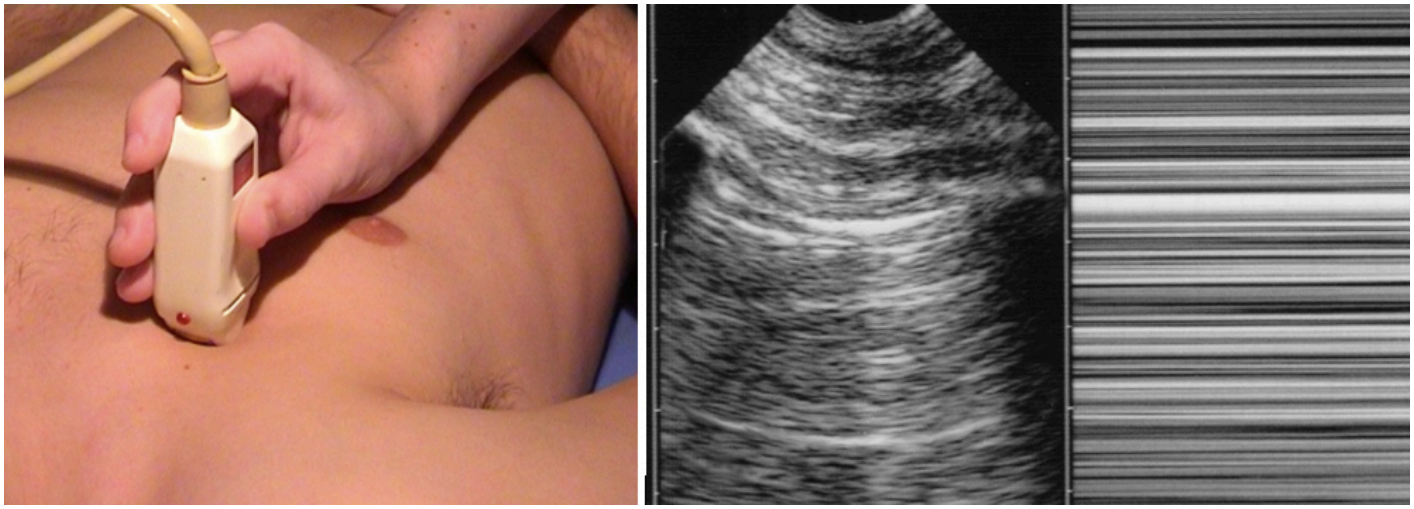
The use of multisite ultrasound in cardiac arrest - the SESAME-protocol

Cardiac arrest is the most critical emergency. The sudden interruption of oxygen supply damages the brain after some minutes. Finding a cause for efficiently fixing the problem is the main target of the frontline physician. Ultrasound is an elegant technique, familiar to everybody, that allows to detect the sex of a baby without radiation. But it can do much more: ultrasound is an overlooked tool for visual medicine, of prime importance in extreme emergencies. Having chosen the discipline of intensivist, we were used to switch-on the machine since 1985 for managing our critically ill patients.



Left: the probe scans the lung, a traditonnally “forbidden area”. This japanese microconvex probe is able to scan the whole body, and the same probe will be applied on the veins, abdomen, pericardium and heart. Middle: a direct vision of lung ultrasound. The dynamic information lacks in this static view, but the user as noted a striking lack of movement (in addition to a horizontal stripe). Using a certain mode (the “M-mode”), this absence of motion can be shown to any observer. Right: the typical pattern of pneumothorax on M-mode, a homogenous stratified pattern, which in ultrasound words indicates absence of any dynamic. This feature is fully unusual regarding the lung: this vital organ is supposed to permanently move.

In dealing with cardiac arrest, there is no time to use traditional tools such as radiographies. If the cardiac arrest does not respond to an electric shock, ultrasound comes in handy, as a visual tool for looking *inside*. Traditionally, ultrasound is not used at all in cardiac arrest. If it is, it is used only for cardiac analysis. Traditionally, ultrasound is a sophisticated tool, that looks like a Boeing cockpit. Paradoxically, the simplest machines work the best for cardiac arrest. We use a basic machine that can be switched-on in a few seconds. SESAME-protocol is the abbreviation for

“sequential emergency sonography assessing mechanism or origin of severe shock of indistinct cause”. It has been designed for having *no* button to touch for the first 4 steps (out of 5). The speed is optimized at each level. Traditional echography requires specifically designed probes for each organ. In extreme urgencies, the time it takes to change the probe is a severe issue (in addition to other drawbacks including costs). We use a single probe which is not only perfect for the lung, but also suitable for the whole body. The lung is the most vital organ, but surprisingly, lung ultrasound has been deemed impossible to achieve, based on the wrong belief that ultrasounds cannot traverse air. We demonstrated that this dogma was wrong (Fig. 1), and that this transparent access to the lung allows to drastically decrease the radiation in many medical fields.

The SESAME-protocol assesses the main reversible causes, which are by providence easy to diagnose. There are 5 sequential steps, the first one assessing the lung, then a specific venous zone (for venous clot detection), then the abdomen (for internal haemorrhage detection), then the pericardium, and last the very heart. Let us take the example of a subject victim of a balistic wound. The cause of the shock or cardiac arrest can come from a pneumothorax (the lung is collapsed, and the gas under tension endangers the neighboring heart). It can also come from an abdominal bleeding. And lastly, it can come from a pericardial fluid (blood) which accumulates around the heart and prevents it from pumping. Each of these causes has an immediate therapy: inserting a tube or giving large amounts of fluids, schematically. Providentially, our unit can make the diagnosis in a few seconds. This is the alternative to making an inefficient rescuscitation.

In other settings, ultrasound will show other causes of cardiac arrest, mainly pulmonary embolism (the migration of a venous clot in the pulmonary circulation). For this, the SESAME-protocol scans the leg at an area involved in half of the cases. Sometimes, ultrasound is useless - but at least the physician using this visual approach can be sure to have the best possible diagnosis to act accordingly.

Finally, the main peculiarity of our SESAME-protocol: we use it each time we scan a patient in less dramatic settings (critical care, anesthesiology...), and even down to traditional check ups. It is used *with no adaptation needed whatsoever*: the tools, logic, technique and simplicity are the same. Truly, ultrasound is an elegant stethoscope of the modern times.

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