An Epidemiologic Assessment of the Risk of Stroke from Chiropractic Care

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Risk of Vertebrobasilar Stroke and Chiropractic Care

Results of a Population-Based Case-Control and Case-Crossover Study

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Study Design. Population-based, case-control and case-crossover study.

Objective. To investigate associations between chiropractic visits and vertebrobasilar artery (VBA) stroke and to contrast this with primary care physician (PCP) visits and VBA stroke.

Summary of Background Data. Chiropractic care is popular for neck pain and headache, but may increase the risk for VBA dissection and stroke. Neck pain and headache are common symptoms of VBA dissection, which commonly precedes VBA stroke.

Methods. Cases included eligible incident VBA strokes admitted to Ontario hospitals from April 1, 1993 to March 31, 2002. Four controls were age and gender matched to each case. Case and control exposures to chiropractors and PCPs were determined from health billing records in the year before the stroke date. In the case-crossover analysis, cases acted as their own controls.

Results. There were 818 VBA strokes hospitalized in a population of more than 100 million person-years. In those aged <45 years, cases were about three times more likely to see a chiropractor or a PCP before their stroke than controls. Results were similar in the case control and case crossover analyses. There was no increased association between chiropractic visits and VBA stroke in those older than 45 years. Positive associations were found between PCP visits and VBA stroke in all age groups. Practitioner visits billed for headache and neck complaints were highly associated with subsequent VBA stroke.

Conclusion. VBA stroke is a very rare event in the population. The increased risks of VBA stroke associated with chiropractic and PCP visits is likely due to patients with headache and neck pain from VBA dissection seeking care before their stroke. We found no evidence of excess risk of VBA stroke associated chiropractic care compared to primary care.

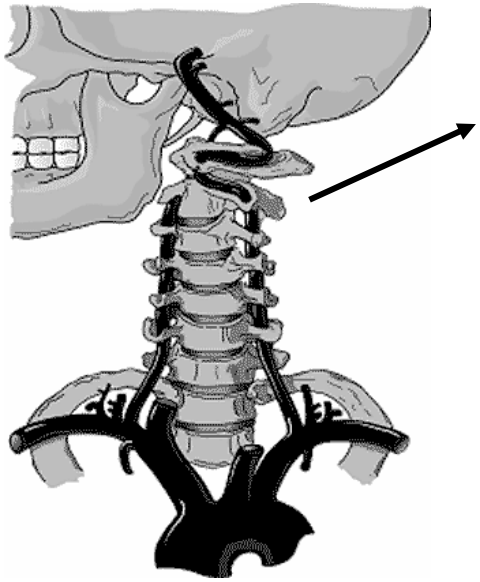
Key words: vertebrobasilar stroke, case control studies, case crossover studies, chiropractic, primary care, complications, neck pain. **Spine 2008;33:S176–S183**

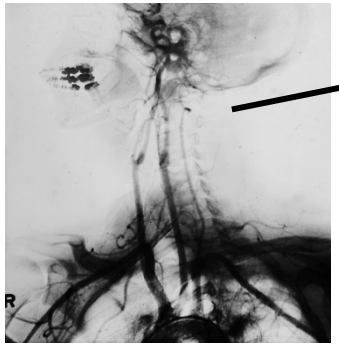
Neck pain is a common problem associated with considerable comorbidity, disability, and cost to society.[1–5] In North America, the clinical management of back pain is provided mainly by medical physicians, physical therapists and chiropractors.[6] Approximately 12% of American and Canadian adults seek chiropractic care annually and 80% of these visits result in spinal manipulation.[7,8] When compared to those seeking medical care for back pain, Canadian chiropractic patients tend to be younger and have higher socioeconomic status and fewer health problems.[6,8] In Ontario, the average number of chiropractic visits per episode of care was 10 (median 6) in 1985 through

Carotid & Vertebral Dissections

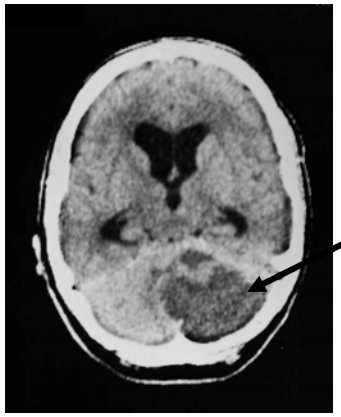
- Arise from intimal tear
  - Possible risk factors: genetic (connective tissue disorder), aortic diameter, migraine, minor trauma, spontaneous
- Prognosis depends on severity (stenosis, collateral circulation and thromboembolic complications)
  - Most strokes due to dissection are thromboembolic
  - Most recover (< 5% deaths)
- Annual incidence of dissection-related strokes (from Olmstead County, MN: Lee et al., Neurology 2006: 67:1809-12):
  - Carotid: 1.72 per 100,000 per year (95% CI: 1.13-2.32)
  - Vertebral: 0.97 per 100,000 per year (95% CI: 0.52-1.40)
    - **80% presented with head or neck pain**

Chiropractic & Vertebral Dissection





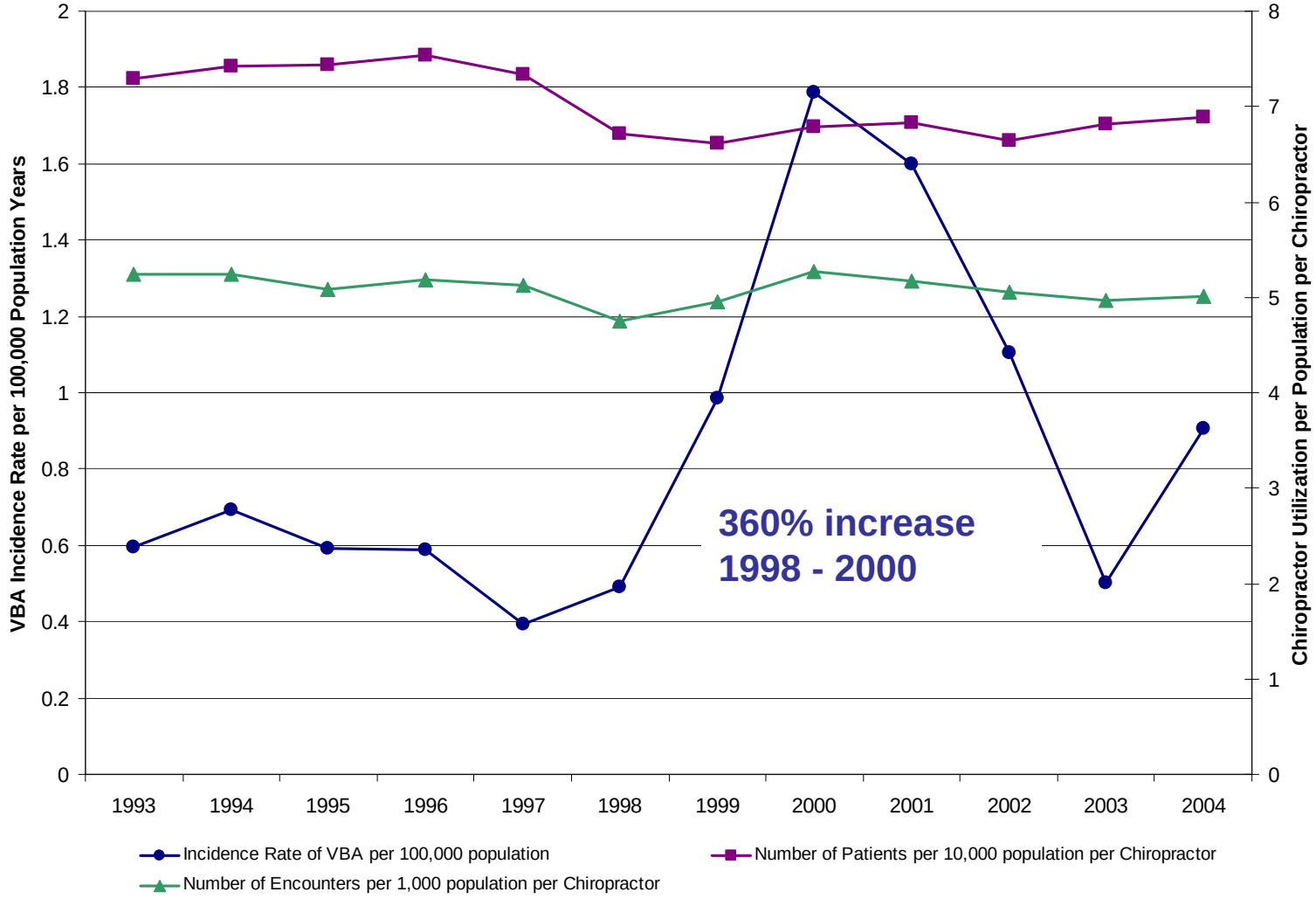
Dissection



Stroke

C1-2 rotational manipulation causes vertebral artery dissection & VBA stroke

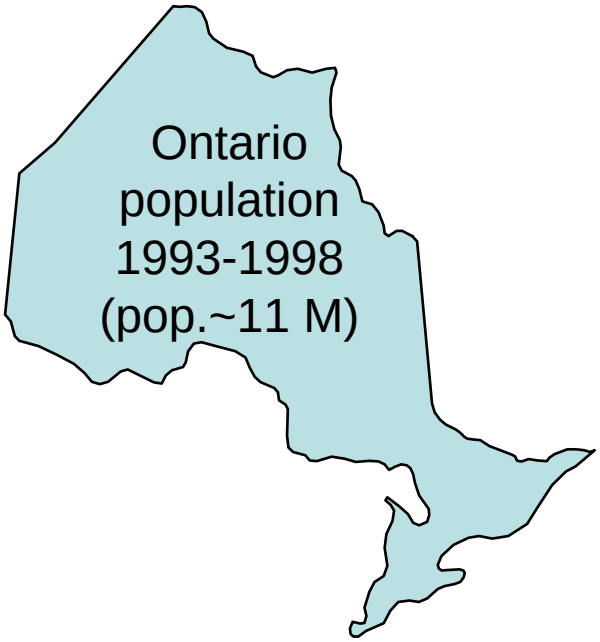
Saskatchewan Annual Incidence & Chiropractic Utilization Rate



Case-Control Study Design

Rothwell et al., Stroke 2001

Past Chiropractic OHIP Service within one month?



Yes → 582 VBA

No

Yes → 2,328 controls
(4 per case matched
on age and sex)

No

Case-control Study of Chiropractic and Stroke

Rothwell et al., Stroke 2001

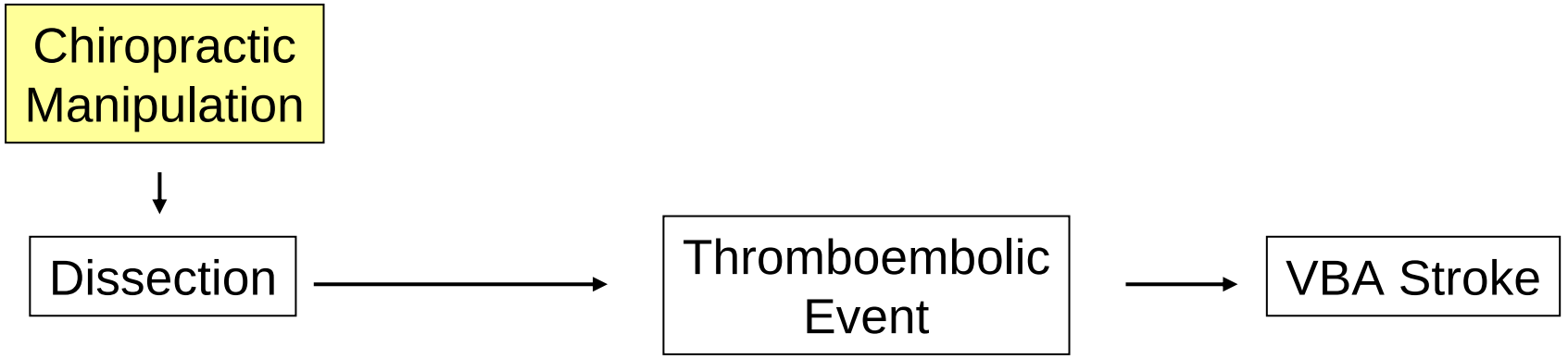
- Results:
  - Most recent chiropractic service within 1 week:*
    - < 45 years old: OR=5.03 (95% CI 1.32-43.87)
    - 45 + years old: OR=0.64 (95% CI 0.13-1.56)
  - Most recent cervical chiropractic service within 1 day:*
    - < 45 years old: OR=5.52 (95% CI 1.03-72.02)
    - 45 + years old: OR=0.85 (95% CI 0.00-2.95)
  - 3 + cervical chiropractic services in previous month:**
    - < 45 years old: OR=4.98 (95% CI 1.07-62.70)
    - 45 + years old: OR=1.60 (95% CI 0.00-10.61)

Reference: no chiropractic service in past year* or month**

Causal Dilemma

Two hypotheses:

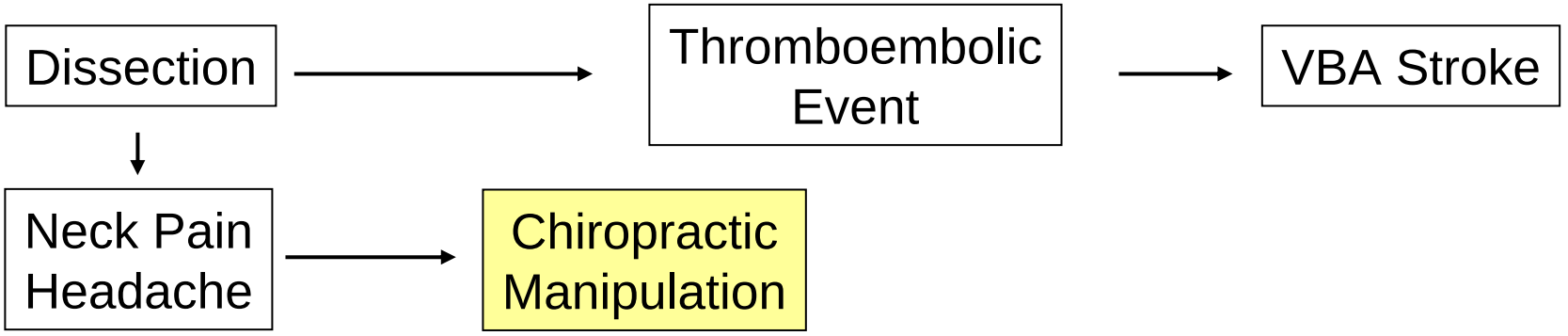
- Chiropractic care (cervical spine manipulation) cause VBA stroke?



Causal Dilemma

Two hypotheses:

2. The association between chiropractic care and VBA is stroke coincidental?



Study Objectives

- Primary:
  - To investigate the association between chiropractic services (DC) and vertebrobasilar artery (VBA) stroke
- Secondary:
  - To investigate the association between general practitioner (GP) services and VBA stroke

Rationale for Computing Risk in GP Patients

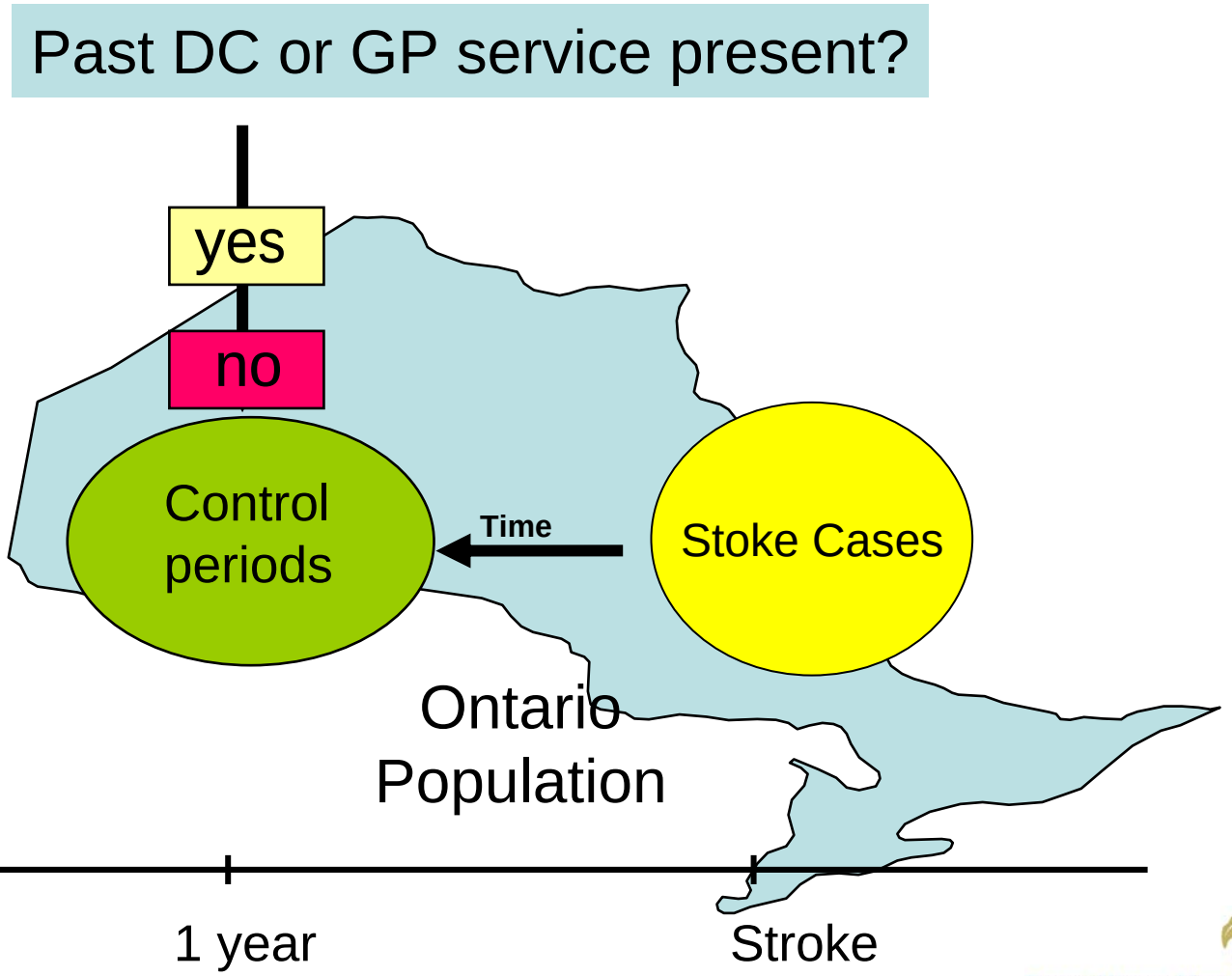
- GP's do not manipulate the cervical spine
  - Assumption: GP's do not cause VBA stroke
- Provides a measure of the background risk of VBA stroke in the population
  - Assumption: GP patients provide a measure of the natural course of VBA stroke
- Any excess in risk between chiropractic and GP patients would suggest an added risk for chiropractic patients

Study Population and Databases

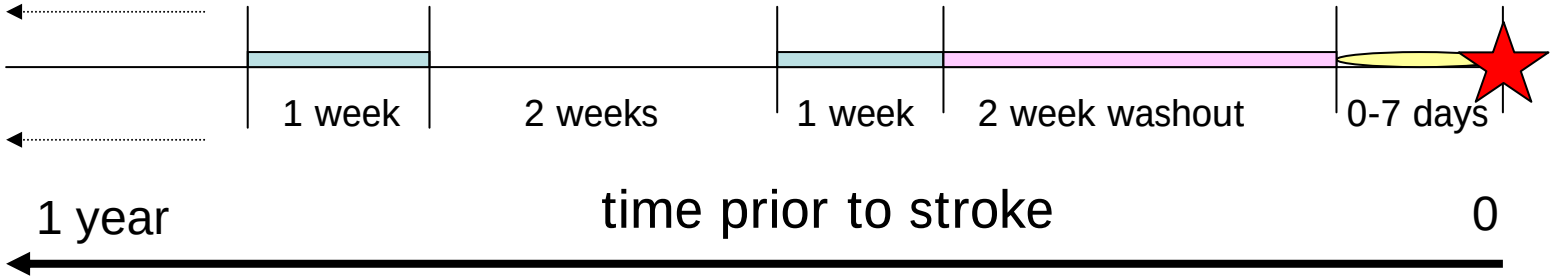
- Ontario population
  - Population ~11 Million
  - Excluding institutionalized, RCMP, Military and natives living on reserves
- Two universal health care data sources used:
  - CIHI hospitalization data captures vertebrobasilar artery (VBA) stroke as a discharge diagnosis
  - OHIP ambulatory health utilization data captures chiropractic and physician visits (exposures)

Design: Case-Crossover Study

Cases provide their own control periods.



Case Crossover Method



- VBA Stroke (index date): ★
- Exposure window (Hazard period): ⬭
- Washout period: ▭
- Reference periods: ▭
- Time stratified control period sampling
  - 4 one-week control periods randomly sampled from remaining control time.

Case/Control Selection

- Cases
  - All incident VBA stroke cases hospitalized in Ontario acute care hospitals over 9 years (1993-2002)
    - ICD-9 433.0 and 433.2 (occlusion and stenosis of the vertebral and basilar artery)
  - No previous Ontario hospital admission for stroke in last 2 years
- Controls (x 4)
  - The control is the same person matched to themselves at randomly selected times

Exposures

- Chiropractic (DC)
  1. All health care services reimbursed Ontario's health care system
     - Excludes radiographic services
  2. Identified headache and cervical services based on diagnostic codes
- General Practitioners (GP)
  - Ambulatory OHIP service and specialty codes used to identify services
  - Includes family physicians (CCFP), general practitioners and community physicians (FRCP)
  - Excludes services not directly involving individual outpatient-based patient care
  - Identified headache and cervical services based on diagnostic codes

Analysis

- Conditional logistic regression
  - Odds Ratios with 95% confidence intervals (CI)
- Accelerated bias corrected bootstraps were used to compute confidence intervals

Vertebrobasilar Artery Stroke

- 818 cases from 1993 to 2002 in Ontario
- 109 million person-years of follow-up
- 36.7% cases were female
- Mean age 63; Median age 66
- 41.2% (337/818) of cases were diagnosed as basilar occlusion and stenosis
- 54.2% (442/818) of cases were diagnosed as vertebral artery occlusion and stenosis
- 4.7% (38/818) had both diagnoses
- 36 cases consulted a chiropractor within the month preceding the stroke

Chiropractic Service

Exposure window for service	Age < 45 years		Age ≥ 45 years	
	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI
0-1 days	5.0 (0.8-31.0)	*	1.1 (0.3-4.0)	0.0-4.8
0-3 days	3.4 (1.0-12.3)	*	0.6 (0.2-1.8)	0.2-2.1
0-7 days	12.2 (2.5-59.0)	*	0.3 (0.1-0.8)	*
0-14 days	4.9 (1.6-12.6)	*	1.0 (0.5-1.9)	0.5-2.0
0-30 days	3.6 (1.4-9.4)	1.5-10.8	0.9 (0.5-1.6)	0.5-1.6

* Unable to estimate

General Practitioner Service

Exposure window for service	Age < 45 years		Age ≥ 45 years	
	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI
1-1 days	15.2 (4.3-54.2)	3.7-68.0	3.7 (2.5-5.5)	2.5-5.6
1-3 days	5.6 (2.6-12.4)	2.1-14.6	2.7 (2.0-3.5)	2.0-3.5
1-7 days	2.9 (1.6-5.1)	1.6-5.1	2.3 (1.9-2.9)	1.9-2.9
1-14 days	3.5 (2.1-6.0)	2.0-6.5	2.3 (1.9-2.7)	1.9-2.8
1-30 days	3.0 (1.8-5.0)	1.7-5.1	2.3 (1.9-2.9)	1.9-3.0

Any Number of DC and GP Services

Any services in month before index date	Age < 45 years	Age ≥ 45 years
	OR (95% CI)	OR (95% CI)
Chiropractic services	1.4 (1.0-1.7)	1.0 (0.8-1.2)
General practitioner services	1.3 (0.9-1.9)	1.5 (1.4-1.7)
Headache or cervical chiropractic services	2.8 (*)	1.0 (0.7-1.3)
Headache or cervical general practitioner services	10.6 (3.5-43.6)	3.5 (2.4-5.3)

* Unable to estimate

Making Sense of the Results!

- 818 VBA strokes per 109 million person-years:
  - ~0.8 per 100,000 person-years
    - 6 saw DCs within 1 day of stroke
    - 14 saw DCs within 7 days of stroke
    - 27 saw DCs within 14 days of stroke
    - 36 saw DCs within 30 days of stroke

Making Sense of the Results!

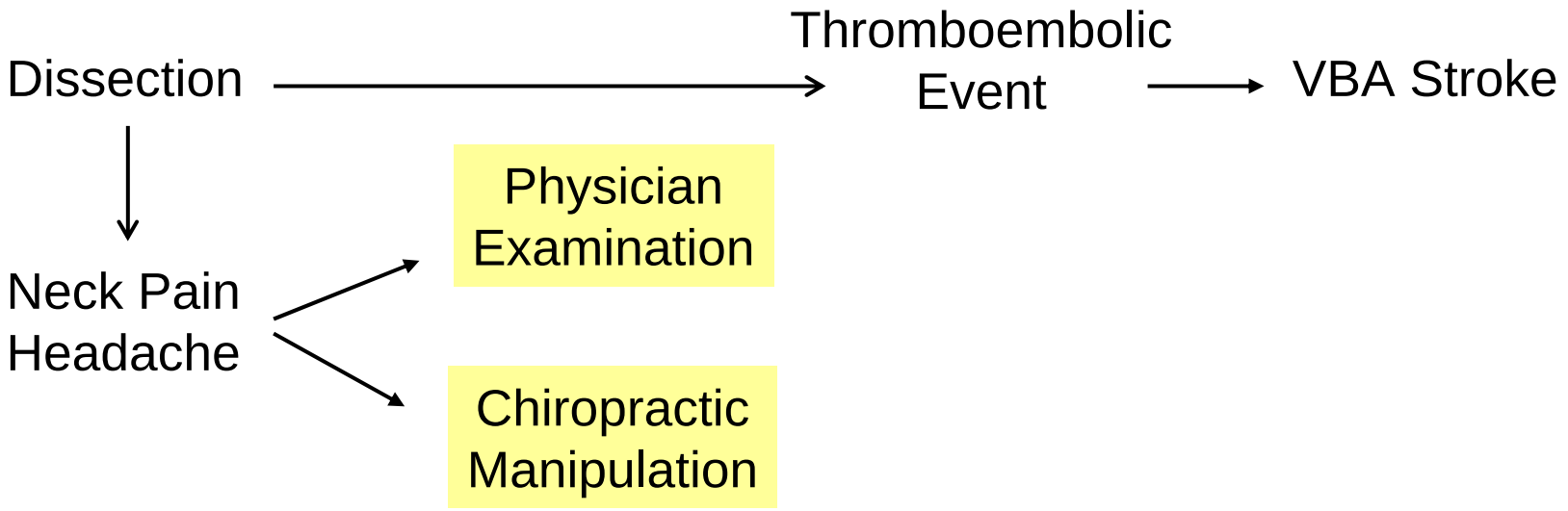
- Primary objective:
  - To investigate the association between chiropractic services and vertebrobasilar artery (VBA) stroke
  - There is an association between chiropractic services and VBA stroke in patients < 45 years of age
    - Risk is 3 -12 times greater with DC care
  - No association between chiropractic services and VBA stroke in patients > 45 years of age

Making Sense of the Results!

- Secondary objective:
  - Investigate the association between GP services and VBA stroke
  - There is an association between physician services and VBA stroke
  - Risk is 3 -12 times greater if consulted a GP before the stroke
  - Provides an estimate of the background risk in the population

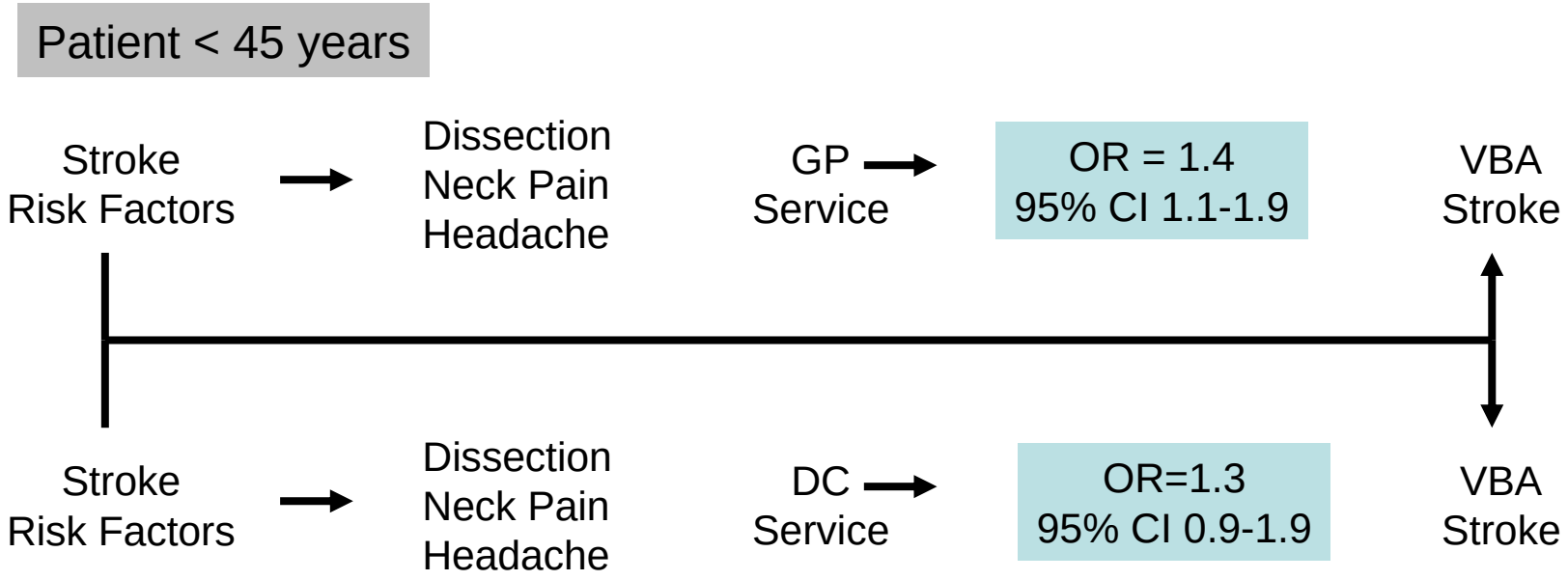
Causal Pathways?

Association is explained by patients with dissection-related VBA stroke presenting with headache and neck pain.



Causal Reasoning!

Assume background risk of VBA stroke is equal to GP risk and any excess risk is causal.



Strengths and Limitations

- Large source population (~12 million over 9 years)
  - More than 100 million person-years of data
- Accurate measures of services from billing records
  - But services are not always cervical manipulations
  - Likely less accurate measure of cervical/head pain visit
- Good control of confounding by design
  - Case crossover design controls for unmeasured risk factors for stroke (obesity, smoking, physical activity, etc.)
- Misclassification of stroke diagnoses
  - Positive predictive values were low in Saskatchewan study in 1990 for IDC-9 433 (Liu et al., Cerebrovasc Dis 1999;9:224-30)

Take Home Messages

- VBA stroke is a rare event.
  - In a population > 100 million person-years, we found 818 cases.
- If chiropractic care caused VBA stroke, then the absolute risk is very low
  - 6 cases over a 9-year period saw a chiropractor within 1 day of their stroke.
- It is likely that patients are presenting to chiropractors and physicians with neck pain and headache from vertebral artery dissection and are in the prodrome of a VBA stroke.
  - The relative risk of VBA stroke is similar after general practitioner and chiropractic services.

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