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Nonlinear Dynamic and Chaotic Analysis of Fetal Heart Rate in Fetal Distress

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Computerized electronic fetal monitoring for fetal surveillance has been developed for two decades. And variability in the fetal heart rate is known to be a sign of fetal well-being, and yet the origin of the variations remains unclear. This study incorporated the nonlinear and Chaos dynamic analytic techniques of phase-space reconstruction with 22 fetal distress heart rate tracings obtained from the pregnant women in labor. Heart rate tracings are divided into two groups retrospectively : 1) 5 acidotic fetus (arterial cord pH below 7.20), 2) 17 non-acidotic fetus (arterial cord pH above 7.20). After low pass filtering of fetal heart rate, phase space attractors were constructed with the method of time delays and showed characteristics consistent with those of nonlinear chaotic system. Delay time, embedding dimension and correlation dimension were calculated. Isochron return map and information entropy resulted in two groups being identified. Results indicated that control of fetal heart rate may be modelled as an nonlinear or chaotic system, and analytic techniques borrowed from the physical sciences are useful in exploring heart rate variability. The different groups could be distinguished among qualitatively similar fetal heart rate tracings may lead to understanding of discrepancies between evaluation of monitor tracing and neonatal outcome..

I S—70 Colored microsphere technique to measure cerebral blood flow distribution in the newborn rats

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[Objective] In the newborn rats model of unilateral carotid artery ligation with hypoxia, little is studied regarding changes in cerebral blood flow distribution during hypoxia-ischemia. In the open chest models we previously examined relationship between the injection route (RV or LV) and distribution pattern, resulting in exclusive accumulation in the lungs in case of RV injection. In the present study, we step forward to inject colored microspheres percutaneously into LV in a blind fashion and observed blood flow distributions. [Method] 7-day-old Wistar rats (n=12) were used. We injected colored microspheres (0.05ml, 15 μ m diameter, 250,000 spheres) percutaneously into LV with a 27G needle. After euthanasia, the cerebral cortex, lungs and kidneys were extracted and microspheres were counted following the standard procedures under a microscope. [Result] We succeeded in LV injection in 92% (11/12). One experiment showed substantial accumulation in the lungs, which was omitted from the further analyses. Microspheres were accumulated in the cerebral cortex (28 spheres/mg), kidneys (27 spheres/mg), and lungs (7 spheres/mg). No distribution difference was observed between the right and left side. [Conclusion] Percutaneous colored microspheres injection can be applied to measure cerebral blood flow distribution pattern in the newborn rats.