The “thermal” sub-theme"

We have adopted a cross-disciplinary approach to research in neonatology. The fundamental research performed in the laboratory - notably on the analysis of thermal exchanges (mannequin studies) and thermoregulation in newborns (clinical studies) - has enabled us to conceive and design new thermal management solutions (software for calculating thermoneutrality in incubators, and the use of polyethylene bags to reduce the risk of hypothermia). We are working to develop these tools further and to validate them in a clinical situation (via a bench-to-bed approach) by using different human approaches (integrated physiology studies) and mathematical/physical models (thermal mannequins). We have also performed other projects in order to identify and characterize risk situations (risk factors for hypo- and hyperthermia); this will enable us to improve the models (see below).

We have written a software package called PRETHERM to calculate thermoneutrality while reliably taking account of all the child’s heat losses. PRETHERM can run on top-of-the-range incubators with an advanced human-machine interface. We have validated the software in technical, clinical and physiological terms. The company Médiprema has applied for a trade mark and has incorporated PRETHERM into its latest generation of incubators (the INOTHERM® range).

In a parallel study (the PSAC project), we evaluated the value of using a polyethylene bag to wrap premature newborns and thus preventing the body temperature from falling during care procedures known to be risk factors for hypothermia (such as venous catheter placement). The results showed that the use of a polyethylene bag significantly reduced the fall in body temperature and also avoided the risk of hyperthermia when the child was warmed at the end of the procedure.

Identifying care procedures with a risk of hypo- or hyperthermia

Routine clinical care can induces sudden changes in the air temperature and relative humidity in the incubator, resulting in a fall in skin temperature. It is important to identify and characterize risk factors for body cooling in the premature newborn, in order to improve care provision. The impact of episodes of body cooling or warming on physiological constants (heart and respiratory frequencies, blood pressure, apnoea and sleep organisation) and the morbidity on discharge from the neonatal unit was also evaluated. Some very frequent care situations (catheter placement) are particularly dangerous and induce a significant fall in body temperature. Conversely, the study also evidenced other care situations that may be associated with a risk of hyperthermia (phototherapy).

The "electromagnetic fields" subtheme"

After healthy adult volunteers had been exposed to a mobile phone (900 MHz, 0.5 W/kg) for 20 minutes, we measured the brain blood flow rate in the middle cerebral arteries (using transcranial Doppler ultrasonography), the microcirculation flow rate in the skin of the face (using laser Doppler flowmetry) and the brain’s electrical activity (using EEG). Our results showed a significant increase in the skin’s microcirculation flow rate during exposure, and no change in the blood flow rate in the middle cerebral arteries. In contrast, the brain’s EEG activity in the alpha band (8-12 Hz) fell during and after exposure.

A similar study of chronic exposure to athermic EM waves (such as those emitted by a mobile relay station) in the presence or absence of mild thermal stress revealed a fragmentation of rapid eye movement sleep, an exacerbation of the peripheral vasoconstrictor tone, and increased food intake. These results enabled us to

conclude that chronic exposure to EMFs triggers certain energy-saving mechanisms. This observation prompted us to suspect an increase in the body's thermoneutral set temperature - triggering cold response mechanisms that would not be activated by an individual not exposed to an EMF.

Taken as a whole, these data evidence an interaction between the effects of EMFs and the thermoregulatory mechanisms involved. They reinforced our hypothesis, in which co-exposure (thermal stress and EMFs) may have an important role and may explain the disparities in the literature between studies that find effects and those that do not. Our results have been cited by (i) the French environment health agency as an example of the increase in the level of proof for the effects of EMFs on sleep (document 2011-SA-0150) and (ii) the WHO in its Monograph on Electromagnetic Fields, as a demonstration of vasomotor effects at intensities below the current regulatory thresholds.

Screening for other effects of EMFs, biomarkers and vulnerability factors
At present, neither a causal link nor an explanatory model has been established for exposure to EMFs and the symptoms reported by electrohypersensitive people. Our recent study of reportedly electrohypersensitive people (the Sensi-RF project) evaluated the effects of EMF exposure on sleep, the vegetative (autonomic) nervous, endocrine and immune systems and screened for biological markers using biochemical analyses. The initial results have shown changes in sleep quality in electrohypersensitive people (according to a questionnaire) in the absence, however, of apparent changes in the melatonin profile.