A Structural Service Plan: Towards Better and Safer Spine Surgeries

Department of Orthopaedics & Traumatology
Tuen Mun Hospital
Cheung KK
Wong CY
Chan Andrew
Tse Alfred
Chow YY

Department of Orthopaedics & Traumatology
Tuen Mun Hospital
Introduction
下半生輪椅度過 護士患骨癌
陳準醫院疏忽
昏天暗地
Spine Surgery

- Narrow margin of error
- Outcomes
  - Difficult to predict
    - Pain Vs neurological deficit
- Complications
  - Potential devastating consequences
    - Patient
    - Family
    - Surgeon
    - Hospital
    - Hospital Authority
    - Community
Spine Surgery Complications

- Complication $\neq$ poor surgical outcome
- Avoiding complication = decrease the chance of potential devastating sequel
Spine Surgery Complications

- Zero complication is un-realistic!
- Some complications are avoidable!
  - Disease factor
  - Patient factor
  - Surgeon factor
A Structural Service Plan was developed for Spine Surgery

Aiming at:
Provide quality care to patients
Decrease surgery related complications
To have a Standard as Reference

Develop a Structured Service Plan

Implementation + Continuous Audit
No standard / reference could be found!

No study / literature either locally or overseas to compare with
We have to create our own reference

Retrospective Data Collection
• From 1\textsuperscript{st} Jan 1999 till 31\textsuperscript{st} Dec 2004
• All bony surgeries of the spine column under general anaesthesia (simple implant removal excluded)
• Operation records, inpatient and outpatient records retrieved from Clinical Management System (CMS) and reviewed by a single assessor
• Operation count was based on the administration of general anaesthesia to one particular pathology in one anatomical region of the spine column
The followings were defined as complications

- One month in-patient mortality
- Deep wound infection requiring surgical exploration
- Incidental durotomy
- Permanent neurological deficit
Salvage operation

- Subsequent operations that are performed because of unsatisfactory results of the index surgeries
  - May or may not be avoidable
The Study Period

All operation involving the bony spine column from 1st Jan 2005 till 31st Dec 2007
The Service Plan

A. Pre-operative Phase
B. Immediate post-operative phase
C. Rehabilitation phase
A. Pre-operative Phase

A good rapport with adequate explanation and examination by a competent and experienced surgeon after peer review.
A. Pre-operative Phase

1. Designated Spine Surgeons
2. Operation Procedure Selection
3. Consent Procedure
4. Documentation
B. Immediate post-operative phase

1. Neurology monitoring
2. Post-operation instructions
3. Designated NS / APN
Neurology Monitoring

![Neurological Assessment Form](image)
Neurological Assessment

Power

Upper limb
C4-Shoulder abduction
C5-Elbow flexion
C6-Wrist extension
C7-Elbow extension
C8-Fingers flexion
T1-Fingers abduction

Lower limb
L2-Hip flexion
L3-Knee extension
L4-Ankle dorsiflexion
L5-Big toe extension
S1-Big toe plantar flexion

Grading
0-complete paralysis
1-flicker of contraction
2-movement as gravity excluded
3-movement against gravity
4-movement against resistance
5-normal power

Sensation

Neurological Assessment

Grading
0-Absent
1-Impaired
2-Normal
NT-Not Testable
Post spine operation order

- Diet
- Intravenous fluid
- Oxygen supplement
- Monitoring
  - BP / P  Q  H
  - SaO2  Q  H
    - Continuous oximeter monitoring needed / not needed*
    - Inform if SaO2 < ______ %
  - Urine output  Q  H
  - Sensory monitoring  Q  H
  - Motor monitoring  Q  H
  - Investigations
    » X-ray
    » Check blood
    » Hb
    » Urgent Electrolyte
    » ABG
  - Transfusion instruction

- Patient positioning
  - Turning
    • free / logroll*  Q  H
  - Prop up
    • To ______ degrees / not allowed*
  - Pillow
    • allowed / not allowed*
    • Ordinary pillow / cervical pillow*

- Keep neck collar / lumbar corset
- Anti-thrombotic stockings
- Chart drain
- Analgesic
- Antibiotic
- Special Instructions
  • In case of need please contact Dr.

- Note: * delete where appropriate
Designated NS / APN

- He / she will make sure the post-operative instructions have been carried out appropriately.
C. Rehabilitation Phase

How is the patient doing after operation with continuous peer review
C. Rehabilitation Phase

1. Clinical aspect
2. Audit
Clinical aspect

- Direct telephone enquiry service provided by designated NS / APN to post-operative cases
- Follow-up in designated clinic for comprehensive care and rehabilitation
- Continuous documentation with various functional charts
Functional Charts

- Cervical and thoracic spine
  - Japanese Orthopaedic Association (JOA) Score
  - Visual Analogue Scale (VAS)

- Lumbar spine
  - Japanese Orthopaedic Association (JOA) Score
  - Visual Analogue Scale (VAS)
  - Oswestry Disability Index (ODI)
Audit

- Clinical outcomes and delayed onset complications will be kept under continuous surveillances.
- Spine surgery audit meetings will be held regularly.
Results
• Reference
  578 operations
  – 537 patients
    • 40 had 2 operations
    • 1 had 3 operations

16 salvage operations
(2.77%)

• Study
  344 operations
  – 329 patients
    • 15 had 2 operations

5 salvage operations
(1.45%)
Age distribution

- Reference

AGE

GROUP: 1 reference group

Std. Dev = 15.93
Mean = 51.7
N = 578.00

- Study

AGE

GROUP: 2 study group

Std. Dev = 15.80
Mean = 52.3
N = 344.00
Sex distribution
(reference)

32% male
68% female
Sex distribution (reference Vs study)

- Reference: 32%
- Study: 40%

- Male: 68%
- Female: 60%
Type of operation
(elective Vs emergency)
(reference)

19% elective
81% emergency
Type of operation
(elective Vs emergency)
(reference Vs study)

- Reference: 19%
- Study: 33%
- Reference: 81%
- Study: 67%

Legend:
- Blue: Elective
- Red: Emergency
Region of operation (reference)

- Cervical
- Thoracic
- Thoracolumbar
- Lumbar
- Other
Region of operation (reference Vs study)

- Cervical
- Thoracic
- Thoracolumbar
- Lumbar
- Other

Study reference
Diagnosis (reference)

- Myelopathy
- Radiculopathy
- Spinal stenosis
- Instability/deformity
- Fracture/dislocation
- Cauda equina
- Others
- Infection

%
Pathology (reference)

- lig. ossification
- degeneration
- PID
- tumour
- trauma
- infection
- inflammation
- iatrogenic
- others

%
Pathology (reference Vs study)

- lig. ossification
- degeneration
- PID
- tumour
- trauma
- infection
- inflammation
- iatrogenic
- others

%
Management (reference Vs study)

decompression fusion decompression + fusion repair deformity correction others

%
Surgical approach (reference)

- Anterior: 81%
- Posterior: 16%
- Combined: 3%
Surgical approach (reference Vs study)

- Study: 2%
- Reference: 3%
- Study: 13%
- Reference: 16%
- Reference: 81%
- Study: 85%

Legend:
- Blue: anterior
- Red: posterior
- Green: combined
Instrumentation (reference)

- Yes: 33%
- No: 67%
Instrumentation reference Vs study

- Reference, 67%
- Study, 69%
- Reference, 33%
- Study, 31%

yes
no
Complications
One month in-patient mortality

- **Reference**
  - 3 in 537 patients (0.56%)
  - 2 oncological cases
  - 1 admitted with traumatic tetraplegia

- **Study**
  - 1 in 329 patients (0.3%)
  - Septic spondylitis
Deep wound infection requiring surgical exploration

- Reference
  - 17 cases in 578 operations (2.94%)

- Study
  - 5 cases in 344 operations (1.45%)
Incidental durotomy

• Reference
  – 27 cases in 578 operations
    (4.67%)

• Study
  – 19 cases in 344 operations
    (5.52%)
Permanent neurological deficit

• Reference
  – 8 cases in 578 operations (1.38%)
  • 1 paraplegia
  • 5 cauda equina syndrome
  • 2 single leg weakness, need walking aids

• Study
  – 1 in 344 operations (0.29%)
  • Single leg weakness, walking aids not needed
Specific diseases groups
- cervical myelopathy
- lumbar spinal canal stenosis
- lumbar radiculopathy

• Reference
  - 324
  - 56%

• Study group
  - 210
  - 61%
Cervical myelopathy
## Post-surgery acute hospital stay

<table>
<thead>
<tr>
<th></th>
<th>Reference</th>
<th>Study group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of operation</td>
<td>103</td>
<td>54</td>
</tr>
<tr>
<td>Percentage of total operation</td>
<td>17.8</td>
<td>15.7</td>
</tr>
<tr>
<td>Mean (days)</td>
<td>24.3</td>
<td>15.2</td>
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<tr>
<td>Median (days)</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Mode (days)</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>
Clinical Improvement

- Before operation
  - VAS
    - 4.2
  - JOA score
    - 10

- At last follow-up
  - VAS
    - 2.4
  - JOA score
    - 13.5

Average follow-up duration:
10.8 months
JOA score improvement ratio

• Improvement ratio of Hirabayashi

\[
\left( \frac{(\text{post-OT score}) - (\text{pre-OT score})}{17 - (\text{pre-OT score})} \right) \times 100\%
\]

\[
\left( \frac{(13.5) - (10.0)}{17 - (10.0)} \right) \times 100\%
\]

= 50%
Lumbar spinal canal stenosis
## Post-surgery acute hospital stay

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<tbody>
<tr>
<td>Number of operation</td>
<td>133</td>
<td>100</td>
</tr>
<tr>
<td>Percentage of total operation</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>Mean (days)</td>
<td>12.4</td>
<td>8.6</td>
</tr>
<tr>
<td>Median (days)</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Mode (days)</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>
Clinical Improvement

• Before operation
  – VAS
    • 7.2
  – JOA score
    • 19.7
  – ODI
    • 43.8

• At last follow-up
  – VAS
    • 2.6
  – JOA score
    • 25.5
  – ODI
    • 19

Average follow-up duration: 11.7 months
JOA score improvement ratio

- Improvement ratio of Hirabayashi

\[
\left( \frac{\text{post-OT score} - \text{pre-OT score}}{29 - \text{pre-OT score}} \right) \times 100\%
\]

\[
\left( \frac{(25.5) - (19.7)}{29 - (19.7)} \right) \times 100\%
\]

= 62.4 %
Lumbar radiculopathy
Post-surgery acute hospital stay

<table>
<thead>
<tr>
<th></th>
<th>Reference</th>
<th>Study group</th>
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</thead>
<tbody>
<tr>
<td>Number of operation</td>
<td>88</td>
<td>56</td>
</tr>
<tr>
<td>Percentage of total</td>
<td>15.2</td>
<td>16.3</td>
</tr>
<tr>
<td>operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (days)</td>
<td>6</td>
<td>4.7</td>
</tr>
<tr>
<td>Median (days)</td>
<td>4.5</td>
<td>4</td>
</tr>
<tr>
<td>Mode (days)</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
Clinical Improvement

• Before operation
  – VAS
    • 7.8
  – JOA score
    • 17.3
  – ODI
    • 49.1

• At last follow-up
  – VAS
    • 1.5
  – JOA score
    • 26.3
  – ODI
    • 8.9

Average follow-up duration: 9 months
JOA score improvement ratio

• Improvement ratio of Hirabayashi

\[
\left( \frac{\text{post-OT score} - \text{pre-OT score}}{29 - \text{pre-OT score}} \right) \times 100\%
\]

\[
\left( \frac{29 - (17.3)}{29 - (17.3)} \right) \times 100\%
\]

= 76.9%
<table>
<thead>
<tr>
<th>Condition</th>
<th>Reference group mean post-OT stay (days)</th>
<th>Study group mean post-OT stay (days)</th>
<th>Average hospital bed-days saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical myelopathy (54)</td>
<td>24.3</td>
<td>15.2</td>
<td>491</td>
</tr>
<tr>
<td>Lumbar spine canal stenosis (100)</td>
<td>12.4</td>
<td>8.6</td>
<td>380</td>
</tr>
<tr>
<td>Lumbar radiculopathy (56)</td>
<td>6</td>
<td>4.7</td>
<td>73</td>
</tr>
</tbody>
</table>
Patient satisfaction
Among 50 randomly selected patients who had spine surgery in 2005

- 96% satisfied with consent procedure, pre-operative preparation and post-operative follow-up arrangements
- 96% satisfied with the professional care, explanation, education and management delivered by spine surgeons and nurse specialist
- Given the choice again, 90% would choose to have the same operation
Conclusion
The implementation of the spine surgery service plan apparently has
– reduced the incidence of major surgical complications
– reduced hospital stay
– generated objective satisfactory clinical outcome after surgery
– generated high patient satisfaction
Limitation and self-criticism
• Experiences of the surgeons
  • Reference group 12.2 years per case
  • Study group 13.4 years per case
• Mobility of the surgeons
  • 3 senior surgeons had left while 3 dedicated spine surgeons added to the pool
• Lack of independence (the auditor involves in operations actively)
• Retrospective nature in reference data collection
• Compliance to the working and auditing protocols
• Avoidance of complications ≠ good clinical outcome
  • Clinical improvement documentation not done in the reference group
The Future
– The service plan
– The data collection
– The auditing process

will be continued
- minimize the avoidable complications
- quality service to be maintained
Thank You