

A MODEL TO QUANTIFY DISEASE STATE BASED ON THE AYURVEDIC CONCEPT OF TRIDOṢA

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ABSTRACT

The ancient Indian medical system of Ayurveda revolves around the concept of tridosha namely vata, pitta and kapha. The disturbance in the steady state of these three factors is said to be the starting point of the development of diseases. Even though the diseases and their associated symptoms are well-described in this medical system, no mention is directly made in the basic texts about the quantification. We offer here a specific protocol to quantify a disease in terms of Ayurvedic principles.

INTRODUCTION :

Development of a model to quantify disease state as well as the potency of a drug is always an open challenge in medical research. This problem is well appreciated and overcome in Western medicine, where diseases and drugs are studied in compartmentalised models.¹ In the ancient Indian medical system of Ayurveda also compartmentalisation is used to understand the disease state. Here the progress was made on the basis of three conceptual

compartments known as tridoṣa, dhātu and mala which are further subdivided and interlocked with each other.

THE THREE CONCEPTUAL COMPARTMENTS :

According to the doctrine of Ayurveda vāta, pitta, and kapha, collectively called tridoṣa are the three omnipresent factors, humours or balancing forces responsible for the regulation of life processes². The human body is made of seven tissue

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elements called dhātu (rasa = tissue fluid, rakta = blood, māṃsa = muscle, medas = adipose tissue, aṭhi = bone, majjā = bone marrow and śukra = reproductive element) and their waste products known as mala (purīṣa = faeces, mūtra = urine and sveda = sweat). A simple model diagram illustrating the Ayurvedic concept of the human body is provided in Fig. 1. The communication between the tridoṣa, dhātu and mala is believed to be two-way as shown in the figure. When vāta, pitta and kapha are in undisturbed steady state, the other two conceptual compartments will also be in undisturbed steady state and the body is said to be in perfect health. Disease is said to be a result of their imbalance.³

NEED FOR A QUANTITATIVE MODEL :

The theory of tridoṣa is inextricably connected with the diagnosis and treatment of diseases. Even though the diseases and associated symptoms are well described in this ancient system of medicine, no mention is made about the quantification of diseases and drug potencies. Moreover, majority of Ayurvedic treatises explain the theory and practice of the system in a series of abstract quatrains. This unique style of presentation obviously leaves much for the student to deduce from the data. Though the qualities, functions and signs of activity of vāta, pitta and kapha are clearly mentioned^{3,4}, intricacies of inter-relationships are

to be derived from interpretation and synthesis of the quatrains. The structuralism associated with Sanskrit vocabulary is also a formidable obstacle. Hence, we made a novel attempt to offer a simple model named as V:P:K code, so that a disease can be quantified in terms of Ayurvedic principles. In this communication vāta (V) pitta (P), and kapha (K) of V:P:K: code are represented with Roman type abbreviations whereas, vāta (V), pitta (P) and kapha (K) of tridoṣa are denoted with italicised letters in lower case.

THE MODEL :

In the celebrated Ayurvedic texts Aṣṭāṅgahṛdaya⁴ and Aṣṭāṅgasamgraha⁵ various symptoms and signs and their association with increase or decrease of tridoṣa, dhātu and mala are described. We have transformed all these symptoms and signs in to *v*, *p* and *k*. Here we made a basic assumption that increase or decrease of *v*, *p* and *k* associated with each symptom (and sign) is by one unit with positive or negative sign respectively. This exercise furnished with V:P:K code of each symptom and sign at the humoral level (Table. 1).

As any disease is a result of combination of symptoms and signs, we postulate that variations of *v*, *p* and *k* at all levels linearly add to one another and exert their resultant influence.

Body (v, p, k) = tridoṣa (v, p, k) + dhātu (v, p, k) + mala (v, p, k) (1)

Thus, the V:P:K code of a disease state can be derived from the V:P:K codes of constituent symptoms and signs by the linear summation principle (see Appendix). V:P:K (disease) = \sum V:P:K (symptom) (2)
A calculation protocol to derive V:P:K code of a disease is exemplified using kapha-related heart disease (kapha hṛdroga) (Table 2).

TEST DATA SET :

Ayurvedic nosological data on vātaja (vāta-dominant), Pittaja (pitta-dominant) and kaphaja (kapha-dominant) groups of sixtythree important diseases were considered to verify the model.⁶ V:P:K code for each disease was derived according to the protocol described above and the codes are listed in Tables 3–5. The validity of the code was tested through correlation study using regression analysis with least square method and the results are cross examined with the tenets of Ayurveda.

VERIFICATION OF THE MODEL CORRELATION STUDY :

In Ayurveda it is often mentioned in veiled statements that the relationship between vāta and kapha is analogous to that of air and water towards fire.⁷ From this it can be deduced that vāta and kapha counteract each other's influence. An

examination of the V:P:K code offers evidence for such antagonistic properties. Interestingly enough, the V and K components of the code are in overall agreement with what is described in Ayurveda, thus giving strength to the concept of linear summation.

In the first examination, the correlations in vātaja (Table 3) and pittaja (Table 4) groups of diseases were found to be less significant. On closer examination however, the vātaja group of diseases is found to be divisible into two subgroups (first sub group includes Nos. 1–4, 6, 11, 12, 15–17, 19 and 20; second sub group includes Nos. 7, 10, 13, 18 and 21 of Table 3) with vātaja tṛṣṇā vātaja udara, vātaja śopha and vātaja arśa as outliers. The correlations between V and K of vātaja group of diseases are shown as follows :

First subgroup

$$V (\text{vātaja}) = 4.560 - 0.223 K (\text{vātaja})$$

$$n = 12, r = -0.786, s = 0.806, F = 16.20$$

$$(F = 10.00) \quad (3)$$

.99

Second subgroup

$$V (\text{vātaja}) = 0.693 - 0.657 K (\text{vātaja})$$

$$n = 5, r = -0.912, s = 0.980, F = 14.88$$

$$(F = 10.10) \quad (4)$$

.95

Here, n is the number of data points; r is the correlation coefficient, s is the standard deviation of the estimate

and F is the ratio between the variance of calculated and derived code values.

In the case of pittaja group of diseases (Table 4), pittaja kāmālā, pittātīsāra, pittaja tṛṣṇā, pānavibhrama, pittaja visarpa, pittaja masūri and jvara (Nos. 3, 4, 7-10 and 13 of Table 4) were found to be the outliers. After exclusion of these seven diseases, in pittaja group also a reasonable correlation was found to exist between V and K as shown below :

$$V (\text{pittaja}) = 2.089 - 0.298 K (\text{pittaja})$$

$$n = 14, r = -0.775, s = 1.116, F = 18.00$$

$$(F = 9.33 \quad (5))$$

.99

However, the best agreement between V and K was found in kaphaja group of diseases (Table 5) as shown in equation 6 (Fig.2).

$$V (\text{kaphaja}) = 1.959 - 0.260 K (\text{kaphaja})$$

$$n = 21, r = -0.865, s = 1.450, F = 56.37$$

$$(F = 8.19 \quad (6))$$

.99

In all the equations presented here, the coefficient of K is negative and indicates the increase of V with decreasing K and *vice versa*. This finding is in agreement with the evidences from Ayurveda.

EVIDENCES FROM LITERATURE :

According to Ayurveda, matter is attributed to possess six basic taste

modalities viz., sweetness (madhura), sourness (amla), saltishness (lavaṇa), pungence (kaṭu), bitterness (tikta) and astringency (kaṣāya), each having specific effects on tridoṣa. While sweetness and saltishness increase kapha, they decrease vāta and decrease kapha^{5,8}. Thus the effects of taste on tridoṣa provide evidence for the inverse relationship between V and K.

The seven dhātu which form the bulk of the body are interconvertible among themselves. Rasa transforms sequentially into rakta, māṃsa, medas, asthi, majjā, śukra and finally cause the circulation of a 'substance' named ojas which has qualities similar to those of kapha. However, increase of vāta activity due to drugs and psychological factors causes diminution of ojas. Simultaneously, all the kapha associated qualities of the body give way to those of vāta.⁵

Insomnia and hypersomnia which are related to increased activities of vāta and kapha respectively, are usually considered as criteria for gauging the functional status of vāta and kapha in the body^{4,5}. Other features of these abnormal states and Ayurvedic information on the circadian and circannual rhythms of tridoṣa^{3,4,9} also favour the model emerging from the present study.

The inverse relationship between vāta and kapha forms the basis for the

tissue building (bṛmhaṇa) and lightening (langhana) styles of Ayurvedic therapy. Matter rich in the elements of 'water' (ap) and 'earth' (pṛthvī) is roborant (kapha-increasing) and leaning (increase in vāta) is attributed to substances having a predominance of the elements of 'fire' (agni) 'air' (vāyu) and 'sky' (ākāśa). The former group is 'heavy' and the latter is 'light'. Using combinations of appropriate food, measures and drugs kapha is increased in vāta-dominant diseases and vāta activity is stimulated in disorders stemming from increased kapha^{4,10}.

SIGNIFICANCE :

The results of this study offer support and validity to the concept of linear summation whereby a simple model is offered to understand the overall vitiation of vāta, pitta and kapha in terms of a V:P:K code. The limited success in the case of vātaja and pittaja groups of diseases is not yet clear. However, the findings are qualitatively in accordance with Ayurvedic theory. The strength of the present investigation lies in the fact that for the first time a quantification model for this ancient system is offered and a qualifying numerical code is derived for disease states in terms of internal characteristics.

Inter-relationship between diseases is not uncommon in Ayurveda¹¹. Correspondingly, a single formulation is often prescribed for a variety of

ailments, the glaring example being Nārasimha cūrṇa which is indicated in nearly 180 diseases in Cakradatta¹². The present model also offers support to the practice of administering one formulation for a large number of diseases.

Though a definite relationship exists between vāta and kapha, Ayurvedic literature does not suggest uniform relationship between vāta and pitta and kapha and pitta. The present investigation is also in agreement with this medical philosophy.

The added advantage of the presented model is that the disease data matrix can be used in generating computer based disease maps which may find wider application in pharmacology and experimental and clinical medicine.

CONCLUSIONS :

Demonstration of the existence of a relationship between the components of tridoṣa obviates the need for ascertaining the identity of these factors. Due to the mysticism of Sanskrit literature, scholars have given varying interpretations, many of them sharing a common ground. Dwarkanath is of the opinion that the activities of vāta are very much akin to those of the nervous system. He equates pitta with thermoregulatory mechanisms and kapha with reproductive and immunological

processes¹³. Nevertheless, considering many of the views expressed¹⁴⁻¹⁶ it is logical to suggest that vāta, pitta and kapha represent respectively, the destructive, regulatory and creative forces operating in a biological system. It is hoped that the V:P:K code will prove instrumental in understanding the finer aspects of Ayurveda, the significance of which in

global health care is increasingly being discussed in recent times¹⁷⁻²⁰.

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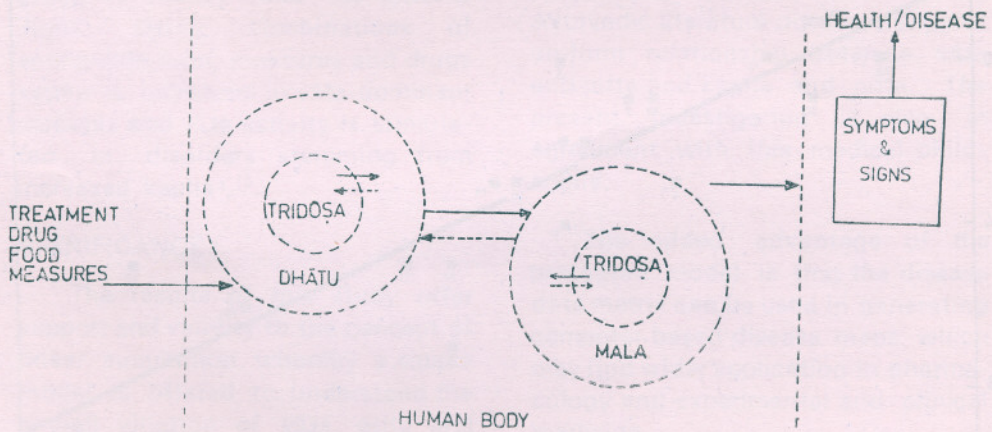


FIG. 1

Flowchart showing the relationship of tridoṣa, dhātu and mala among themselves as well as with symptoms and therapy. Tridoṣa, dhātu and mala are shown in circles to signify their ubiquitous distribution. Solid arrows indicate direct influence and broken arrows denote indirect influence. Discontinuous lines and circles symbolise their ability to interact with surroundings.

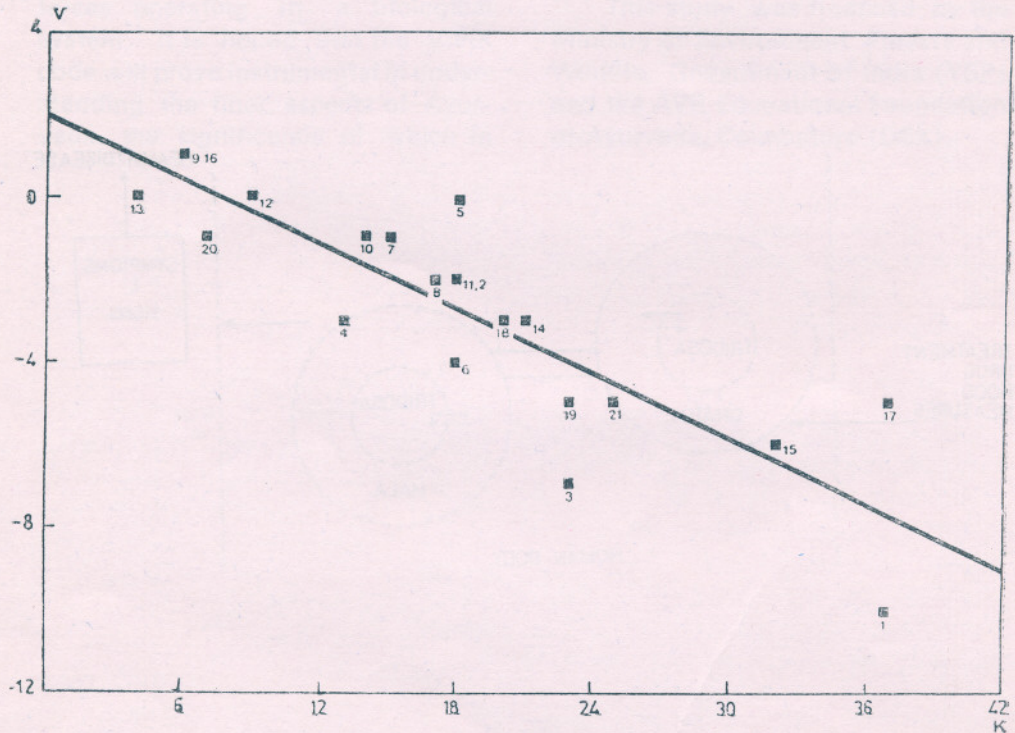


FIG. 2

A graphical representation of the inverse relationship between estimates of vāta (V) and kapha (K) in kaphaja group of diseases (Table 4). The straight line passing through the points indicates the best fit derived through least square method.

TABLE 1

Tridoṣa, dhātu and mala activities, their associated symptoms and signs and corresponding V:P:K codes

Component	Symptoms and signs	V:P:K Code symptom/sign
(1)	(2)	(3)
I tridoṣa		
vāta +	leaning, black colour, increased motor activity, "feeling of pulsations", interest in warmth, insomnia, constipation, flatulence, borborygmi, inability to concentrate, fear, anxiety	1 : 0 : 0
vāta —	anorexia, nausea, disinterest to talk or work, decreased libido, indigestion	-1 : 0 : 0
pitta +	yellowing of skin, tiredness, interest in coolness, burning sensation, bitter taste in mouth, fainting, anger	0 : 1 : 0
pitta --	coolness, anorexia, roughness of organs, shivering	0 : -1 : 0
kapha +	white colour, coolness, obesity, lassitude, hypersomnia, dyspnoea, cough	0 : 0 : 1
kapha—	giddiness, insomnia, pricking pain, lightening of joints	0 : 0 : -1
II dhātu		
rasa +	increased salivation, inability to discriminate tastes, disinterest towards sweetness, signs of kapha +	0 : 0 : 1
rasa —	shivering, leaning, pricking pain, "feeling of pulsations", dyspnoea on mild exertion	0 : 0 : -1
rakta +	skin diseases, burning of eyes, red colour, signs of pitta +	0 : 1 : 0
rakta —	roughness of skin, interest in sourness and coolness	0 : -1 : 0

(1)	(2)	(3)
māṃsa +	tumours, obesity, signs of kapha + and rakta +	0 : 0 : 1
māṃsa —	leaning, roughness of organs, tiredness	0 : 0 : -1
medas +	prodromes of diabetes mellitus, obesity, signs of kapha +, rakta + and māṃsa +	0 : 0 : 1
medas —	feeling of emptiness of joints, roughness of organs, leaning, dyspnoea, interest to consume fatty meat, signs of māṃsa —	0 : 0 : -1
asthi +	increased growth of bones	-1 : 0 : 0
asthi —	breaking of teeth, nails, hair etc., roughness, pricking pain in bones	1 : 0 : 0
majjā +	reddishness and heaviness of eyes and organs, ulcers in joints	0 : 0 : 1
majjā —	feeling of emptiness of bones, giddiness, blurred vision	0 : 0 : -1
śukra +	increased libido, pathology of prostate	0 : 0 : 1
śukra —	dyspnoea, loss of stamina, dryness of mouth, anaemia, infertility	0 : 0 : -1
III mala		
purīṣa +	stomach pain, borborygmi, heaviness of body	0 : 0 : 1
purīṣa —	flatulence, abdominal pain, pain in the flanks, precordial pain	0 : 0 : -1
mūtra +	swelling and pricking pain in bladder, diuresis	0 : 0 : 1
mūtra —	dryness of mouth, dysuria, haematuria	0 : 0 : -1
sveda +	hyperidrosis, itching, body odour	0 : 1 : 0
sveda —	loss of hair, cracking of skin, roughness, hypoidrosis	0 : -1 : 0

* Rasa, mamsa medas, majja, sukra, purisa and mutra have predominance of kapha. Piti is more in rakta and sveda and vata abounds in asthi. The increase of all dhatu except asthi is followed by concomittant increase of the humour present in it. However, when asthi increases vata decreases and *vice versa*.

TABLE 2

Step-wise derivation of V:P:K code of kapha-dominant heart disease (kapha hṛdroga)

Symptom/sign	V:P:K Code												linear Summation (symptom)
	tridoṣa			dhātu						mala			
	vāta	pitta	kapha	rasa	rakta	māmsa	medas	asthi	majjā śukra	puriṣa	mūtra	sveda	
Heaviness in cardiac region	-1:0:0		0:0:1										1:0:1
Heaviness of head			0:0:1										0:0:1
Cough	-1:0:0		0:0:1	0:0:1		0:0:1	0:0:1						-1:0:4
Lowering of "abdominal fire"	-1:0:0	0:-1:0	0:0:1	0:0:1	0:1:0	0:0:1	0:0:1						-1:0:4
Nausea	-1:0:0		0:0:1	0:0:1		0:0:1	0:0:1						-1:0:4
Hypersomnia	-1:0:0		0:0:1	0:0:1		0:0:1	0:0:1						-1:0:4
Adynamia	-1:0:0		0:0:1	0:0:1		0:0:1	0:0:1						-1:0:4
Fever		0:1:0											0:1:0
Anorexia	-1:0:0	0:-1:0		0:0:1									-1:-1:1
Stiffness of body		0:-1:0		0:0:-1									0:-1:-1
Sweetness in mouth			0:0:1										0:0:1
Linear summation (humours)	-7:0:0	0:-2:0	0:0:8	0:0:5	0:1:0	0:0:5	0:0:5						-7:-1:23 (disease)
Disease V:P:K code :	-7:-1:23												

TABLE 3

Hypothetical V:P:K code for some vātaja group diseases

S. No.	Name of the disease	V:P:K Code (disease)		
		V	P	K
(1)	(2)	(3)	(4)	(5)
1 ^a	Vātaja hṛdroga (heart disease)*	5	3	-3
2 ^a	Vātaja jvara (fever)	7	-1	-9
3 ^a	Vātaja grahaṇī (diarrhoea)	7	-1	-6
4 ^a	Vātaja kāsa (cough)	6	2	-3
5	Vātaja tṛṣṇā (thirst)	7	6	-3
6 ^a	Vātaja visarpa (spreading suppurations)	4	4	5
7 ^b	Vātaja masūri (pox)	4	2	-6
8	Vātaja udara (abdominal disease)	7	0	-1
9	Vātaja śoṣha (oedema)	7	-3	-3
10 ^b	Vātaja granthi (tumour)	2	1	-1
11 ^a	Vātaja chardi (emesis)	6	0	-3
12 ^a	Vātaja pradara (menstrual disorder)	7	5	-9
13 ^b	Vātaja aśmari (urolithiasis)	-1	0	1
14	Vātaja arśa (haemorrhoids)	7	-4	6
15 ^a	Vātaja pāṇḍu (anaemia)	6	-5	-10
16 ^a	Vātaja madātyaya (alcoholism)	4	1	1
17 ^a	Vātaja vidradhī (abscess)	5	-1	-5
18 ^b	Vātaja vṛaṇa (sore)	4	-3	-5
19 ^a	Vātaja bhagandara (anal fistula)	4	0	-3
20 ^a	Vātaja visphoṭa (exanthema)	4	5	-1
21 ^b	Vātaja pīnasa (rhinitis)	3	-2	-2

a = first subgroup of vātaja diseases, b = second subgroup of vātaja diseases.

* = the words given in parentheses are the nearest equivalents of the Sanskrit words.

TABLE 4

Hypothetical V:P:K code of some pittaja group diseases

S. No.	Name of the disease	V:P:K Code (disease)		
		V	P	K
(1)	(2)	(3)	(4)	(5)
1	Halīmaka (chlorosis) *	1	9	6
2	Pittaja śopha (oedema)	3	13	1
3 ^a	Pittaja kāmālā (jaundice)	-2	10	6
4 ^a	Pittātisāra (dysentery)	2	9	7
5	Pittaja pariṇāmasūla (peptic ulcer)	0	4	2
6	Pittaja kāsa (cough)	-1	9	8
7 ^a	Pittaja tṛṣṇā (thirst)	2	10	10
8 ^a	Pānavibhrama (alcoholism)	3	6	6
9 ^a	Pittaja visarpa (spreading suppurations)	8	14	7
10 ^a	Pittaja masūri (pox)	-2	7	-3
11	Pittaja hṛdroga (heart disease)	3	13	10
12	Pittaja granthi (tumour)	1	3	-2
13 ^a	Pittaja jvara (fever)	5	14	3
14	Raktapitta (haemorrhages of obscure origin)	1	7	1
15	Pittaja grahaṇī (diarrhoea)	-2	7	10
16	Pittaja chardi (emesis)	3	9	1
17	Pittaja pradara (menstrual disorder)	3	3	-3
18	Raktagulma (haematometra)	2	5	0
19	Pittaja udara (abdominal disease)	1	13	9
20	Pittaja śūla (colic)	4	8	-4
21	Pittaja gulma (abdominal tumour)	1	7	2

* = the words given in parantheses are the nearest equivalents of the Sanskrit words.

a = not included in deriving equation 5

TABLE 5

Hypothetical V:P:K code of some kaphaja group diseases

S No.	Name of the disease	V:P:K code (disease)		
		V	P	K
(1)	(2)	(3)	(4)	(5)
1	Kaphaja jvara (fever)*	-10	-3	37
2	Āmasūla (colic due to indigestion)	-2	0	18
3	Kaphaja hṛdroga (heart disease)	-7	-1	23
4	Āmavāta (rheumatism)	-3	0	13
5	Medas (obesity)	0	12	18
6	Kaphaja pradara (menstrual disorder)	-4	0	18
7	Āmājirṇa (indigestion)	-1	0	15
8	Kaphaja kāsa (cough)	-2	-2	17
9	Urusthambha (stiffness of legs)	1	-1	6
10	Udarda (erythema)	-1	10	14
11	Kaphaja śopha (oedema)	-2	-1	18
12	Kaphātisāra (dysentery)	0	0	9
13	Āmātisāra (a type of dysentery)	0	1	4
14	Kaphaja grahanī (diarrhoea)	-3	5	21
15	Kaphaja chardī (emesis)	-6	-1	32
16	Kaphaja tṛṣṇā (thirst)	1	3	6
17	Kaphaja visarpa (spreading suppurations)	-5	-2	37
18	Kaphaja masūri (pox)	-3	-1	20
19	Kaphaja udara (abdominal disease)	-5	-2	23
20	Kaphaja granthi (tumour)	-1	-3	7
21	Kaphaja gulma (abdominal tumour)	-5	-3	25

* = The words given in parantheses are the nearest equivalents of the Sanskrit words.

APPENDIX

If S_i is a symptom (or sign), then S_i can be expressed as :

$$(V_{ij} : P_{ij} : K_{ij})_{1 \times 11} \tag{7}$$

where j is 1 to 11 are tridoṣa (1), dhātu (rasa (2), rakta (3), mām̄sa (4), medas (5), asthi (6), majjā (7), śukra (8)) and mala (purīṣa (9), mūtra (10), sveda (11)), respectively. Hence, a symptom can be expressed as a unique row of elements, a row vector. Expression (7) can be rewritten as follows :

$$\left(\begin{matrix} V \\ ij \end{matrix} \right)_{1 \times 11} : \left(\begin{matrix} P \\ ij \end{matrix} \right)_{1 \times 11} : \left(\begin{matrix} K \\ ij \end{matrix} \right)_{1 \times 11} \tag{8}$$

Here, summation over j shall provide the V:P:K code of the symptom S_i , that is

$$\sum_{j=1}^{11} V_{ij} : \sum_{j=1}^{11} P_{ij} : \sum_{j=1}^{11} K_{ij} \tag{9}$$

A disease D can be viewed as resultant of combination of various symptoms and signs. Hence, the disease D can be represented as a column vector of symptoms/signs.

$$\left(\begin{matrix} S \\ i \end{matrix} \right)_{m \times 1} \tag{10}$$

Summation over i in expression (10) shall provide the V:P:K code of the disease D, that is,

$$\sum_{i=1}^m \left(\sum_{j=1}^{11} V_{ij} : \sum_{j=1}^{11} P_{ij} : \sum_{j=1}^{11} K_{ij} \right) \tag{11}$$

Expression (10) can be rewritten in the following way :

$$\left(\begin{matrix} v & P & K \\ ij & ij & ij \end{matrix} \right)_{m \times 11} \tag{12}$$

that is, the disease D can be expressed as an array of $m \times 11$ elements, a rectangular matrix. Summation over j in expression (12) shall provide a unique row vector, similar to expression (7), for the disease D, that is,

$$\left(\sum_{i=1}^m V_{ij} \quad : \quad \sum_{i=1}^m P_{ij} \quad : \quad \sum_{i=1}^m K_{ij} \right) \quad (13)$$

1×11

Summation over j in expression (13) shall again provide the V:P:K code of the disease D as in expression (11).

Here we attempted to provide different expressions of disease in terms of basic V, P and K; the simplest being the V:P:K code with one entry each for V, P and K and the most complex being $m \times 11$ array of elements for each V, P and K. Each expression has its own application. For example, the simple V:P:K code can serve as a measure of derangement of constituent humours, whereas the complex $m \times 11$ array of elements may provide a disease map or signature, in addition to many other uses.

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सारांश

आयुर्वेदीय त्रिदोष सिद्धान्त पर आधारित
रोगावस्था के परिमाण निर्धारणार्थ एक नमूना

— वाई. एस. प्रभाकर
— डी. सुरेश कुमार

प्राचीन भारतीय चिकित्सा पद्धति आयुर्वेद त्रिदोष सिद्धान्त पर आधारित है। यह त्रिदोष—वात, पित्त तथा कफ है। इन तीन घटकों की समावस्था में आई विषमता ही रोगों को उत्पत्ति का कारण होती है। यद्यपि रोगों एवं उनके लक्षणों का उल्लेख इस चिकित्सा पद्धति में उपलब्ध है तथापि उनके परिमाणार्थ कोई संदर्भ मूल ग्रन्थों में नहीं मिलता। यहां पर आयुर्वेदीय सिद्धान्तों के अनुसार रोग परिणाम निर्धारण हेतु एक विशिष्ट संलेख प्रस्तुत किया गया है।