

弦滑脉的血液动力学分析

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中医脉象研究从血液动力学的角度出发,用非线性弹性腔理论建立流体动力学的数学模式,导出脉图图形与血液动力学参数之间的定量关系式⁽¹⁾,从而对脉图的生理病理意义进行了探讨。本文通过临床分析定出滑脉、平脉与弦脉所对应的血液动力学参数的变化范围,最后通过动物实验,借助药物改变动物血液动力学参数探讨了弦脉、平脉与滑脉之间的过渡情况。

有关心血管参数获得的方法如下:每搏心输出量 SV(ml/b)是采用胸阻抗法测得,血压值,收缩压 Ps(mmHg)及舒张压 Pd(mmHg)是在右侧前臂用血压计测得,压力脉搏波图是用压力应变仪在右侧桡动脉处获得,从而用血压标定图形取得收缩期的脉图压力面积 As(mmHg·sec),舒张期的脉图压力面积 Ad(mmHg·sec)以及整个心动周期脉图压力面积 AT(mmHg·sec)。另外总外周阻力 R(mmHg·sec/ml),动脉顺应性 C(ml/mmHg)及动脉弹性模量 (mmHg/ml),根据有关公式⁽¹⁾求得:

$$R = \frac{AT}{SV}; C_0 = \frac{Ad/R - 0.9 \times 10^{-3}(P_s^2 - P_d^2)}{(P_s - P_d) - 3 \times 10^{-3}(P_s^2 - P_d^2)}$$

$$C_p = (6.0 C_0 + 1.8) \times 10^{-3} P + C_0; E_p = \frac{1}{C_p}$$

其中 C_0 为零压时的动脉顺应性, C_p 为某一压力点时的动脉顺应性, E_p 为某一压力点时动脉弹性模

量, 这样以不同压力点的值代入上式可以求得有关平均压时的动脉顺应性 $\bar{C}$, 收缩压时动脉顺应性 C_s , 舒张压时动脉顺应性 C_d , 以及平均压时的动脉弹性模量 $\bar{E}$, 收缩压时的动脉弹性模量 E_s , 舒张压时动脉弹性模量 E_d , 这样就可以分析这些参数与临床脉图之间的关系。

方法与对象

在上午安静卧床的条件下用脉象仪记录检测对象的右侧桡动脉脉图, 测量同侧血压, 同时用胸阻抗仪测得心输出量, 记录心音图以测量心脏收缩时间及舒张时间, 利用上述关系式算出有关心血管参数及脉波的上升与下降的速率。对高血压弦脉 47 例, 正常人平脉 28 例, 妊娠滑脉 32 例, 进行血液动力学有关参数的分析。

结 果

弦脉、滑脉、平脉之间血液动力学参数见附表, 把弦脉从零压动脉顺应性 $C_0 < 1.5$ 具有动脉硬化特征, 与 $C_0 > 1.5$ 的功能性弦脉分开, 则显示 47 例的高血压弦脉可以分为动脉硬化性 17 例, 功能性弦脉 30 例。

心输出量 (Q): 功能性弦脉的每搏心输出量比平脉小, 而由于心率稍快, 每分心输出量与平脉无显著

附表 弦脉、滑脉、平脉之间血液动力学参数

脉 型	人 数		平均 年龄	Ps	Pd	Q				R	P 值
	男	女				ml/b	P 值	L/min	P 值		
滑 脉	—	32	28	102	68	92.7 ± 19	>0.05	7.9 ± 1.6	<0.001	0.6 ± 0.1	<0.001
平 脉	18	10	37	113	75	90.7 ± 17		5.75 ± 1.1		0.99 ± 0.2	
功能性弦脉	17	13	39	145	99	80.24 ± 15	<0.05	5.63 ± 1.1	>0.05	1.36 ± 0.3	<0.001
硬化性弦脉	15	2	61	164	96	59.9 ± 11	<0.001	3.6 ± 0.6	<0.001	1.9 ± 0.3	<0.001

脉 型	C_0	P 值	$\bar{E}$	P 值	E_s	P 值	E_d	P 值	E/R	P 值
滑 脉	2.8 ± 0.5	>0.05	0.7 ± 0.1	>0.05	0.8 ± 0.1	<0.01	0.58 ± 0.1	>0.05	1.2 ± 0.2	<0.001
平 脉	3.0 ± 0.3		0.74 ± 0.2		0.97 ± 0.3		0.6 ± 0.2		0.77 ± 0.2	
功能性弦脉	2.9 ± 0.5	>0.05	1.14 ± 0.3	<0.001	1.74 ± 0.5	<0.001	0.8 ± 0.2	<0.001	0.77 ± 0.1	>0.05
硬化性弦脉	1.19 ± 0.4	<0.001	2.1 ± 0.6	<0.001	3.3 ± 1.1	<0.001	1.6 ± 0.5	<0.001	1.12 ± 0.4	<0.001

差异,而动脉硬化性弦脉则明显比正常平脉小,每搏心输出量,每分心输出量均有明显差异。滑脉的每搏心输出量与平脉无显著差异,而每分心输出量则明显比平脉大。

外周阻力(R):功能性弦脉及动脉硬化性弦脉的外周阻力均明显比平脉大,而滑脉的外周阻力明显比平脉小。

动脉弹性模量(E):功能性弦脉及动脉硬化性弦脉的平均压、收缩压、舒张压时的弹性模量($\bar{E}$, E_s , E_d)均比平脉各相应血压值时的弹性模量明显增大,有显著差异。滑脉的收缩压时的弹性模量(E_s)明显比平脉小,而舒张压及平均压时的弹性模量(E_d , $\bar{E}$)与平脉相比无明显差异。

零压动脉顺应性(Co):硬化性弦脉明显比平脉小,滑脉、功能性弦脉与平脉相比无显著差异。

动物实验

对狗在静脉麻醉状态下,进行上肢动脉的腔内测压,同时记录压力波形,开胸在主动脉根部用电磁流量计测心输出量。用去甲肾上腺素在下肢静脉内滴注观察及记录心输出量,血压及压力波形。另外用桑寄生的提取液(扩血管药物)作静脉推注,同上描记各指标。用去甲肾上腺素时,出现心输出量降低,外周阻力增加,动脉弹性模量增加,脉图波形由平脉逐步向弦Ⅰ→弦Ⅱ过渡;当用桑寄生注射液时,出现每搏心输出量增加,外周阻力降低,动脉弹性模量降低,脉图波形由平脉逐步向滑脉过渡(图1)。上述实验五次,五只狗均出现一致性的现象。

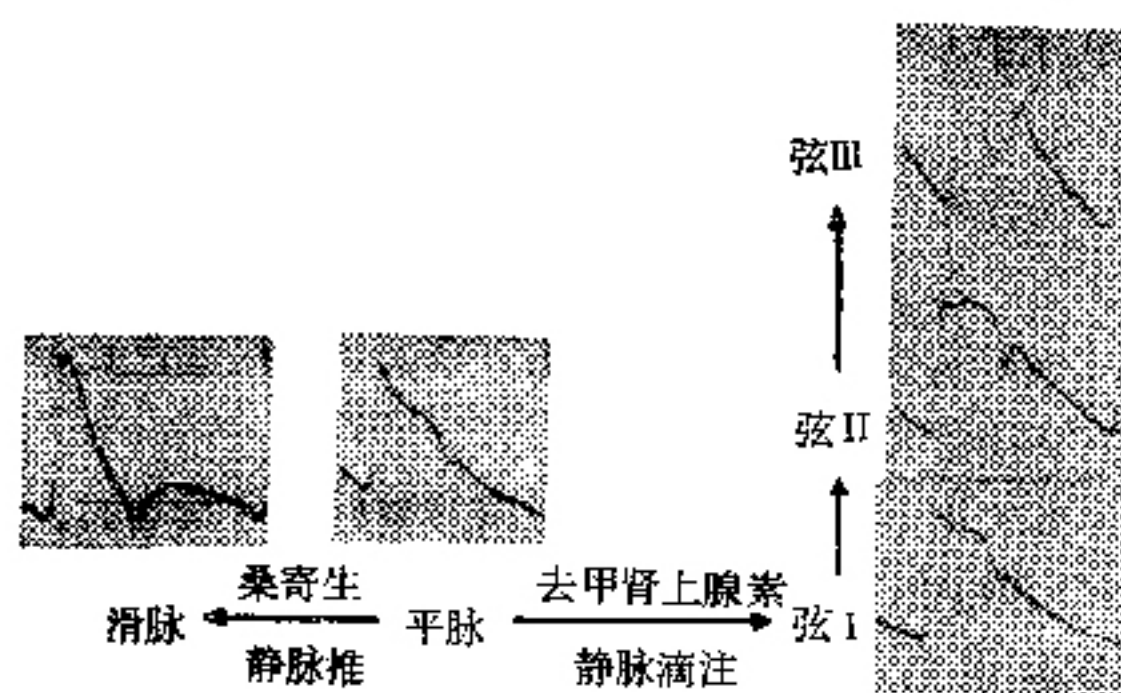


图1 动物实验弦滑脉的过渡

讨论

零压动脉顺应性表征着动脉在去除压力负荷时的动脉弹性状态,具有个体的特异性,作者以眼底及甲皱微循环等作为对照检查,发现零压动脉顺应性 $Co < 1.5$ 时绝大部分已有不同程度的动脉硬化,故而

弦脉中 $Co < 1.5$ 的归纳为硬化性弦脉, $Co > 1.5$ 的为功能性弦脉。

弦脉中的外周阻力增高,它反映高血压病的病理特征,血压的升高不是由于心输出量的增加,在动脉硬化阶段心输出量相反比正常低得多。外周阻力的增加,完全取决于毛细血管前细动脉的痉挛而引起血压升高,这些结果与我们过去报告相一致⁽²⁾。

滑脉中的心输出量增加及外周阻力降低,完全反映了妊娠期的生理特征,妊娠期20~28周心输出量达高峰,可比孕前增加25~40%,我们的检查对象大都在7个月左右,比正常人增加38%,妊娠期由于激素的作用,外周血管扩张,血液稀释及胎盘形成动静脉短路,使外周循环阻力减低,因而血循环量增大满足妊娠期特殊生理需要。

弦脉:中医临诊描写为“端直以长,如按琴弦”⁽³⁾,从上述检测结果中,不管是功能性弦脉还是动脉硬化性弦脉,其收缩压、舒张压以及平均压时的动脉弹性模量均比平脉大,弹性模量增大亦即血管的刚性增大,故而有“如按琴弦”之感。

滑脉:中医临诊描写为“往来流利,如珠走盘,应指圆滑”。从检测的结果中 $\bar{E}/R$ 代表着脉图压力波的上升速率与下降速率都远比平脉大,形成了速降波的特征,这完全与脉图图形一致。

从脉图的图形(图2)中可以看到平脉、滑脉的重搏波非常明显,说明血管的弹性状态良好,而功能性弦脉由于处于在主动脉瓣刚关闭时的动脉内的压力较高,在这一压力点上的相应动脉弹性模量较高,亦即

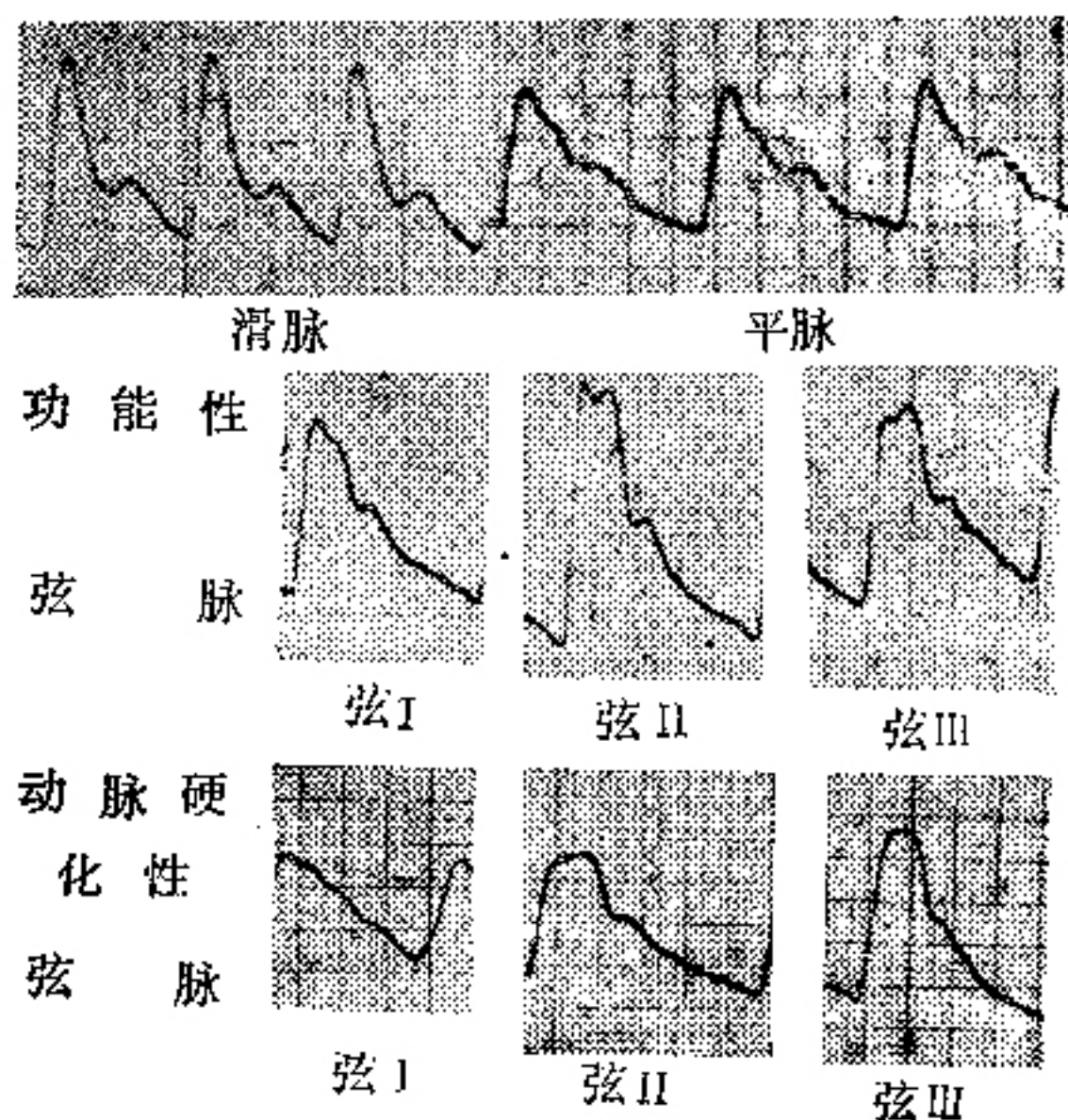


图2 临床弦滑脉图形

该时顺应性较差故而出现重搏波比平脉远为减弱，至于动脉硬化性弦脉，由于血管硬化其零压动脉顺应性很小，其在主动脉瓣关闭时这一压力点上的动脉顺应性极小，即可扩张度极差，主动脉瓣关闭时主动脉内血流返流冲击主动脉瓣关闭再度激起主动脉壁扩张而引起的重搏波极小甚至消失，这亦是动脉硬化性脉图的重要特征之一。

至于弦脉中重搏前波由弦Ⅰ→弦Ⅱ的逐步提高，是由于压力波在周围血管中反折叠加而成，随着血压的升高，外周阻力增加，引起终端血管的反射系数增大，以及血管壁在高压状态时的弹性模量增加，引起压力波传导速度加快，二者使反折波来回叠加显著增加，而使重搏前波逐步抬高。滑脉的情况与此相反，外周阻力降低，末梢血管扩张使终端反射系数减小，血管弹性模量降低，压力波传导速度减小，反折波来

回叠加显著减小，使重搏前波比平脉低以致完全消失不见，形成了滑脉的脉图特征。动物实验的方法，采用缩血管药物完全证实了上述平脉向弦Ⅰ→弦Ⅱ的过渡过程。在平脉的基础上使用扩血管药物便过渡到滑脉。从实验结果完全取得了与临床相符合的资料，从而更说明了弦滑脉的形成机理。

(本工作还有范明昌、吴晔、吴美枝三同志参加)

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耳廓化脓性软骨膜炎的中西医结合治疗

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临床资料 我院自1969~1981年收治耳廓化脓性软骨膜炎74例，其中男性46例，女性28例。年龄14~66岁，20~40岁者占84%。住院时间5~50天。对64例进行了细菌培养，主要致病菌为绿脓杆菌，占66%；其次为金黄色葡萄球菌，占11%和变形杆菌，占9.4%；另有大肠杆菌、粪产碱杆菌和革兰氏阴性杆菌类。

治疗方法

一、紫花地丁软膏外敷：将紫花地丁洗净，煎煮两次，浓缩至糊状，加入等量之凡士林调和即成，每日2~3次敷耳廓患处。现有软膏成品，使用方便。

二、抗菌素应用：应根据病情、感染时间、细菌种类和药物敏感试验，选用青霉素、链霉素、庆大霉素和多粘菌素等治疗。

三、手术处理：耳廓重度肿胀或已成波动的化脓性软骨膜炎，软骨可能破坏者，手术应在全麻下施行，彻底清创除去病变组织和不健全的软骨。

治疗结果 本组74例系较严重耳廓化脓性软骨膜炎。其中6例正值急性化脓期，经紫花地丁软膏涂敷和抗菌素的应用，避免了手术。其余病例施行1~2次手术，遗留耳廓轻重不同的变形。其中5例化脓已

波及全耳廓，用两瓣法清创治疗，获得较满意的效果。

体会 紫花地丁软膏适用耳廓化脓性软骨膜炎的各期。对急性软骨膜炎尚未化脓或化脓范围尚小者，软膏涂敷患处，每日2~3次，可促进吸收消散而痊愈。其中有耳廓红肿、疼痛剧烈、经软膏涂敷治疗后，局部炎症消退，达到治愈。本组病例半数以上患者皮肤溃破，软骨坏死或已作过多次切开排脓，长时期不愈而转来的。入院后经局部软膏涂敷结合清创和抗菌素使用，获得缩短病程、缓解耳廓变形的显著效果，比单用西医治疗效果优异。

其次手术应注意在脓肿最明显部位作纵形切口。范围小者只切一个口，如脓肿波及大部耳廓时，并行作两个切口，禁忌横切。应保持耳轮边缘完整，以免影响血流供应和防止变形。对多次清创、周围形成瘢痕者，只需在病变部切开排脓，碘仿纱条填塞脓腔，外敷软膏。对全耳廓波及的采用两瓣法，造成一个形似张开的蚌壳组织腔，彻底清创，用2.5%碘酒涂擦脓腔，生理盐水冲洗后，再以蘸有抗菌素的薄纱布放于两瓣之间，加以包扎。隔日换药，炎症消退，将皮肤边缘对合包扎，借以重建耳廓外形。

X-Ray Research of Gastro-Entero-Functional Examination for the Deficiency Syndrome of Chronic Bronchitis

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This paper reports results from GI examination of the barium meal in 123 cases of chronic bronchitis and 20 cases of healthy subjects as control. The results obtained have shown that abnormality in the GI tract for the patients with Qi deficiency in the lung is insignificant. However, patients with Yang deficiency in the spleen and kidney have quite a few varied abnormal phenomena: retention of moderate quantity of gastric juice in the empty stomach; folds of the gastric membrane being thickened; gastric hypotension; decrease in speed, number and frequency of the gastric peristalsis wave; and prolongation of empty period in the stomach and the intestine. However, colon's motor function is increased. This may explain pathologically why patients with Yang deficiency in the spleen and kidney appear to possess symptoms typical of the digestive system. (Original article on page 225)

Observations on Cerebral Functions in the Aged

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This paper tries to provide simple methods and parameters for the prevention of aging. We have tested nearsighted visions, auditory function, transient memory of various shapes of drawings and function of extrapyramidal system (tremor of hands) in 53 healthy persons aged over 60. 121 healthy persons below 60 were grouped according to their age scale as controls. Our study has indicated that the functions mentioned above decreased markedly over 50 years of age. In those over 60, they had a negative correlation with the increase of age. These results suggest that the prevention of the regression of cerebral functions should be started at the age of 50. Because of the waning of the kidney in most of the aged, which is the main cause of regression of the cerebral functions, it is reasonable to replenish vital energy or essence of the kidney for the prevention of regression of the cerebral functions. (Original article on page 227)

Analysis of Blood Flow Dynamics of Taut Pulse and Slippery Pulse

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Examination of the radial pulse has been one of the important items of clinical diagnosis in TCM. The physiological and pathological implications of the radial pulse have not been fully studied until recent years. We have reported the establishment of a mathematical model according to non-linear elastic chamber hypothesis and derivation of the relative equations for the stroke volume of the heart (SV), the total peripheral resistance (TPR) and arterial compliance (Co) from the pulse wave form by using strain gauge method and impedance rheogram.

In this clinical study, 28 normal pulse, 32 slippery pulse of pregnancy, and 47 taut pulse of hypertension were investigated. A comparison between slippery pulse was classified according to hardness into three grades, namely 1, 2 and 3 respectively. It was found that the predicrotic pulse wave of the taut pulse ascended with increasing hardness, whereas in the case of slippery pulse, the predicrotic pulse descended. The higher the taut pulse, the greater the increase of TPR, arterial elastic modulus and the decrease of the stroke volume. This turned out opposite in the case of slippery pulse.

Animal experiment in dogs has demonstrated that infusion of nor-epinephrine, a vasoconstricting agent, induced a pulse pattern similar to taut pulse, while *viscum coloratum*, a vasodilating agent, induced a pulse pattern similar to slippery pulse. (Original article on page 232)

A Preliminary Study of Internal Heat Due to Deficiency of Yin — The Sodium Inhibitory Action of Anemarrhena Rhizome in Vivo

Chen Ruiqun (陈锐群), et al

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It was mentioned in our previous report that a kind of saponin from *Anemarrhena Rhizome* had been isolated. The saponin and its hydrolytic product, sapogenin, are potential inhibitors of sodium pump in vitro. In this paper, the sodium pump inhibitory action of the sapogenin in vivo is reported. Eighteen rats were divided into three groups—control, thyroxine group and thyroxine plus sapogenin group. The duration of drug administration was three weeks. Then the animals were killed and the sodium pump activity of four organs (liver, kidney, the mucous membrane of the small intestine and brain) were measured. The results revealed that the activity of the three organs (liver, kidney and the mucous membrane of the small intestine) were markedly induced by the thyroxine and the induced enzyme can be inhibited totally by the sapogenin in vivo. Significances of the result are discussed.

(Original article on page 235)