsie rèanimation* **24**, 617–20 (2005).

13. McRae, P. J., Bendall, J. C., Madigan, V. & Middleton, P. M. Paramedic-performed fascia iliaca compartment block for femoral fractures: A controlled trial. *J. Emerg. Med.* (2015). doi:10.1016/j.jemermed.2014.12.016

14. Ketelaars, R. *et al.* Emergency physician-performed ultrasound-guided nerve blocks in proximal femoral fractures provide safe and effective pain relief: a prospective observational study in The Netherlands. doi:10.1186/s12245-018-0173-z

15. Wilson, J. *et al.* Training Emergency Physicians in Ultrasound-guided Fascia Iliaca Compartment Blocks: Lessons in Change Management. *Cureus* **11**, (2019).

16. Foss, N. B. *et al.* Fascia Iliaca Compartment Blockade for Acute Pain Control in Hip Fracture Patients. *Anesthesiology* (2007). doi:10.1097/01.anes.0000264764.56544.d2

17. BORDERES, S. Efficacité du bloc fémoral écho guidé réalisé par l'urgentiste pour la prise en charge antalgique des fractures de hanche du sujet âgé. (2016).

18. Leeper, A. D., Brandon, P. T., Morgan, A. V. M., Cutts, S. & Cohen, A. M. M. Fascia iliaca compartment block reduces morphine requirement pre-operatively for patients with fractured neck of femur. *Eur. J. Trauma Emerg. Surg.* (2012). doi:10.1007/s00068-012-0230-x

19. Mouzopoulos, G. *et al.* Fascia iliaca block prophylaxis for hip fracture patients at risk for delirium: A randomized placebo-controlled study. *J. Orthop. Traumatol.* (2009).

doi:10.1007/s10195-009-0062-6

20. Dolan, J., Williams, A., Murney, E., Smith, M. & Kenny, G. N. C. Ultrasound Guided Fascia Iliaca Block: A Comparison With the Loss of Resistance Technique. *Reg. Anesth. Pain Med.* (2008). doi:10.1016/j.rapm.2008.03.008

21. Lamperti, M. *et al.* International evidence-based recommendations on ultrasound-guided vascular access. in *Intensive Care Medicine* (2012). doi:10.1007/s00134-012-2597-x

22. Rodriguez-Paz, J. M. *et al.* Beyond 'see one, do one, teach one': Toward a different training paradigm. *Postgraduate Medical Journal* (2009). doi:10.1136/qshc.2007.023903

23. Chen, X. X. *et al.* Ultrasound-Guided Regional Anesthesia Simulation Training. *Reg. Anesth. Pain Med.* (2017). doi:10.1097/AAP.0000000000000639