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Thank you Mr. Newton

Paradigm Shift in stroke rehab has more than one facet.

- Please note; all under gray highlight is clinically practiced in stroke rehabilitation today……
  All in blue text is paradigm shift practiced in Vasa Concept, with clinical experience based empirical understanding of underlying mechanisms behind abnormal sensory motor symptoms.

1. **Understanding that for safety reasons brain automatically transfers control on centre of mass [COM] safety to good side of the body and withdraws it from paretic side with instant cortical plasticity.**
2. **Understanding the goal of the brain and its priority. Make brain's priority as a primary goal in therapeutics.**
3. **Goal in therapeutics is to prioritize safety of the brain using paretic body in order to re-reorganize self-organized brain which is inclined to prioritize safety exclusively using good limbs.**
4. **Understanding that lesion and paresis 'switches off' the distant subcortical postural circuits in non-lesioned hemisphere, reflected empirically from the fact that small lesion makes half body paretic.**
5. **Recognizing that poor afferent inflow from paretic body makes brain to endorse 'switch off' to economize on energy needs.**

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6. **Understanding that lesioned brain shuts down and 'switches off' distant areas for safety reasons, safety being a priority when paretic body cannot control COM safety.**
7. **Recognizing that to 'switch on' the subcortical postural connectivity in non-lesioned hemisphere is critical and imperative for true recovery of lost control.**
8. **Voluntary control in paretic body can emerge as a byproduct by restoring automatic control on COM safety using paretic body as against relearning of voluntary control with repetition and forced use or stimulating cortical plasticity with high tech machines.**
9. **Recognizing that critical need in therapeutics is to promote subcortical plasticity in subcortical, cerebellar structures in non lesioned hemisphere to make paretic body capable to control COM safety on priority basis.**
10. **Targeting voluntary control as primary goal promotes compensatory control and prevents possibilities for true recovery.**
11. **Understanding and implementing clinically 'What not to do' with the body and with the brain is highly indispensable to prevent negative plasticity and compensatory motor control in presence of gravity.**
12. **Understanding 'What to do', how to exploit gravity (Ground Reaction Forces) instead of fearing it, exploit passive mechanics and interactive forces in linked body, exploit passive inertial body mass for safety of COM on Newtonian principles, aligning and realigning multi linked body in special postures inorder to re-reorganize brain with positive plastic changes for true sensory-motor recovery with therapeutics in Vasa Concept.**

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1. Shift from palliative impairment oriented, symptom based treatment [1] and (re)learning how to do activities in presence of lost skills to…..

   Channelizing true sensory-motor recovery by re-reorganizing the self-organized brain by prioritizing its safety goal.

   - For safety reasons selforganized plastic brain transfers control on COM safety exclusively to good non-paretic body. Vasa Concept helps self-organized brain to re-reorganize by by promoting muscles

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of paretic trunk, UL and LL to control COM safety automatically. Therapy exploits lesioned brain and paretic body itself as a window to the brain instead of considereing lesioned brain as a problem.

2. Shift from promoting compensatory control [2] to…..

Promoting true recovery of lost sensory motor control by promoting paretic body to control and restore COM safety.

-  Use of cane, crutch, any external device for safety in standing and walking compensates for paretic LL for support of inertial mass of the body. Cane, or tripod also **transfers control on COM safety from paretic LL to good UL.** External support also reduces loading of the paretic LL and pushes the COM further away from paretic side of the body.
- **Good UL compensates for the paretic LL** for safety of COM and switches the safety control from both sides of body to unilateral control using good side UL nad LL. This is one of the major causes why recovery turns negative.
- **Experience dependent plastic changes** from constant use of good side of UL and LL for safety of COM results into morphological and structural changes in muscles and in postural neuronal circuits ***(of non-lesioned hemisphere, cerebellum and spine).*** contracture in connective tissue, fascia and muscles helps bind paretic body with good body at the central axis.
- Contracture in intrinsic muscles of spine and fascia on paretic side of the spine turns multisegment spine into single unit with help from plastic changes in vermis of cerebellum which receives imbalanced information from two sides of trunk. It is not out of place to specuate that vermal part of cerebellum does this gesture to bind paretic body to good body to enable easy towing  when spine turns stiff like one unit in place of multi segmented unit.
- **Inability of paretic body to lead and control COM safety** makes self-organizing brain to continue to endorse use of good body without allowing exchange of dominance between paretic side and good side making true recoveory very difficult.

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3.   Shift from focusing on paretic muscles by treating muscle spasticity [3] with inhibition and muscle weakness by strengthening [4] it to…..

   Radical reorientation in thinking to treat the lesioned brain itself and re-reorganize it by exploiting paretic body and lesioned brain as the best available tools for true recovery of lost control.

   - Lesioned brain and paretic body of the stroke patient is not only the best tools possible, rather they are the only tools capable to re-reorganize self organized barin. *(available for free compared to any man made high tech tools have huge limitations and cannot channelize recovery)*.

4. Shift from cortically influenced motor re-learning [5] of volitional movements and aiming for segmental control to…..

   Therapeutically aiming for sub-conscious automatic control on safety of global COM with muscles of paretic upper limb, lower limb and torso.

   - Voluntary control is not the goal or the priority of the brain post lesion.
   - Therapeutics can achieve voluntary control and cognitive, perceptual, speech abilities as a byproduct in therapeutics with paretic body trained to take care of control on global COM safety automatically, spatio-temporally effectively.
   - Prioritizing safety of COM repeatedly, using paretic body 'switches on' distant distributed 'switched off' connections of **non-lesioned hemisphere** including cerebellar connectivity.

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5. Shift from compensatory control [6] (maladaptive negative) plasticity to…….
   Restoration of lost control and true sensory motor recovery (positive plasticity).
   - Use of vision and touch is cortical compensation with automatic sensory reweighting for subcortical sensation proprioception. It is negative plasticity and prevents restoration of lost control.
   - Restoring Use of subcortical sensation like proprioception for automatic safety and balance carves the niche for true recovery.
6. Shift from long standing understanding about spasticity, as uninhibited facilitation and reflex contraction of paretic muscle [7] from central nervous system (CNS) lesion when limb is moved passively by researcher while patient is lying on table to……
   Clinician's experience of movements outside laboratory in real life situation and understanding many factors internal as well as external that influence birth of spasticity can also help to get rid off it completely.
7.  From thinking of spasticity as a velocity dependent resistance to stretch, where a lack of cortical inhibition

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results in subcortical over activity and uninhibited facilitation [8] in lesioned hemisphere to……

Spasticity is born as a solution for safety of COM by self-organizing brain in an attempt to bring in homeostasis of forces between within and outside when large muscles of body get paretic, flail and weak and are not able to generate enough forces within, to combat external invariant gravitational force that poses threat to safety of COM.

- It is brain's most economic way of handling gravitational threat from outside to COM safety
- Increased degrees of freedom is a threat from within to COM safety from paresis.
- Spasticity restricts degrees of freedom by offering resistance to move to give indirect safety to COM.
- Brain exploits anticipatory postural circuits for spastic contraction in a group of muscles with slightest threat to COM safety. Grouping remains invariant thereby gives indirect safety.
- Brain also takes advantage of inertial segmental body mass to trigger continuous reflex stretch contraction in muscles that could take care of segmental inertial mass against gravity as in antigravity muscles like biceps and quadriceps.
- When good body does all voluntary actions and exclusively leads as well as controls COM, brain exploits paretic muscles like pectoral and psoas that bind limbs to the torso and lattissimus which binds upper and lower girdle and spine together for easy towing of paretic body which turns a 'FOLLOWER' when good body 'LEADS' uninterruptedly.

8. Shift from thinking about abnormal synergic grouping in paretic limbs as pathological and inevitable [9] in presence of lesion to……

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Why and how problem solving brain exploits interlimb knowledge

and   

Inter limb connectivity through commissural connections and ascending descending connections within the spinal cord to trigger motor neurons of the ventral horn on paretic side to trigger abnormal looking spastic synergic grouping in a chain of paretic muscles irrespective of lesion location!!! *(Why typical signature hemiplegic pattern surface consistently in all stroke victims irrespective of different demographic lesion location)!!*

- Synergic grouping in UL in flexion brings segmental COM closer to central axis in an attempt to refrain it within the limits of stability which gets reduced from poor loading of paretic LL. *(Lower limb influences the UL posture to refrain COM to remain within stability limits).*
- Synergic grouping of flail weak muscles remains invariant which helps COM safety indirectly. Synergic grouping also restricts increased degrees of freedom from paresis and thereby also helps COM safety.
- Invariant synergic grouping in flexion in UL and in extension in LL also reduces risk to safety of COM indirectly by not allowing variability.
- Abnormal Synergic grouping can be prevented from appearing with therapeutics that could restore automatic ability of paretic LL to load itself with inertial body mass of HAT and exploit inter limb knowledge in different postures.

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9.    Shift of therapeutic goal from voluntary control [10] to .....

Focus on maintaining CNS priority and CNS goal; 'Safety of COM' as the primary goal in therapeutics with one critical change and i.e. prioritizing safety using paretic trunk and limbs to help 'switch on' postural centers in non-lesioned hemisphere including cerebellum with huge afferent inflow from paretic limbs and torso.

-  **Key to therapeutic success is in maintaining brain's priority primarily using paretic body to control COM safety**

10. Shift from focusing on individual parts of the body which tend to divide and separate one integrated body into two separate sides e.g. addressing foot drop with foot drop splint [11], wrist finger flexion contracture with static /dynamic splint, shoulder sub-luxation with shoulder sling, etc. which tend to divide the attention of the patient in the mind to be conscious about paretic body and deal with it with special focus and conscious attention to……..

Preventing the body from being divided as two separate entities, paretic and non-paretic.

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-  To make entire body *(paretic and non-paretic)* combined to work as one functionally integrated whole automatically in specially designed postures.
  - *(It is very important not to let two sides of the body get divorced with each other in the mind for true recovery. Mind protects weak side and does not allow the paretic body to take lead in any action).*
  - *(Paretic body being anatomically united to other good side, can become a liability if two sides no longer exchange dominance between each other. It leads to towing of paretic body by good body and vicious circle of abnormal sensory motor symptoms instead of true recovery).*

11. Shift from uninterrupted control on COM safety exclusively with good body and to lead and propel entire body with good side as well as major role played by good body also for voluntary control and in all activities of daily living [12] to…….

    Making paretic trunk and limbs capable of controlling and restoring COM to safety and preparing them to lead and propel the body such that the exchange of dominance between two sides and 'leading' and 'following' depending on the need of the moment is automatically restored.

12.     Shift from, goal to achieve voluntary control in upper limb by constraining movements of good UL and repetition of movement [13] to…….

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Recognizing that UL recovery is completely dependent on capacity of paretic LL to automatically control COM safety. Failing to recognize that spinal interlimb knowledge and exclusive control on COM safety by good limbs makes all chances for recovery on paretic side harder to achieve. Invariant abnormal grouping in muscles do not allow variability and any voluntary action at all.

- First and foremost priority in therapeutics is preventing mal-connections to get established in CNS with birth of invariant pathological synergic grouping in UL.
- Second, promoting 'switching on' of postural centers in non-lesioned hemisphere which gets shut down and 'switched off' with striking of lesion for self safety.
- Third, preventing need for the brain to freeze / resist paretic body segments from moving, and to resist fluid change in global and segmental COM movement for self safety by giving birth to spasticity.
- Prevent anticipatory postural actions exclusively coming from good segments with good body's attempt to safe guard COM with slightest movement of any segment of body.
- Promote paretic muscles to act by moving good body segments when paretic body segments are kept static in specially designed postures to take advantage of safety from passive mechanics of posture that exploit GRFs.
- Modify sub-cortical, cerebellar, and spinal motor output to paretic LL, torso and UL with increased proprioceptive input to spine and cerebellum and thalamus to cortex from paretic torso, LL, and UL in specially designed postures.
- Manipulate inter-limb spinal motor circuits with commissural fibers connecting right side with left side, and descending and ascending motor neurons within the cord from LL to UL and vice versa to prepare arm for voluntary control by making paretic lower limb capable to control and restore COM to safety.

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13.   Shift from forced use of paretic upper limb [14] for activities which are in general mostly unilateral like eating, drinking, combing hair, writing etc. tends to trigger compensatory actions at other joints when forced with paretic UL and are esthetically not pleasing and energetically highly uneconomic to……

Radical reorientation in thinking that recognize that therapeutic goal and goal of the brain cannot be two separate or two different goals. Therapy must aim for the same goal as the goal of the brain. Also one must recognize that most of these actions are in general mostly unilateral so what is most important is that it is carried out without fatigue and is spatio-temporally effective and esthetically pleasing without compensation

- Goal of the brain is safety. Prioritize safety of brain with safety of body COM with one simple but critical change; doing so not with good body as what brain does instantly automatically post lesion with instant plasticity but using paretic UL and LL and torso to control COM safety.
- Prioritizing COM safety with paretic body opens up and facilitates 'switching on' of distributed distant postural connectivity of CNS that got 'switched off ' for safety with onset of lesion.
- 'Switching on' of distributed postural network and re-reorganization of self-organized brain facilitates emergence of voluntary control as a byproduct.

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14.  Shift from supporting the sub-luxated shoulder in a sling [15] moving the shoulder passively for better circulation and giving electrical stimulation to deltoid muscle does not restore selective shoulder control and may still have a risk to develop shoulder-hand syndrome from passive stretch on free nerve endings of capsule to……

Generating support to the subluxated gleno-humeral joint from within by generating ground reaction forces (GRFs) under the elbow or palm in specially designed postures to help Humerus bone to approximate in the Glenoid cavity with co-contraction in many shoulder and elbow muscles to restore sub-luxation permanently from within without precipitating shoulder hand syndrome and shoulder pain   

- Sling prevents automatic postural reactions from UL, critical for inducing contraction in deltoid.

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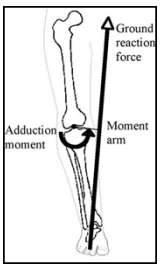
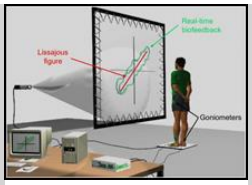
15. Shift from fearing gravity for balance control [16] to……



exploiting gravity to generate GRFs in specially designed postures to trigger internal muscular forces in a chain reaction to counter gravity for safety of local and global COM.

- **'Safety of COM is a priority for all living beings'.**

16. 

Shift from consciously loading the paretic lower limb and voluntarily weight shifting in standing, use of force plates, Biofeedback [17] [18] and verbal commands from therapist to facilitate weight shift to…….

Targeting automatic loading of lower limb by…

-   Making paretic hip strong to sustain weight of head, arms and trunk on paretic hip in basic simple postures like BUDDHA and NAMAZ without letting good trunk and good hip to sustain inertial mass of entire body and compensate for paretic side.

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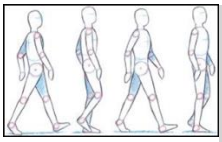
- Exploiting bilateral innervation of trunk muscles in special postures to force paretic trunk muscles to act for safety.
- Exploiting anticipatory proactive action to trigger huge avalanche of motor neuronal action from postural circuits of brain to paretic torso in special postures so that paretic torso sustains weight of entire torso, head and arms.
- Motor avalanche to weak paretic trunk muscles is triggered by brain for automatic safety of COM when good limbs are moved to cause internal disequilibrium in simple basic posture like Buddha. Such postures exploit passive mechanics for safety of posture while internal disequilibrium triggers brain to act for **safety from within.**

(Safety from within is superior to safety from external devices like stick, cane, held in good hand which shifts the COM away from paretic body making true recovery still more difficult)

- With repeated practice, paretic hip muscles get ready to sustain inertial mass of entire body in standing and walking.



17. From aiming training of hemiplegic gait [19] [20] which is cyclical in nature to …..

To understand that influencing any phase of a cyclical action by therapist with verbal, auditory cortical commands cannot be implemented by patient on exact time of the intended phase of gait cycle making it more abnormal. One needs to…..

- Re-introduce automatic safety of COM, propelling, controlling and restoring COM safety using paretic lower limb in special postures so that gait cycle becomes automatic.

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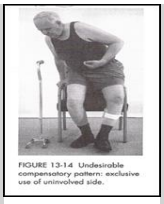
- Re-introduce capacity of paretic torso and LL to lead the body while walking.
- Re-introduce inter-limb influence wherein paretic body and good body exchange dominance cyclically automatically with LEADING and FOLLOWING exchanged between two sides cyclically.
- Restore automatic coplanar action at hip and knee for energy economy with cyclical action.
- Push off is very critical to propelling COM forwards. Foot drop splint for walking prevents much needed push off critical to propel COM using paretic LL during gait.
- Shoulder sling prevents swing in UL critical during gait cycle.
- Cortical interference through vision and touch in gait makes the gait abnormal, making 'normally abnormal' become 'normal' for stroke patients.

18.   
FIGURE 13-14 Undesirable compensatory pattern: exclusive use of uninvolved side.

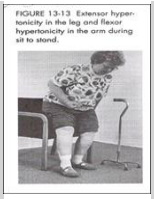



FIGURE 13-13 Extensor hypertonicity in the leg and flexor hypertonicity in the arm during sit to stand.
Shift from compensatory sensory reweighting with cortical sensation; 'vision and touch' [21] for safety of COM (negative plasticity) to…….. Restoring subconscious automatic control on COM safety with subconscious sensation; 'Proprioception' (positive plasticity) and discouraging vision and touch for safety.
19. Shift from thinking only about cortical plasticity, [22] axonal growth [23] and dendritic sprouting [24] to facilitate voluntary control and to facilitate lesioned hemisphere [25] which is under inhibition [26] from opposite non-lesioned hemisphere [27] as reported in many fMRI studies [28] to…

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Promoting subcortical plasticity in postural motor centers of non-lesioned hemisphere as well as cerebellum on paretic side of body.

- [**Postural centers in Non-lesioned sub-cortex and cerebellum gets 'switched off'** with striking of stroke ***(from instant plasticity)*** as is obviously evidenced in paresis of all muscles of one side of the body with the onset of small lesion in one hemisphere].
- [Non-lesioned sub-cortex and cerebellum remains highly inhibited ***(from adaptive plasticity)*** with no voluntary actions and with reduced proprioceptive input from poor loading of paretic body and poor contribution of paretic body in global COM safety]
- Self-organizing brain maintains 'switch off' of, Non lesioned sub-cortex for self- safety ***(in self-defense)*** when paretic muscles are unable to control safety of COM against invariant gravity.
- [Plastic self-organizing brain for self –safety transfers control on COM safety exclusively to subcortical postural centers of LESIONED hemisphere reflected in **uninterrupted use of good body for safety** coupled with **uninhibited facilitation of sub-cortex** (understood in physiology to result in spasticity]

20. Shift from thinking about recovery possibly from redundant pathways, [29] axonal recovery in surrounding areas and in distributed distant area of diachisis [30], synaptogenesis and general healing of brain as primarily responsible for recovery from stroke to……

'Switching on' the sub-cortical postural centers of non-lesioned hemisphere and inter hemispheric connectivity of cerebellum and its connection with cortex and spine for true recovery of lost control and simultaneously preventing adaptive plasticity which can be compensatory and negative.

- Restoring ability of paretic trunk and limbs to control COM safety automatically.
- Preparing both sides of body for exchange of dominance **'to lead and to follow'** depending on the need of the moment.

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- Relay between Sub-cortical postural centers in both hemisphere and relay between cerebellar hemisphere and vermal and para-vermal zone for regulation of trunk and proximal joints for true recovery as against compensatory recovery.
- In my speculation Plastic changes in cerebellar vermal, paravermal zone is promoted by selforganizing brain to make paretic torso and proximal limbs to get fused and bound to the spine to enable easy towing of paretic body by good body.
- Voluntary control is facilitated as a byproduct of 'switching on' of connectivity between cerebellum non-lesioned sub-cortex and lesioned cortex.

21. Shift from…. loss of brain cells from lesion as an irreparable loss and presence of lesion being the cause for sensory-motor problems to….

Understanding that though many varied factors underlie sensory motor problems post stroke, vicious circle of major problems primarily takes birth from brain's actions as a problem solver and solution finder ***(without waiting for any medical help)*** in self-defense for its own safety as its priority.

- Half side of the body gets paretic and loses the muscle force.
- This increases the degrees of freedom causing added threat to COM safety.
- Instant plasticity switches the safety control to good side automatically.
- Multiple defensive actions are triggered by brain for self-safety to refrain COM within stability limits reduced with narrowing of BOS from poor loading of LL.
- Spino spinal connectivity triggers Abnormal synergic grouping when good body leads and controls COM safety uninterruptedly all the time. Typical signature picture of hemiplegics emerges from interlimb spinal connectivity.
- Intense clinical help is necessary to make constantly defensive self-organized brain to re-reorganize to become capable of controlling and restoring COM to safety using paretic body which in turn restores lost sensory motor control as a byproduct.

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