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脉图参数在人体静息状态时的波动及其检测校正方法的探讨

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内容提要　人体在静息状态下的脉图参数，呈现与呼吸时相有关和无关的两种波动，致使两次随机测定的脉图参数之间产生差别。这种由抽样引起的最大可能误差与每次检测抽样的连续脉波数之间呈类似双曲线的关系，抽样脉波数在10个以下时，误差很大，超过20个以后，误差渐接近于最小值。

脉象的现代研究多用脉搏图作客观指标，而在人体静息状态时，脉图参数仍出现相当大的波动，如果在测算时，不注意消除这种影响，必然会产生相应的误差，甚至由此而得出错误的结论。这一问题尚未引起人们足够的重视。本文观察健康成人在静息状态时，脉图参数波动的情况，试图探讨消除或减少这种波动影响的脉图检测校正方法。

对象与方法

以172例健康人为对象，不分性别，年龄18～66岁。在室温18～20°C 下，坐息10分钟后，平静仰卧，用中国医学科学院基础医学研究所研制的硅杯脉搏传感器及放大器，连接多导生理记录仪，检测右手寸口关部桡动脉脉图，并同步记录Ⅱ导心电图及呼吸活动曲线。受试者始终保持平静，避免呼吸活动受主观意识控制。

脉图参数：测脉波起点至终点的时限，即脉波周期(AA′)；脉波起点至降中峡最低点的时限(AE′)；主波高(HB)及降中峡高(HE)，见图1。均以对应于呼吸时相 a 的脉图参数值作标准，用百分数表示之。

结　果

一、脉图参数随呼吸时相的波动：在一个呼吸周期中，各个脉图所对应的呼吸时相不同。以脉率/呼吸率（P/R）比值等于6（即一个呼吸周期内有6次脉搏者）为例，可顺序出现：a.屏气—吸气，b.吸气—屏气，c.屏气—呼气，d.持续呼气，e.呼气—屏气，f.持续屏气6种情况。当P/R等于5、4或3时，脉图对应的呼吸时相分别只有5(缺d)、4(缺d,f)或3(缺b,d,f)，见图2。P/R 大于6的例数甚少，未予分析。当 P/R 不为整数，而接近某一整数时，其脉图与呼吸时相的对应关系与该整数的对应关系基本相

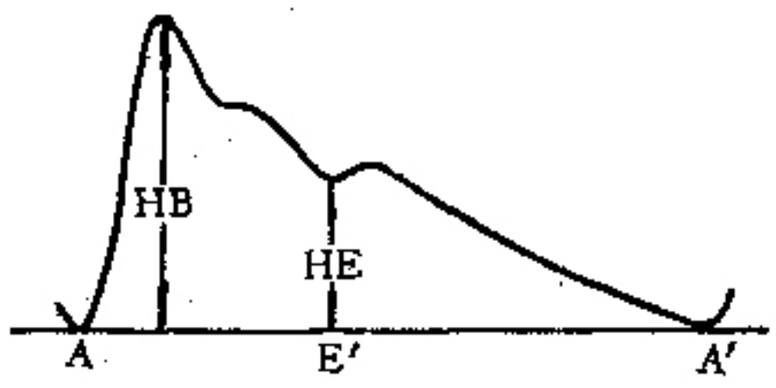

图 1　脉图参数示意图

表1　不同呼吸时相的脉搏周期(AA′)变化

P/R	例数	呼吸时相 a	b	c	d	e	f
3±0.2	39	100.0		△△ 94.7		△* 98.5	
4±0.2	45	100.0	△△ 95.8	△△ 96.3		* 99.2	
5±0.2	21	100.0	97.0	△△ 94.0		△△ 96.1	** 98.4
6±0.2	20	100.0	△△ 96.4	△△ 94.0	△△ 95.9	99.2	** 100.3
比值非整数组	40	100.0	97.2	△△ 95.8			

注：与a相比较：△△P＜0.01，△P＜0.05；与c相比较：**P＜0.01，*P＜0.05

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似。为了便于统计分析，将P/R 值范围为3±0.2、4±0.2、5±0.2和6±0.2者，分别列为4

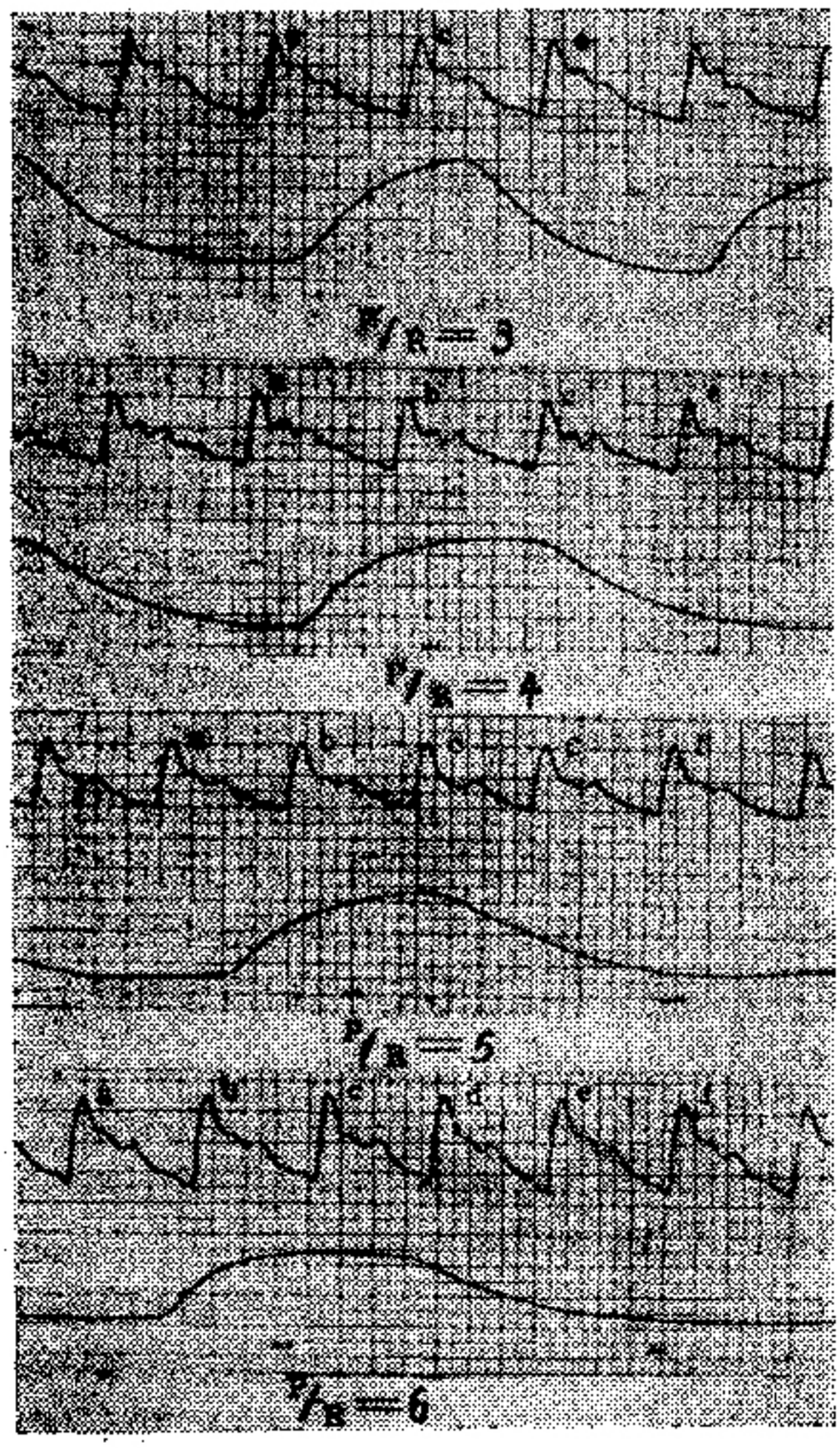

图2 P/R等于3、4、5和6时，脉图与呼吸时相的对应关系

组。P/R值与整数差距大于0.2者，另列为一组（比值非整数组），只测 a、b、c 三个时相的脉图参数（表1），各组中均排除呼吸性窦性心律不齐者。

在各 P/R 组中，AA′值均由 a 相到 c相逐步减少，而由 c 相到 f 相又逐渐增大，最后基本恢复到 a 相水平（表1）。AE′值随呼吸时相的波动情况与 AA′值的波动几乎完全一致。幅值参数 HB 和 HE 随呼吸时相的变化颇不规律。但将同一受试者在3～5个呼吸周期内的 HB 值，按呼吸时相分组，作 F 检验。在随机抽取的10例中，HB 值在不同呼吸时相之间差别显著者 6 例(6/10)。HE 值随呼吸时相变化的情况基本相似。

二、与呼吸时相无关的脉图参数波动：10例的 F 检验结果还表明，对应于相同呼吸时相的 HB 值，在不同呼吸周期间差别非常显著者 7 例(7/10)。AA′值也出现相似的波动，但差别显著的例数较少(3/10)。

三、脉图参数测算的最大可能误差与计测脉波数的关系：要在测算脉图参数时，排除上述两种波动的影响，应测定一段时间内各个脉波的数据，取其平均数。考虑到时辰对脉象的影响，抽样时间不宜过长。测算连续 3 分钟内的平均数(一般含二百多个脉图)，在 30 分钟内，多次重复测算，未见有明显变化，故将它作为有代表性的标准值。但是在实际应用中，计测连续 3 分钟的脉图还是很不方便的，有必要寻找一种既简便又不产生较大误差的方法。为此，以 AA′值为例，观察了两次脉图参数测算间的最大可能误差与取样脉波数之间的关系。将受检者连续 3 分钟的脉波记录，测算逐个脉波的 AA′值，以其平均值作为该受检者的 AA′标准值。再将全部 AA′值中的最大值与最小值之差，以标准值的百分数表示，即为每次检测只取一个脉波测算参数时，两次检测间可能出现的最大测算误差。如将 3 分钟记录，依次按每连续5个脉波求出一个 AA′的平均数，其最大值与最小值之差(以标准值的百分数表示)，即为每次检测取连续5个脉波的平均值时，两次检测间可能出现的最大测算误差。同法分别求出每次检测取连续10、20、40和80个脉波测算 AA′值时，可能出现的最大测算误差

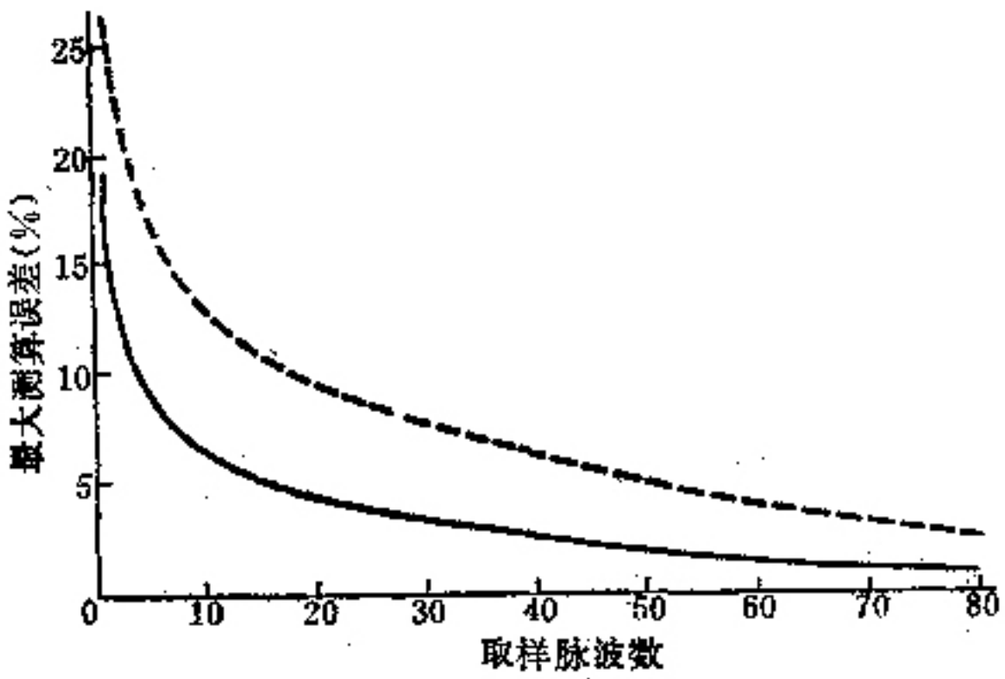

图3 正常人AA′值的最大测算误差与取样脉波数之间的关系。实线：正常人；虚线：窦性心律不齐的正常人

(表2)。以最大测算误差为纵坐标，以取样脉波数为横坐标，作出的关系曲线近似双曲线(图3)。

在检测取样脉波数较少(<10)时，曲线与纵坐标趋向平行，最大可能误差很大；而在取样脉波数超过20以后，曲线与横坐标渐趋平行，测算误差逐渐接近于最小值。在窦性心律不齐的正常人，此曲线的形状与非窦性心律不齐的相似，不过其误差数值都较大。

表2 AA′值的最大测算误差与连续取样脉波数的关系

取样脉波数	最大测算误差(%)	
	正常心律 (n=7)	窦性心律不齐 (n=7)
1	19.05±7.69***	26.48±11.27***
5	9.06±2.52***	16.60± 6.86**
10	6.59±2.13**	13.00± 5.18**
20	4.42±1.76**	9.40± 4.16**
40	2.60±1.39**	6.20± 2.71**
80	0.88±0.64*	2.30± 1.39*

注： 均数的显著性***P<0.001， **P<0.01，*P<0.05

讨　论

正常人(不含呼吸性窦性心律不齐者)的AA′值和AE′值，随呼吸时相出现规律性波动，在吸气过程中逐渐减小，而在呼气过程中又逐渐增大。这种变化与呼吸性窦性心律不齐的正常人相同，但波动范围较小。脉律是心律的一种反映，吸气时心率加快，而呼气时心率减慢，已是临床肯定的现象[1]。实验资料证明颈迷走神经及心迷走神经分支上的迷走传出冲动，在吸气时减少，而在呼气时增多[2]。在呼吸影响下，来自肺部、心脏与大血管内神经末梢，以及呼吸中枢的神经冲动，对迷走神经中枢发生兴奋与抑制作用[1]，通过迷走传出冲动，使心律和脉律发生变化。

HB 和 HE 虽也随呼吸时相变化而波动，但无明显的规律，而且个体差异较大。这点可能与影响幅值参数的因素比较复杂有关。

与呼吸时相无关的脉图参数波动，未见文献报道，本文所观察到的这种波动似无明显规律，它可能是由于机体各种内外感受器的传入冲动，以及大脑皮质的活动，影响了心血管中枢，使其紧张性活动产生波动所致。

有人提议计测屏气时的脉图参数，来消除上述波动的影响[3]。我们对 5 例受试者进行了实际观察，分别在平静吸气末屏气与平静呼气末屏气时，连续计测12～15个脉波(相当于平静呼吸时 3～5 个呼吸周期内的脉波数)的AA′值和 HB 值，发现在平静吸气末屏气时，AA′和 HB 的变异系数的平均值分别为 3.67和2.12，而在平静呼气末屏气时，则分别为2.33和1.62，说明在这两种屏气状态下，脉图参数仍然有一定的波动。屏气是停止呼吸活动，这就进一步证明脉图参数存在着一种与呼吸时相无关的波动。

图 2 中两条曲线的绘制，分别只用了正常心律与窦性心律不齐的正常人各 7 例，但是均数显著性测验说明它们对总体样本具有代表性(表2)。另外，随机抽取10例正常心律者的脉图记录，按前法测绘出各自的最大测算误差——取样脉波数曲线，均能与图 2 的曲线相吻合，说明该曲线可供实际应用。

本文仅以AA′值为例，测绘了最大测算误差——取样脉波数曲线，实际上其它各项脉图参数同样也可测绘出各自的类似曲线。这类曲线有两点重要意义：(1)人体静息状态下的脉图参数检测，以计测连续20个以上脉波，取平均数为宜，因其误差较小，可以忽略。如只计测10个以下的脉波，则可出现很大的误差。(2)将某种动因引起的脉图参数变化以百分数表示，再按计测时的取样脉波数，在坐标图上定位，如果该点落在曲线的右上方，则可以肯定这种变化是由该动因引起的。反之，如落在曲线上或其左下方，则此变化是否由该动因造成尚属可疑，因为变化在可能的最大测算误差范围以内，有可能是人体静息状态下存在的波动所致。

参 考 文 献

1. 董承琅，等。实用心脏病学。第二版。上海：上海科学技术出版社，1978:296。
2. Randall WC. Neural regulation of the heart. Inc New York:Oxford University Press, 1976:161.
3. 殷文治，等。呼吸活动对脉象图形分析的影响。上海中医药杂志 1983; 12:45。

Study on Treatment of Children's Iron-Deficiency Anemia with Invigorating the Spleen and Replenishing the Qi (气)

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This paper is an investigation on anemia with spleen deficiency syndrome and treatment with invigorating the spleen and replenishing the Qi (ISRQ), and compared with tonifying the blood, ferrotherapy and blank control separately. The change of xylose excretion rate between pre-and post-treatment was observed, and the essence of "spleen is the origin of blood formation" was explored. Result: A group of 3076 children, aged 2 ~ 7 years, from 11 nurseries of local municipal and district institutions in Beijing, have their blood examined. They were free from any kind of infectious disease. The Hb of children below 3 years old was less than 11 g/dl, and those over 3 years were 12 g/dl. A total of 967 cases had iron-deficiency anemia (IDA), the incidence was 31.5 %, which was irrelevant with age and condition of the nursery. 789 of them were spleen deficiency (81.6 %), and 178 were blood deficiency (18.4 %) in TCM. Therefore, spleen deficiency was the main pathogenic factor of IDA. 548 IDA children were treated in 3 batches with ISRQ method comparing with tonifying blood group (140 cases), ferrotherapy group (76 cases) and blank control group (67 cases). The marked effective rates were 84 ~ 38.6 % in ISRQ groups which were significantly higher than the 28.4 % in blank control ($P < 0.001$), and approached 56.7 ~ 28.8 % in tonifying the blood and 38.2 % in ferrotherapy group. Before the treatment of ISRQ, the average xylose excretion rates were 15.86 ± 3.4 %, and after the treatment, 21.86 ± 8.7 %. It indicated that the reason of those spleen deficiency anemic children were their own spleen deficiency even if they were well nourished. So the ISRQ method is better than tonifying the blood and approach to ferrotherapy. It had no side effect, was easy to take for a long time, could stimulate the appetite and prevent from catching cold. This study suggests that the mechanism of ISRQ improved the intestinal absorption of nutrient substance for blood formation, which elucidate the essence of the theory "spleen is the origin of blood formation".

(Original article on page 469)

Clinicopathologic Analysis and Treatment of Infantile Cytomegalic Inclusion Disease — A Report of 30 Cases

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The clinical manifestations and pathological features of cytomegalic inclusion disease (CID) of 30 infants were reported in this paper. The symptoms of CID were jaundice, hepato-splenomegaly, liver function impairment, bleeding tendency, purpura and nervous system disturbance. The pathological changes were involved in all organs of the body. Typical intracellular cytomegalic inclusion bodies were demonstrated in tissue cells, which were characteristic for CID. Different anomalies were found in 13 of the 20 autopsy cases. 10 CID infants were treated with combined TCM-WM therapy. Among them 5 cases were clinically cured. The therapeutic effect of Chinese medicinal herbs used in eliminating jaundice was distinct which had been confirmed by modern medicine, but their therapeutic effect to cytomegalovirus remained unclear.

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Fluctuation of Radial Sphygmogram Parameters in Human Body at Rest and the Approach of Deviation Correction

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After determining synchronously the right radial sphygmogram (at "Guan" (关) position of the wrist), electrocardiogram (standard limb II lead), and curve of respiratory movements in healthy persons proved in health checkup, who were in a supine position at rest, it was found that their sphygmogram parameters presented two types of fluctuations: one was related to respiratory phases and the other was irrelevant to that. Owing to the presence of these fluctuations, there existed variations between the values of sphygmogram parameters in the two random examinations of the same subject. The relation between the maximal probable error from the sampling and the number of consecutive pulse waves determined in each examination was similar to a hyperbolic curve. When the number of consecutive pulses taken in each test was below 10, the maximal probable error between the two random examinations might be very large; but if the number was over 20, the curve would gradually become parallel to abscissa, i. e. the probale error reached minimum. Therefore, it was suggested that if a representative and precise value of each sphygmogram parameter was expected, one had to examine more than 20 consecutive pulses in each test and took the average of the measured values.

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