INTRODUCTION

PART 1

Background - Basic & clinical science
Post-manipulation Stroke
  • Mechanism
  • Link
  • Incidence

PART 2 Doppler ultrasound - rationale & application

Provocational Tests
  • Validity?

Doppler Ultrasound
  • Validity/Reliability
  • Clinical practicality
PART 1: BACKGROUND

Post manipulation stroke

Mechanism
Vertebral A  approx 48x Int Carotid A post-manipulation strokes

Modified from Cunninghams
Vertebrobasilar territory

Thalamus

MIDBRAIN
PONS
MEDULLA

Mid sagittal

Base of brain

Posterior circulation

Occipital lobe
Brain stem
Cerebellar peduncles
superior
middle
inferior
Cerebellum

Cranial nerve nuclei - mainly pons & medulla

Posterior circulation

Dorsal brainstem

Lateral
Post manipulation stroke

First reported 1934

Mostly no particular syndrome due to variability in circulation (Frisoni et al, 1990)

Most common syndrome - Postero-lateral medullary (Wallenburg). PICA
First described 1895, same year chiropractic began. (Terrett, 1996)

Most serious syndrome - “Locked in” (Cerebro-medullary spinal disconnection).
First described in “The Count of Monte Cristo” (re: M. Noitier de Villaforde) by Alexandre Dumas, 1844.
Post manipulation stroke patients

Typically:
- are relatively young, healthy adults
- have little or no risk factors for stroke
- cannot be identified as being at risk from their history or by standard clinical examination, including X-ray **BUT** new techniques such as **Doppler** may have potential to assist.
Anterior view of PICA, & brain-stem bent backwards

Infarcted area

Oclusion of PICA

X section of Medulla

PICA Territory
Posterior inferior cerebellar A. most common VA branch in post manipulation cases

Dorso-lateral medulla

Inf. Cerebellar peduncle

Spinal tract of trigeminal nerve

VIII

Lateral medulla
Post-manipulation Stroke - MRI X section

Sir Charles Gairdner Hospital
Perth, Western Australia

Right cerebellar infarction
Arterial dissection

Most commonly identified cause of post manipulation stroke

4 vessel Arteriography: “gold standard” Dx
Intimal disruption

Arterial dissection
ICAs 2x VAs

Intima

Artery wall

Blood flow

Blood tracking under intima

Thrombus

ICA

Can be delayed

Thrombus — embolus (carried downstream) — occlusion (of branch)

(maystenose)
Clinical presentation
- posterior territory stroke: most common
  - very severe sharp, first time felt, unilateral
  - neck/head pain (poor indicator by itself)
  - prior to onset of neurological deficit: very common
- may heal without stroke developing
Other possible mechanisms

- Minor intimal disruption
- Thrombus due to hypercoagulability & stenosis
- Vasospasm
Summary - Mechanisms

Most common: artery - Vertebral A
branch - PICA

syndrome - Wallenburg: 3Ds And 3Ns
identified cause - arterial dissection BUT

other causes may be important

Dissections 1. Aetiology - intrinsic weakness of arterial wall
Arteriopathies: FMH? Collagen defects?
- Mechanical stresses?

2. Risk factors? - Current OCP use?, Migraine?
Stroke & Manipulation Link

Close timing between manipulation & stroke - 63% immediate (Terrett, 1996)
∴ Unlikely that all cases coincidental
Later onset could be due to delayed thrombus propogation or embolism

Cadaveric studies suggesting stresses to Vertebral A during neck motion. (Selecki, 1969)
Stroke & Manipulation Link

Case control studies

• Stroke (dissection/occlusion) in patients < 45 yo attended chiropractors for neck complaint. (Rothwell et al, 2001)

Limitations - confounding factors
• Stroke (dissection) in patients who had neck manipulation (Smith et al, 2003)

Limitation - selection bias?

Link unproven BUT high index of suspicion
Strokes coincidental with manipulation? Due to weak arterial wall only?

Spontaneous dissections similar to minor trauma eg manipulation cases (Mas et al, 1987)

**BUT** Major difference-

- Spontaneous cases ICAs 2x VAs
- Manipulation cases VAs 48x ICAs

Stretch on VAs: Neck manipulation < cervical ROMs (Symons et al, 2002)

**BUT** Extremely poor experiment design eg: Wrong testing locations, No full rotation manip
Effects of cervical rotation

Causes VA stenosis/stress more than other cervical motions.

Most - cervical rotation at C1/2
- motion at C1/2 is rotation

C1/2 >>

Lower Cervical:
Rotational stenosis & Minor trauma (eg manipulation) dissections

Contralateral >>

Ipsilateral

Symons et al tested here - wrong side & location!
Effects of cervical rotation

↑ C1/2 rotation (>35°) = ↑ rotational stenosis (MRA studies by Dumas et al, 1996)

Full Rotational manipulation likely ↑ risk

Proposed Definition: Head rotated passively = or > end range

Chiropractors do use full rotational techniques - □

BUT uncommon in Perth (Haynes, 1996)

BUT most post manipulation strokes in Perth involved rotation (Heye et al, 1995)

Symons et al needed to check for full rotational manipulation but didn’t.
BIOMECHANICAL STUDIES VA ROTATIONAL STENOSIS

METHOD:
- Duplex US only studies: 20 participants
- MRA & Doppler studies: 13 participants
- Cadaveric studies: 1 specimen
VA Cadaveric Studies

Neutral  Contralateral rotation  Ipsilateral rotation

C1/2 curves straightening, no stretch

Adding slack

Compressio
Colour US duplex scan upper cervical VA - Neutral

VA curving medially toward C1

VA leaving C2

CEPHALAD

CAUDAL

LT C1-C2 NEUTRAL POSITION
Colour US duplex scan upper cervical VA - Rotation

Decreased curvature

VA leaving C2

LT C1-C2 FULL CONTRALATERAL ROTATION

?DECREASED CURVATURE
MRA 3D VIEWS
MRA Studies of VAs

Neutral

Rotation Contralateral

Note straightening of C1/2 curves, no stretch, no compression
VAs usually well designed for neck rotation
VA Rotational Stenosis (Marked)

- 60% reduction lumen cross sectional area - Doppler

- Causes jetting effect at site without affecting blood flow, (like putting a finger over the end of a hose that is turned on)

  OR just major decrease
Marked rotational stenosis

VA Doppler spectral waveforms

Neutral

Full contralateral rotation
1. Compression or kinking precedes stretch induced by rotation.

2. Stretching insufficient to cause Doppler signals to be markedly affected.
3. Effect of C1/C2 rotation offset by: a) curves in VA  
   b) lateral flexion C1/C2
4. Increasing intramural pressure decreases compression
CLINICAL RELEVANCE

Cervical movement usually causes little stress to VAs, so manipulation unlikely to cause injury.

Rotational stenosis due to faulty biomechanics eg inadequate VA curves & C1/C2 lat flexion. May ↑ risk of injury from manipulation.

Detecting this indicates compression & early warning prior to injurious stretch.

Repeated compression may weaken artery similar to popliteal artery entrapment syndrome. FMH predilection for VA at C1/2?

Doppler findings are affected by blood pressure - needs measuring in case hypertension masks stenosis
Marked Rotational Stenosis

Healthy participants
5% VAs (n=280) - Doppler (Haynes, 1996)
7% VAs (n=79) - arteriography (Faris et al, 1963)

TIA vertebrobasilar patients
33% VAs (n=60) - Doppler (Arnetoli et al, 1989)
56% VAs (n=64) - MRA (Weintraub & Khoury, 1995)

Independent risk factor for VB stroke

TIA patients
0.5% ICAs (n=1638) - arteriography (Opala & Arkuszewski, ‘89)

VAs >> ICAs
May explain why VAs >> ICAs in post manip stroke despite ICAs >> VAs in arterial dissections
Growing body of clinical & biomechanical circumstantial evidence suggests that neck manipulation may at least trigger some cases of stroke, due to increased stress to VA. No evidence which contradicts this.

2 case control studies provide more direct evidence, but have limitations - inconclusive. **BUT high index of suspicion. Clinically wise to accept link - for safety of patients.**

VA design & C1/2 biomechanics generally protect from injury. Abnormalities can cause stress, indicated by rotational stenosis - needs to be screened prior neck manipulation.
Post manipulation stroke

Incidence
Incidence

Accurate rate unavailable - probably impossible to determine due to rarity (Rothwell et al, 2001)

Great difficulty retrieving all cases.

**Note:** true incidence of stroke in general not obtained until last 10-15 years.
Incidence Estimates

1/100,000 - (Australia): Haynes, 1994, 2006

- (USA): Dabbs & Lauretti, 1995
- (Canada): Rothwell et al, 2001
Comparative safety

Medical iatrogenesis alarming statistics ➔ very serious problem.

USA preventable hospital deaths (annual rate = 120,000) equivalent to a jumbo jet crash every day!

Available data suggests that cervical manipulation is relatively safe, no evidence to the contrary, & growing evidence that it is effective.

Neck manipulation is appropriate for most chiropractic patients □BUT not all.
Incidence of post-manipulation stroke

Summary

- Precise incidence is unknown.
- Generally accepted that most severe cases are rare - so cervical manipulation is safe in the vast majority of cases.
- Is probably more common than many chiropractors realize.
- Not so rare as to excuse chiropractors from using reasonable, best evidence approach to reduce risk, especially since stroke is so serious.