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Prevention of iatrogenic infections in interventional rheumatology: optimal measures but adapted to each risk

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Osteoarticular iatrogenic infections may be serious and justify suitable and optimised preventive measures depending on each risk, as much in terms of mortality as of morbidity. Its appreciation has been the subject of more and more studies which allow the importance of the problem to be better evaluated. The level of iatrogenic infections after arthroscopy is evaluated at 1 to 5‰ on a recent series of knee operations, but they may be much higher for the elbow [1,2]. In practice, this examination is no longer used for diagnosis as it was 10 years ago, the progress in imagery means this invasive act is no longer necessary. In a recent meta-analysis, prosthetic surgery led to a level of deep iatrogenic infection of about 9‰ for the hip, but with a confidence interval of 95%, included between 4 and 22‰ [3].

Significantly, the existence of a perioperative wound with secondary infection is associated with iatrogenic infection. In 20% of the cases, these are Methicillin resistant staphylococcus. The level of infection for shoulder replacements is of the same magnitude of 10‰, but is around 20‰ for knee replacements [4]. Prior cortisone local injections do not appear to increase the risk of later sepsis [5]. However, the increase in asepsis, with the implementation of laminar airflow in operating theatres, does not appear to increase the level of security for the considerable additional costs [6]. Although, it is clear that asepsis measures reduce the risk of iatrogenic infections, it is more difficult to determine the optimal threshold of preventive measures necessary without falling for an excess of costly and not very profitable measures.

Where are we with articular and periarticular local injections? At the present time, we only have retrospective inquiries available, with very low levels of iatrogenic infections, between 0.002 and 0.07‰ (table 1)[7-13]. A prospective study will be very difficult to carry out with the necessary number of patients, in the hundreds of thousands with no losses, to follow-up, taking account of the rarity of the event. Two studies have recently been published after on

the ground enquiries looking for the totality of real septic arthritis cases found in a given population [7,11]. However, the figures that have been discovered are particularly divergent: 0.026‰ (close to previous enquiries) for one and 0.37‰ for the other, i.e. a difference by a factor of 10. How do we explain this difference? If the number of sepsis has been the subject in the 2 exhaustive research studies, the methodology was quite different to evaluate the number of interventional local injections acts. In the Icelandic study, it is the number of acts charged for and reimbursed which was used. In the French study, a real evaluation over a 2 weeks period was carried out with 98% of rheumatologists in the region who perform 3/4 of the local injections. In France, when a local injection is performed, the associated consultation may be quoted in the database and be reimbursed, without the act performed appearing. The database largely underestimates the number of acts performed. The French population is also much more important (1,290,533 versus 287,559), with the number of acts retained more than 10 times greater (75,698 versus 6,891). Furthermore, the local injection technique and asepsis used are unknown to the Icelandic Doctors, for a previous old period 1990-2002. In the French study, clean hands, with or without sterile gloves, single-use equipment and use of iodine or Chlorhexidine type antiseptics were the order of the day. The difference between the 2 figures is important: 0.37‰ and it is close to the 1-5‰ of arthroscopies, which may justify operating type asepsis measures, whilst with only 0.026‰ this very low risk would not appear to justify additional preventive measures to what is actually practised and recommended in France by the HAS [14]. For our part, and in agreement with the results, the recommendations and practices carried out in France, we retain as level for iatrogenic infections after rheumatology interventions the figure of 0.026‰.

The balance benefits – risks from local injections should be evaluated to estimate if the negative incidence of local injection risk is largely outweighed by the beneficial positive effects. The centres who practice and evaluate the benefits of osteoarticular local injections techniques find satisfaction levels reaching 90% [15]. In the evaluation carried out by Zhou covering 771 interventional acts, the EVA fell from 6.7 to 2.4 after the therapeutic interventional act, with a NNT for an improvement of more than 50% to 1.4 [15]. Iatrogenic infection remains as the most serious complication, with risk of rapid articular destruction and definitive secondary functional impotence. If mortality from osteoarticular infections remains high, it is difficult to evaluate the importance of morbidity and mortality of these osteoarticular infections after local injections, based on the literature. Only one death has been found, related to an important diagnostic delay [16]. It remains that a patient informed of the risk should allow for rapid care and few sequelae. We can only insist on the indispensable character of patient information, better guarantee of early care for an eventual complication to avoid sequelae. The balance, benefit-risk however remains largely positive (Figure 1).

SIRIS (Section Imagerie et Rhumatologie Interventionnelle de la Société Française de Rhumatologie) (Imaging and Interventional Rheumatology Group of the French Rheumatology Society) proposes suitable preventive measures for each act depending on each particular patient risk and in each environment (Table 2). In fact, the septic risk depends on the type of act: the number of acts, the aggressive character and size of the cutaneous puncture, duration of the act. It is important to define the notion of sterile zone – clean zone interface. So, the surgeons hand must be sterile, the same as all the parts of his body that contributes to movement near the operating site (sterile scrub). For acts with a simple cutaneous puncture, after asepsis of the skin with major antiseptics such as iodine or

Chlorhexidine antiseptics, the choice may be made between the sterile – clean interface at the level of either the hand (sterile gloves and clean clothes), or either the needle or the syringe. On one hand, certain product syringes are not guaranteed sterile, and the problem of having a hand in a non-sterile glove which holds the syringe makes us consider that we should take account of the syringe-needle interface for simple acts. However, touching the needle or its connector should be avoided by introducing the "double no touch" notion, don't touch either the skin or the needle. Patients at risk also justify more additional measures: ageing, malnutrition, obesity, diabetic, prior surgery, haematopathy, cirrhosis, distant infections, carrying AIDS, iatrogenic (chemotherapy, biotherapy) and family immunodeficiency. Finally, the ambient surroundings need to be taken into account, with infection risk and germ virulence being different, depending on the place (medical office, radiology, clinic, hospital).

We have established these recommendations by taking into account the literature data, from an open enquiry with rheumatologists during a congress of the French Society of Rheumatology (after a communication in December 2011) , and the advice from SIRIS experts (co-authors). We have seen that the techniques were very different from one person to another, with a clear increase in asepsis measures with the youngest. We propose recommendations albeit tempered, with a request for optimisation of each procedure, but without falling into the excess of precaution of the operation type, both costly and ineffective.

We have distinguished the usual acts, whether they are superficial or deep, periarticular (shoulder, elbow, wrist, hip, knee, ankle, foot, plantar fasciitis, trigger finger, finger retinaculum section), tunnels (carpel, tarsal, Morton, pelvis, shoulder), or articular (shoulder

complex, elbow, wrist, finger, hip, knee, ankle, tarsal, foot, sternoclavicular, temporomandibular, zygapophyseal), more complex acts such as puncture aspiration of calcifications, cementoplasty, aponeurotomy, wrist retinaculum section, bone, synovial or muscular biopsies. Certain people are tempted to propose stricter prevention methods for deeper after local injections, such as the hip or sacroiliac. There is no data which allows this direction to be followed. Surveillance should simply be more precise concerning the absence of visible inflammatory signs for these deep articulations. Guidance (fluoroscopic, ultrasound or scan) may be an additional risk. It may be the environment of the x-ray table where all the potentially infected patients pass. Additional precautionary measures should be taken (level 2), and the room disinfected after each passage suspected of being an infection risk. Ideally, a room dedicated to osteoarticulations would be preferable. CT-scan requires several comings and goings between the guide and the image controls, which justifies additional precautions and also changing to level 2. Ultrasound guidance presents a risk of contact with the probe, the needle should at all times be at least 1 cm away. Technical aids may be of use: an articulated arm to keep the probe close by without the need to rest it on another support, protecting the probe, the context of which will decide if this should be sterile or not, and a foot pedal to take the reference images. For all these guided acts, an assistant may be needed when the act is complex. However, for the more usual acts, there is no data justifying stricter precautionary measures for an ultrasound guided act compared to an act relying on anatomical guidance. The ASA score defines in anaesthesia the overall health state and the potential fragility of the patient. The HAS has established recommendations as to the optimal environment necessary to perform interventional acts [\[17\]](#). This environment, with an eventual assistance for performing more complex acts, and above all surveillance after the interventional act will be adapted case by case for the ASA 3 & 4. The anaesthetic

will remain local, with possible nerve or distal block. But an ASA 4 patients, locoregional proximal and plexus block anaesthetic techniques, and associated sedations justify the presence of a nearby anaesthetist. The characteristics of the required first aid kit are also specified. Note that the necessity to have an oxygen supply for level 1 (HAS recommendation) is far from unanimous for interventional rheumatologists. The quality of the environment or place where the act is performed is subject to a certain number of criteria between level 1 and 2, level 3 remaining as the operating theatre, but it is the cleanliness and its traceability that will be preponderant. A room or immediate surveillance area is required for level 2. Disinfection is required after the passage of an infected patient. Additional risk elements may envisage changing a patient from level 1 to level 2, on a case by case basis and depending on the practitioner's appreciation: infectious risk, general situation (ASA 3, poorly balanced), for example obvious allergic risk, anticoagulants or antiplatelets, morbid obesity, malnutrition, dementia. The HAS propose to define intermediate levels 2a and 2b. The intermediate level 2a is a level 1 with reinforced asepsis (sterile gloves, sterile probe protection), with optional assistant, without however justifying the presence of an anaesthetist close by. This level 2a could be used for risk patients (ASA 3 or infectious risk) and for the use of a mix of nitrous oxide 50% and oxygen 50% (gas and air). Level 2b is the equivalent of level 2. It could be reinforced only if estimated to be necessary (antiseptic shower, sterile gloves and scrub, cap), in an environment close to those found in the operating theatre (level 3). Biopsy acts justify stricter asepsis measures as they include as secondary benefit a diagnosis dimension and not therapeutic.

In total, even if these recommendations should be indicators, that one can adapt case by case, nothing justifies an inflation of asepsis protection measures within the scope of 'principle of precaution' which may be just as useless as expensive if we consider the more

than 2 million interventional rheumatology acts performed each year in France, with less than 100 septic complications of which less than 10 are subject to claims for damages.

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Table 1: Level of iatrogenic osteoarticular infections in interventional rheumatology

for 1 000 acts.

In France

Séror (Rheumatology 1999) **0.015**

Lebrun (Rheumatologist Letter 1999) **0.015**

Maugars (Rev Rhum 2013) **0.026**

In Great Britain

Weston (Ann Rheum Dis 1999) **0.002**

In the USA

Hollander (State Med J 1970) **0.067**

Gray (Clin Orthop 1993) **0.020**

In Iceland

Geirsson (ARD 2008) **0.37%**

Table 2: SIRIS recommendations for patient, practitioner and material asepsis and adapted environment for interventional rheumatology

	Level 1 Usual injections and acts	Level 2 More complex injections and acts
T PE OF INJECTION	<ul style="list-style-type: none"> -periarticular (shoulder, elbow, wrist, hip, knee, ankle, foot, plantar fascia, trigger finger, finger retinaculum section^a) - tunnels (carpal, tarsal, Morton, pelvic, shoulder) - articular (shoulder complex, elbow, wrist, finger, hip, sacroiliac, knee, ankle, tarsal, foot, sternoclavicular, ATM, interapophyseal) - epidural (interlaminar or caudal) or foraminal 	<ul style="list-style-type: none"> - Puncture aspiration of calcification, cementoplasty, kyphoplasty, aponeurotomy, wrist retinaculum section - bone, synovial or muscular biopsies
PATIENT ASEPSIS	<p>local disinfection of the skin using iodine or Chlorhexidine antiseptic, wait 2' (if alcohol solution: 30")</p> <p>"no touch" skin procedure</p> <p>clean in 5 steps if poor cleanliness</p>	<p>local disinfection of the skin using iodine or Chlorhexidine antiseptic, wait 2' (if alcohol solution: 30")</p> <p>"no touch" skin procedure</p> <p>clean in 5 steps if poor cleanliness</p>
PRACTITIONER'S ASEPSIS	<p>clean hands (hydroalcoholic gel) after each patient, non-sterile gloves</p> <p>paper mask, glasses if risk of projection</p> <p>clean gown or clothes</p>	<p>clean hands (hydroalcoholic gel) after each patient, sterile gloves</p> <p>paper mask, glasses if risk of projection</p> <p>clean gown or scrub</p>
MATERIAL ASEPSIS	<p>single-use equipment</p> <p>clean or sterile compresses and sterile syringe</p> <p>"no-touch" sterile needle</p>	<p>single-use equipment</p> <p>clean or sterile compresses and sterile syringe</p> <p>"no-touch" sterile needle</p>
GUIDED INJECTIONS	<p>Ultrasound: probe and cable cleaned with wipe or antiseptic solution, non-sterile probe protection (+ non-sterile gel), respect the distance needle - probe > 1 cm</p> <p>Fluoroscopy: protective material cleaned with antiseptic after each patient</p>	<p>Ultrasound: probe and cable cleaned with wipe or antiseptic solution, sterile probe protection (+ non-sterile gel), respect the distance needle - probe > 1 cm</p> <p>Fluoroscopy: protective material cleaned with antiseptic after each patient</p>
PATIENT RISK	<p>High infectious risk judged important^b: possible evaluation case by case to pass to level 2^a</p> <p>General acceptable risk: ASA^c 1-2 even 3</p> <p>Anaesthesia: local or digital block or distal block</p>	<p>High infectious risk: reinforced level 2 may be considered^d</p> <p>General risk: ASA^c 1-2-3 even 4</p> <p>Anaesthesia: local or locoregional, plexus block, possible associated sedation, gas and air^a</p> <p>Anaesthetist available at proximity if necessary</p>
FIRST AID KIT	<p>Blood pressure instrument, stethoscope, oxygen^e (mask or nasal cannula)</p> <p>SC adrenalin, SC atropine, corticoid, antihistamine (+ analgesics, NSAIDs)</p> <p>Optional: anticonvulsant, bronchodilator, intravenous fluids</p>	<p>Blood pressure instrument, stethoscope, thermometer, ECG apparatus, oxygen (mask or nasal cannula), oxymeter, intubation and aspiration cannula, laryngoscope, ventilation mask, ventilator (manual or automatic), defibrillator,</p> <p>SC adrenaline, SC atropine, corticoid, antihistamine, bronchodilator, ephedrine, anticonvulsant (Flumazenil type), +/- muscle relaxant (Dantrolene type)</p>

		(+ analgesics, NSAIDs) Intravenous perfusion material, physiological serum and hyperosmolar solution
ENVIRONMENT	Fitted out consultation room: treatment area separate from the office area, hygiene traceability, single-use equipment, asepsis of potentially unclean elements (reinforced for guided acts), circuit for waste disposal, aeration, washable examination table, swivel lamp, portable tablet, wash basin, closed cabinet Optional assistant	Fitted out consultation room with in addition: zone for cleaning and disinfection, reinforced and regular asepsis, decontamination zone, operating table (+/- ventilation, sas (air-lock) entrance, electric generator) Simple recovery room Assistant

^a possibility of an intermediate level 2a (sterile gloves, sterile probe protection, optional assistant)

^b ageing, malnutrition, obesity, diabetic, prior surgery, haematopathy, cirrhosis, distant infections, carrying AIDS, iatrogenic (chemotherapy, biotherapy) or family immunodeficiency

^c ASA score: **1** = patient normal ; **2** = patient with moderated systemic anomaly; **3** = patient with severe systemic anomaly; **4** = patient with severe systemic anomaly representing a constant vital threat; **5** = patient moribund whose survival is unlikely without 'intervention

^d addition of cap and sterile scrub

^e this HAS recommendation for level 1 is not approved by the majority of the experts

Figure 1: Balance benefits-risks from osteoarticular after local injections

