

# Is a Brain-Dead Body an Organism?

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# Definition of Death

“The permanent cessation of functioning of the organism as a whole.”

Bernat et al., *Ann Int Med* 1981;94:389-94

Irreversible unconsciousness is not death.

# Categories of Integration

## Levels of Integration

- **Structural-functional**
  - Organism
  - Organ, tissue
  - Cell
- **Ontological-hierarchical**
  - Intellectual-volitional
  - Sensorimotor
  - Vegetative

## Types of Integration

- **Life-constituting** – makes the entity to *be* a living whole
  - “Bubble of anti-entropy”
- **Life-sustaining** – helps the entity to *stay* a living whole
  - Internally directed:  
**Health-maintaining**
  - Externally directed:  
**Survival-promoting**

# Correlates of Types of Integration

## Life-Sustaining

### Substitutability

- Relative
- Examples
  - Thyroid function
  - Hearing



## Life-Constituting

### Non-substitutability

- Absolute
- Examples
  - Resistance to entropy
  - Consciousness

# Brain's Integrative Role with Respect to the Body

Defenders of BD maintain that:

- not only is brain-based integration *necessary* for an organism's constitutive integration, but
- it *is* the constitutive integration;
- moreover, *any* residual brain function suffices for organism-level constitutive integration (an almost-but-not-quite BD person is *not* dead).

# To the Contrary...

We shall see that:

- *All* brain-mediated *somatic* integration is either health-maintaining or survival-promoting.
- The body's constitutive integration is *entirely* non-brain-mediated.

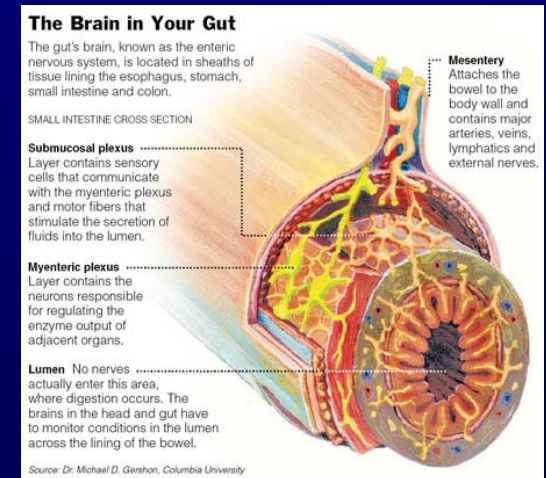
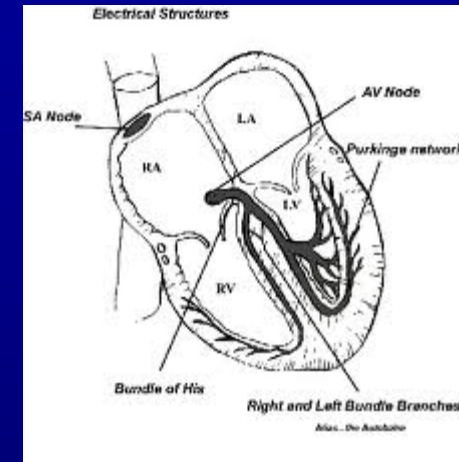
# How Could Integration Take Place Throughout the Body Without Brain-Based Coordination or Brain-Regulated Endocrine Function?

- There is more to the nervous system than the brain.
- There is more to “the endocrine system” than the hypothalamic-pituitary axis.
- There is more to the circulatory system than a mere means by which endocrine information is transferred.

# Non-Brain-Based Neural Integration



- Spinal cord
- Cardiac nervous system
- Enteric nervous system





# Brain-Mediated Somatic Integration Is Non-Constitutive

“It is primarily the brain that is responsible for the functioning of the organism as a whole: the integration of organ and tissue subsystems by neural and neuroendocrine control of temperature, fluids and electrolytes, nutrition, breathing, circulation, appropriate responses to danger, among others.”

Bernat, *Semin Neurol* 1984; 4:45-51, at 48.

Health-maintaining  
Survival-promoting

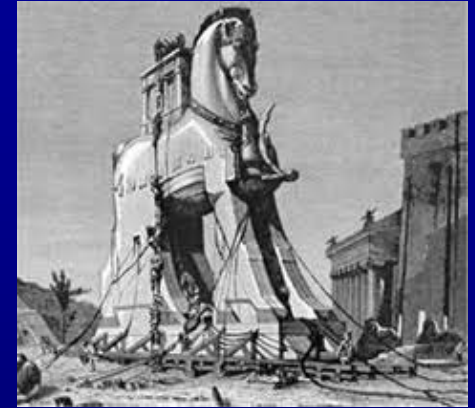
# Brain-Mediated Somatic Integration Is Non-Constitutive

- Bulk of brain = cerebral hemispheres  
→ survival-promoting integration
- Brain functions tested in clinical BD determinations are health-maintaining or survival-promoting
  - Coma
  - Brainstem reflexes
  - Apnea
- Brain-body disconnection: body remains a living whole
  - Severe Guillain-Barré
  - High spinal cord transection



# The Requirement of Irreversibility – Trojan Horse for BD Theory

- General anesthetic suppressing all brain function
- Not clinically BD, because of reversible “confounder”
- But the body is nevertheless receiving no brain-based integration
- Dilemma for BD defenders: 3 possible analyses
  - Body *must* be dis-integrating
  - Latency between loss of brain function and beginning of somatic dis-integration
  - Concede that somatic integrative unity is *not* lost upon cessation of all brain functions



That *reversible*, loss of all brain function is recognized by all as *not* death implies that brain-based somatic integration is *entirely* of the non-constitutive type.

# Acute Instabilities and Early Asystole in BD

- Spinal shock
- Direct multisystem damage from whatever caused the brain injury
- Multisystem hypoxic damage from apnea
- Multisystem damage due to process of brain herniation *prior to BD*
- Generalized inflammatory response

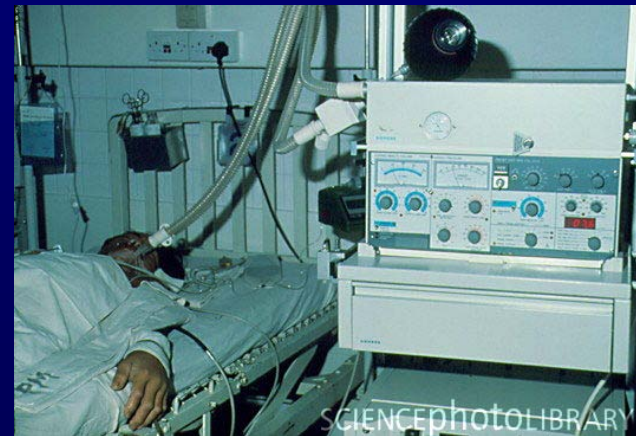
These dysfunctions:

- either result in early asystole or resolve
- are due to causes other than mere absence of brain-control

# Brain-Based Somatic Integration in Clinical BD is Substitutable

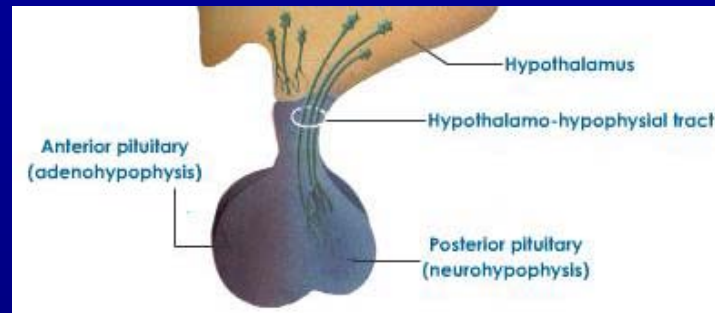
“The main objectives [in the medical support of BD organ donors] remain the maintenance of oxygenation and circulation, control of polyuria, and control of hyperglycemia... The overriding principle is **maintenance of normal or near-normal physiology**. Therefore, **several acute processes... can and should be reversed.**”

Wijdicks, *Brain Death*. 2011, 120.



# The Endocrine System(s)

## Brain-Regulated = Hypothalamic-Pituitary Axis



- Pituitary functions variably preserved in BD
- Posterior pituitary function present in ~1/3 of BD cases
- Only three pituitary hormones necessary for survival (i.e., target-organ function necessary for survival)
  - TSH
  - ACTH
  - ADH
- All are substitutable, health-maintaining

# The Endocrine System(s) Non-Brain-Regulated

## ■ Digestion, metabolism

- insulin, somatostatin, secretin, cholecystokinin, insulin-like growth factor, glucagon, pancreatic polypeptide, ghrelin, vasoactive intestinal peptide (“neuroimmune axis”), leptin, adiponectin, resistin
- gastrointestinal system, adipose tissue

## ■ Blood pressure, volume

- renin-angiotensin-aldosterone axis; atrial natriuretic peptide
- kidneys, liver, lungs, adrenals, heart

## ■ Stress hormones

- epinephrine, norepinephrine
- adrenal medulla

## ■ Blood cell formation

- thrombopoietin, erythropoietin
- liver, kidneys, marrow

## ■ Calcium homeostasis

- parathyroid hormone, calcitonin, cholecalciferol
- parathyroids, thyroid, skin, bone, liver, kidneys

All are of the health-maintaining type of integration.

# The Circulatory System

- Reaches all parts of body (nervous system doesn't)
- Means of intercellular biochemical communication
  - Homeostasis
  - Anti-entropy
- Circulation is not the integration; the homeostatic, anti-entropic mutual interactions among all parts of the body are the integration.
  - Life-constituting integration
  - Non-substitutable





# Level of Integration in BD

“The cardiac arrest patient with whole brain destruction is simply a preparation of unintegrated individual subsystems, since the organism as a whole has ceased functioning.”

Bernat, *Semin Neurol* 1984;4:45-51, at 48.

A BD body is nothing more than:

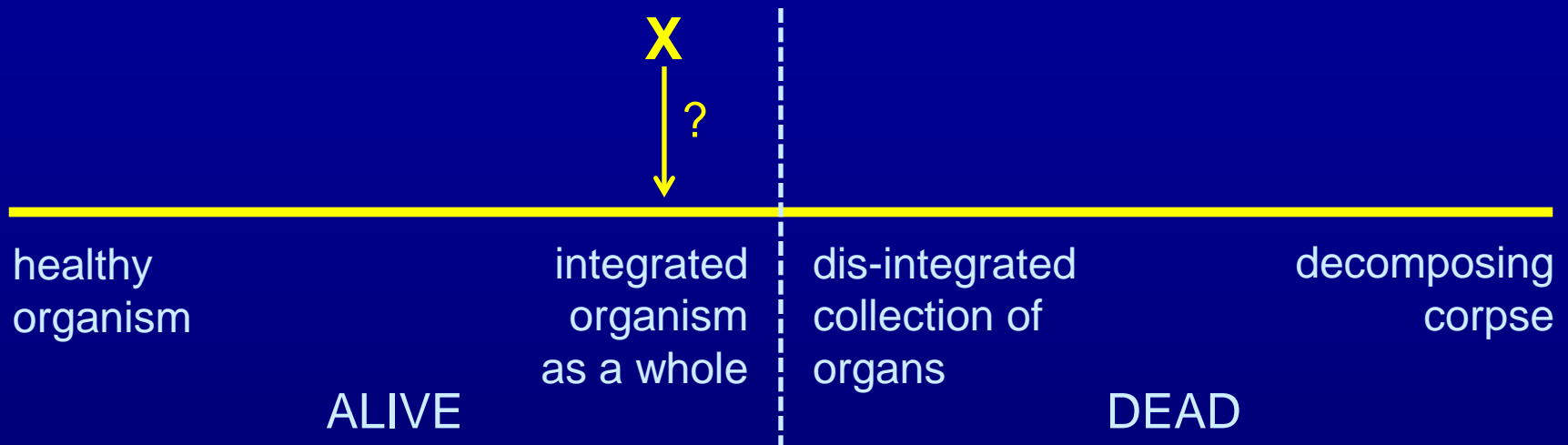
- “a ventilator [keeping] a heart beating in a corpse.”

Daroff, in Sanchez Sorondo (ed), *The Signs of Death*. 2007, LXXII, 275.

- “a magnificent cell culture.”

Wijdicks & Bernat, in Sanchez Sorondo (ed), *The Signs of Death*. 2007, LXXIII, 276.

# Level of Integration in BD



- Continuum of degrees of integration
- Discontinuity of level at “whole” vs. “collection”
- No operational definition or method of measurement of degree or level of integration
- Need indirect criteria for which side of dividing line X lies

# Criterion 1

Integrative unity is possessed by a putative organism if it possesses *at least one emergent, holistic-level property*.

- Emergent: The property derives from the mutual interaction of the parts.
- Holistic: The property is not predicable of any part or subset of parts, but only of the entire composite.

# **Criterion 1**

## **Holistic Properties in Chronic BD**

- physiological and chemical homeostasis
- maintenance of fluid and electrolyte balance with min. adjustment of volume & composition
- assimilation of nutrients
- elimination, detoxification, recycling of cellular wastes
- energy balance
- maintenance of temperature

# **Criterion 1**

## **Holistic Properties in Chronic BD**

**(cont.)**

- teleological wound healing
- fighting of infections and foreign bodies
- cardiovascular and hormonal stress responses
- proportional growth of BD children
- sexual maturation of BD children
- successful gestation of a fetus in BD women

# Criterion 1

## Holistic Properties in Chronic BD

(cont.)

- resuscitatability & stabilizability after cardiac arrest
- ability to recover from hypotension, aspiration, etc.
- spontaneous improvement in general health
- overall ability to survive with little medical intervention, in a nursing facility or even at home

# Criterion 1

## Holistic Properties in Chronic BD

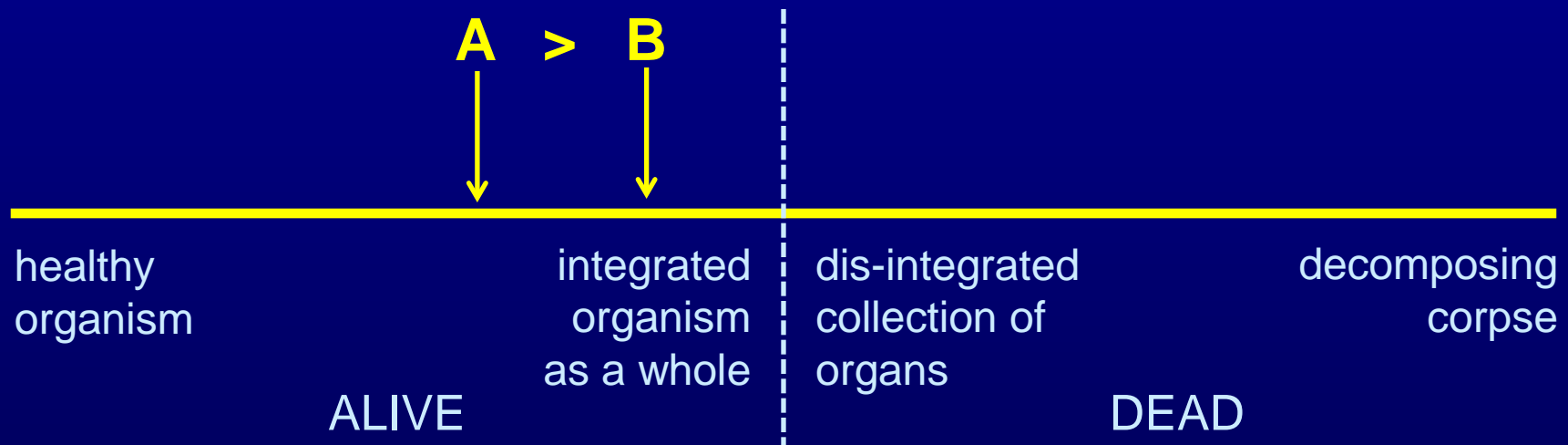
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“If being alive as a biological organism requires being a whole that is more than the mere sum of its parts, then it would be difficult to deny that the body of a patient with total brain failure can still be alive, at least in some cases.”

President's Council on Bioethics, *Controversies in the Determination of Death*. 2008, 57.

# Criterion 2

Any body requiring *less* technological assistance to maintain its vital functions than some other similar body that is nevertheless a living whole must possess at least as much integration and hence also be a living whole.



If A has more integration than reference entity B, and B is on the “whole” side of the dividing line, then A is necessarily also on the “whole” side of the dividing line.



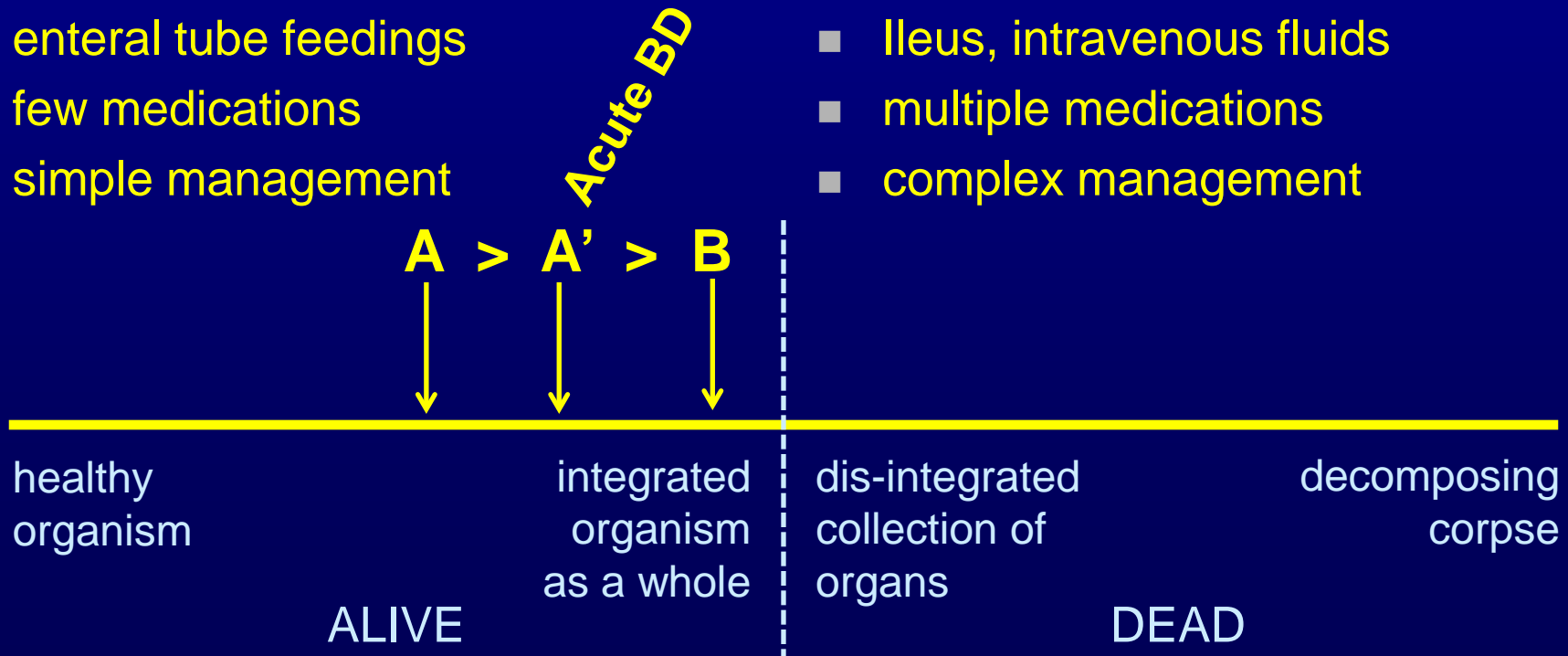
# Criterion 2

## A – Chronic BD

- at home
- stable
- no pressors
- viscera functioning normally
- enteral tube feedings
- few medications
- simple management

## B – end-stage cancer, septic shock, comatose on ventilator but not BD

- in ICU
- unstable, deteriorating
- pressor-dependent
- kidney & liver failure, DIC
- Ileus, intravenous fluids
- multiple medications
- complex management



# Conclusions

- The brain is not the body's thermodynamically “critical” organ; the body has no such “critical” organ.
- *All* brain-based somatic integration is either of the health-maintaining or survival-promoting type.
- The body's *life-constituting* integration is the anti-entropic mutual interactions among all its parts, mediated by circulation.
- BD patients are severely disabled, totally dependent, tenuously alive *organisms as a whole*.