Acta Neurochir (Wien) (2008) 150: 111–118
DOI 10.1007/s00701-007-1472-y
Printed in The Netherlands

Acta Neurochirurgica

Clinical Article

Immediate (0–6 h), early (6–72 h) and late (>72 h) complications after anterior cervical discectomy with fusion for cervical disc degeneration; discharge six hours after operation is feasible

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Received 24 August 2006; Accepted 13 November 2007; Published online 10 December 2007

Summary

Objectives. The introduction of minimally invasive techniques and total intravenous anaesthesia has led to reports of the performance of anterior cervical discectomy and fusion as an outpatient. The safety of this approach, requires information about the complications presenting within this period. The aim of this study was to assess the rates and types of immediate (0–6 h), early (6–72 h) and late (>72 h) complications after anterior cervical discectomy with fusion.

Methods. We prospectively studied complications after anterior cervical discectomy with fusion in patients with degenerative cervical disc disease. There were 390 consecutive operations: 278 fused with autologous iliac crest bone graft and 112 with a PEEK (Polyetheretherketone) graft.

Results. No patient died. Thirty seven patients (9%) experienced one or more complications that could be related to the operation. These presented in the immediate, early and late periods in 17, 1 and 19 patients, respectively. Thus, 18/37 complications were detected before discharge from the neurosurgical department 48–72 h after operation and of these 17 (4.2%) were detected within the first 6 h after surgery. Each of the five potentially life-threatening neck hematomas was detected within 6 h (immediate).

Conclusions. After anterior cervical discectomy and fusion, a 6 h postoperative observation period followed by discharge from the neurosurgical unit is likely to be as safe as observation as an inpatient for a longer period.

Keywords: Cervical disc disease; anterior cervical discectomy with fusion; complications; surgery; inpatient; outpatient.

Introduction

Anterior cervical discectomy with fusion is a well-established treatment for symptomatic degenerative cervical disc disease [7, 9, 12, 15]. Currently most neurosurgeons perform this operation on an inpatient basis and discharge the patient only after postoperative neurosurgical observation for between 48–72 h. This has been regarded as essential in view of the possibility of serious complications, such as a neck hematoma, vascular injury, esophageal injury, vocal cord paresis and neural injury in this period [1, 2, 6, 14, 18, 23, 24, 26, 35, 37].

The introduction of minimally invasive techniques and total intravenous anesthesia has made it possible to perform cervical spine surgery on an outpatient basis [31, 34, 36]. However, adoption of an outpatient arrangement requires knowledge of the rate of occurrence of complications, especially those presenting within the

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first 72 h after surgery. Early discharge such as after a 6 h postoperative observation period will be appropriate only if it is very rare for a complication to present between 6 and 72 h after surgery.

In order to investigate the appropriateness of discharge from the neurosurgical unit after observation for only 6 h, we prospectively studied a consecutive series of patients who underwent anterior cervical discectomy and fusion as an inpatient. The complications that were detected were classified as immediate (presenting within 0–6 h after surgery), early (presenting within 6–72 h after surgery) or late (presenting >72 h after surgery).

Patients and methods

The study was performed prospectively in a single centre, the National Hospital Rikshospitalet, Oslo in Oslo in the period January 2003–2005. Data were collected on the post operative complications that occurred in 390 consecutive patients who underwent anterior cervical discectomy for cervical disc disease.

The criteria for selection for operation were: persistent severe radicular pain not responding to conservative management, cervical radiculopathy with progressive paresis and myelopathy due to disc disease. Exclusion criteria were: cervical injury within the previous four weeks, cervical tumour, ongoing cervical infection. The diagnosis was based on history and neurological examination and cervical MR imaging. In a few patients in whom MRI was contraindicated, cervical CT-myelography was used.

Anterior cervical decompression

In all patients we used an anterior approach to the cervical spine with a right-sided skin incision, as originally described by Robinson and Smith [28]. After verification of the level of interest with intraoperative X-ray radiography, a self-retaining retractor was mounted (Shadow line, V. Mueller Neuro/Spine Product, Cardinal Health, San Carlos, CA). The disc and the posterior longitudinal ligament were removed back to the uncovertebral joints. In most cases, we used the operating microscope and the disc was removed with a high-speed drill (Midas Rex, Medtronic, Memphis, TN). Removal of the posterior longitudinal ligament and the final decompression of the nerve roots were performed with small rongeurs. Bilateral nerve root decompression was always per, even in cases with unilateral symptoms. Distraction was achieved by using the Shadow line distraction System (V. Mueller Neuro/Spine Product, Cardinal Health). Fusion was either performed with a tricortical iliac crest auto graft or a PEEK (Polyetheretherketone) cage (Cervios, Stratec Medical, Oberdorf, Switzerland), at the discretion of the surgeon. After removal of the Shadow line distracter, the screw holes were always plugged with bone wax (Ethicon, Johnson & Johnson, Somerville, NJ) in order to prevent postoperative bleeding. Wound drainage was not routinely used. As infection prophylaxis, a single dose of cephalothin (30 mg/kg) was given 15–30 min before skin incision [13, 20–22, 25, 29, 30].

Iliac crest auto graft

The tricortical iliac crest auto graft was harvested from the right iliac crest. Care was taken to preserve the anterior 2 cm of the iliac crest and the lateral cutaneous femoral nerve.

The bone graft was harvested using an oscillating saw and graft cutter.

The bone bed was waxed with bone wax (Ethicon, Johnson & Johnson,USA).

Wound drainage was not routinely used. After wound closure 20 cc of bupivacaine was infiltrated into the surrounding soft tissue.

Number of neurosurgeons

The 390 patients included in this series were operated upon by twelve different neurosurgeons at Rikshospitalet, Oslo. The average number of procedures per surgeon was 32 (range 1–95).

Postoperative care

The patients were observed in a recovery unit for the first 4–6 h after surgery, before transfer to the ordinary neurosurgical ward. All patients were mobilized within 24 h after surgery and provided with a stiff collar. The vast majority were discharged from our hospital to the referring neurological department within 48–72 h after surgery. All were encouraged to return to their normal activities within 6–14 weeks after surgery. Outpatient review was done one, two and three months postoperatively by the referring neurological department. A final follow up was done after six months in our outpatient clinic when a detailed review of postoperative complications was carried out and an assessment of the final clinical result.

Surgery related complications

The following surgery-related complications were recorded: death within 30 days after surgery, operation at the wrong level, postoperative hematoma in need of surgical evacuation, injury of a carotid or vertebral artery, injury of esophagus, nerve root lesion, spinal cord lesion, dural tear with cerebrospinal fluid (CSF) leak, wound rupture, wound infection, lesion of the recurrent laryngeal nerve, urinary tract infection and pneumonia presenting within one week after surgery and tromboembolism presenting within one month after surgery. In patients in whom we used autologous crista bone graft, the following donor site complications were registered: postoperative hematoma in need of surgical evacuation, wound infection, wound rupture, lesion of lateral cutaneous nerve of thigh and donor site pain at six months postoperatively. Donor site pain was scored on a visual analogue scale (VAS, 1–10), and compared to an identical registration of donor site status preoperatively.

Database and statistical analysis

All data were entered in a database (Microsoft Access). Statistical analyses were performed using SPSS software (version 12, Chicago, IL).

Ethics

The database used in this study was approved by the Norwegian Authorities. In addition, all patients gave signed informed consent for entry of data into the database and study.

Results

Patient characteristics

We studied prospectively 390 patients of whom 178/390 (46%) were female and 212/390 (54%) male. The mean age at time of surgery was 48.1 years (range 26.9–82.8 years). Twenty-two (5.6%) of the patients had previously undergone anterior cervical discectomy and fusion. Operations were performed on 542 disc levels in the 390 patients. The number of fused levels per procedure, level of fusion and the fusion method used are given in Table 1.

Mortality

No patient died within 30 days after operation.

Table 1. *Characteristics of 390 patients undergoing anterior cervical decompression and fusion*

ACDF	No. of patients (%)
Levels per procedure	
One level	240 (61.5)
Two levels	148 (38.0)
Three levels	2 (0.5)
Level	
C3/C4	7 (1.8)
C4/C5	56 (14.4)
C5/C6	266 (68.2)
C6/C7	207 (53.1)
C7/Th1	6 (1.5)
Method of fusion	
Autologous bone graft	278 (71.3)
PEEK* cage	112 (28.7)

* Polyetheretherketone.

Table 2. *Summary of complications in 390 patients undergoing anterior cervical decompression and fusion*

Event	Rate	95%CI
Operation at the wrong level	1/390 (0.2%)	0.0–1.6%
Lesion of major artery	0/390 (0%)	–
Lesion of esophagus	0/390 (0%)	–
Vocal cord paralysis	1/390 (0.2%)	0.0–1.6%
Neurological deterioration	5/390 (1.2%)	0.5–3.1%
Hematoma (neck)	5/390 (1.2%)	0.5–3.1%
Wound infection (neck)	1/390 (0.2%)	0.0–1.6%
CSF leak	2/390 (0.5%)	0.2–1.2%
Thromboembolism	1/390 (0.2%)	0.0–1.6%
Pneumonia	0/390 (0%)	–
Urinary tract infection	5/390 (1.2%)	0.5–3.1%
Anterior graft dislocation	4/390 (1.8%)	0.3–2.8%
Dysphagia	3/390 (0.9%)	0.2–2.4%
Donor site morbidity (autologous crista graft)		
Hematoma	3/390 (0.9%)	0.2–2.4%
Infection	3/390 (0.9%)	0.2–2.4%
Lesion of lat. cut. nerve of thigh	3/390 (0.9%)	0.2–2.4%

Morbidity

A total of 37 complications were recorded in 35 patients during the study period. Thus, 9% of the patients experienced one or more complications that could be related to the surgical procedure. A summary of the complications are given in Table 2. Information about the complications for the respective patients are given in Table 3.

Time from surgery to detection of complications

The complications were detected during the immediate, early and late detection periods in 17, 1 and 19 patients,

Table 3. *Description of complications in affected patients*

Patient no.	Age (years)	Sex	ABG or cage	Disc level	Type of complication	Immediate, early or late	Persistent deficit at 6 months
1	37	F	ABG	6 + 7	operated at the wrong level	immediate	no
2	39	F	ABG	5 + 6	permanent vocal cord paresis	immediate	yes
3	44	M	ABG	5	neurological deterioration	late	yes
4	45	M	ABG	5	neurological deterioration	late	yes
5	48	M	ABG	4	neurological deterioration	immediate	yes
6	48	M	ABG	6	neurological deterioration	late	yes
7	48	M	Cage	5	neurological deterioration	immediate	yes
8	35	M	ABG	6	hematoma neck	immediate	no
9	56	M	Cage	5 + 6	hematoma neck	immediate	no
10	55	F	ABG	5 + 6	hematoma neck	immediate	no
11	53	F	ABG	4	hematoma neck	immediate	no
12	48	F	Cage	5	hematoma neck	immediate	no
13	64	M	ABG	5	wound infection neck	late	no
14	68	F	ABG	5 + 6	CSF leak	early	no
15	45	F	ABG	4 + 5	CSF leak	immediate	no
16	47	M	ABG	5 + 6	deep venous thrombosis	late	no
17	60	F	ABG	5	urinary tract infection	late	no
18	54	F	ABG	5	urinary tract infection	late	no
19	60	F	Cage	5 + 6	urinary tract infection	late	no
20	40	M	Cage	5	urinary tract infection	late	no
21	48	M	Cage	5	urinary tract infection	late	no
22	45	M	ABG	4	graft dislocation	immediate	no
23	54	M	ABG	4 + 5	graft dislocation	late	no
24	48	F	ABG	5 + 6	hraft dislocation	late	no
25	42	F	ABG	5	graft dislocation	late	no
25	42	F	ABG	5	dysphagia	late	no
24	48	F	ABG	5 + 6	dysphagia	late	no
28	51	F	ABG	6	dysphagia	late	yes
29	59	F	ABG	5	hematoma iliac crest	immediate	no
30	67	M	ABG	5	hematoma iliac crest	immediate	no
31	28	F	ABG	6	hematoma iliac crest	immediate	no
32	51	M	ABG	5	wound infection iliac crest	late	no
33	43	M	ABG	4 + 5	wound infection iliac crest	late	no
34	51	M	ABG	5 + 6	wound infection iliac crest	late	no
35	53	F	ABG	5	lesjon n.cut. fem. lat	immediate	yes
36	59	F	ABG	5	lesjon n.cut. fem. lat	immediate	yes
37	56	M	ABG	5 + 6	lesjon n.cut. fem. lat	immediate	yes

ABG Autologous bone graft.
Immediate = presenting within 6 h of surgery.
Early = presenting 6–72 h after surgery.
Late = presenting >72 h after surgery.

respectively (Table 3). Thus, 18/37 were detected before discharge from the neurosurgical department 72 h after the operation, and 19/37 after discharge. Of the 18 complications detected before discharge, 17/18 were detected within the first 6 h after surgery. Each of the five potentially life-threatening neck hematomas was detected within 6 h (immediate).

Postoperative neck hematoma

Five patients (1.2%) developed a postoperative hematoma. Each had symptoms of airway obstruction and swallowing disturbance, and the hematomas were diagnosed and evacuated within the first 6 h. They all recovered without any late effects.

Surgery performed at the wrong disc level

One patient had surgery at the wrong disc level (patient no. 1 in Table 3). Discectomy and fusion were planned on C5/C6 and C6/C7, but were performed on C6/C7 and C7/Th1. The mistake was discovered on the routine X-ray film taken 6 h after surgery. The patient refused to undergo a second operation. At the six-month follow-up consultation she had no symptoms or signs of cervical disc disease, and she was satisfied with the functional result of the operation.

CSF leak

Two instances of a CSF leak were detected. One patient (patient no. 14) was diagnosed during the operation and a

duraplasty was performed because of a rather large dural defect. This patient was Vietnamese and had pronounced ossification of the posterior longitudinal ligament. The CSF leak in patient no. 15 was diagnosed and reoperated after two days, with no consequences for outcome.

Wound infection

One patient (0.2%) developed a wound infection in the neck. The infection was diagnosed after discharge from the neurosurgical department. The patient was treated with systemic antibiotics and he recovered without any late problems.

Graft dislocation

Anterior graft dislocation was diagnosed in four patients (1%), while posterior graft dislocation was not observed. Each of the four patients with anterior graft dislocation had been fused with iliac crest bone graft. Thus, graft dislocation was not seen in patients fused with a PEEK cage. One dislocation was diagnosed immediately in the X-ray film taken routinely within 6 h after surgery (no. 22). This patient had no symptoms from the dislocated graft. The three other dislocated grafts were diagnosed late. Two of the patients had problems swallowing and were referred to X-ray (nos. 24 and 25). The swallowing problems resolved in both patients within three months. The third was diagnosed after three months after a routine X-ray film examination. None of the patients was reoperated upon within the six-months follow-up period.

Dysphagia

Three patients reported dysphagia. Two of them also had an anterior graft dislocation (nos. 24 and 25). These two patients had no problems with eating or drinking, and they considered their swallowing problem as minor. The third patient had severe swallowing problems that persisted at the six-month control. No graft dislocation was detected in this patient.

Vocal cord paralysis

One patient (0.3%) (no. 2) developed a permanent vocal cord paralysis. This was most possibly due to compression of the right recurrent laryngeal nerve due to suboptimal placement of the retractor.

Nerve root and spinal cord lesions

Neurological deterioration was diagnosed in five patients (1.2%). Patient no. 5 woke up after discectomy and fusion of C4/C5 with immediate weakness in the left arm, most pronounced in C5–C7 innervated muscles. Immediate MRI did not reveal any compression of neural structures. The patient recovered with a slight permanent paresis. Patient no. 7 woke up with a Horner's syndrome and during the following few days he developed a reflex dystrophy-like syndrome in the left arm and a light left sided myelopathy The Horner's syndrome disappeared, but the myelopathy and reflex dystrophy were still present after six months.

Patient no. 6 developed a complete right-sided C5 paresis after discharge from our department. He had been operated at level C6/C7, and MRI of the cervical column and plexus brachialis at time of neurological deterioration showed no signs of nerve compression.

Patient no. 4 developed a severe myelopathy with muscle and sensory symptoms after discharge. MRI showed that the nervous elements were decompressed and there were no new pathological signals in the spinal cord. Patient no. 3 reported no symptom relief after surgery, and he experienced worsening of his C6 radiculopathy after discharge. Each of the five patients with neurological deterioration still had a neurological deficit at six months.

Deep venous thrombosis and pulmonary embolism

Patient no. 16 developed a deep venous thrombosis and pulmonary embolism. He developed symptoms three days after surgery. Diagnostic work-up revealed Protein 3 deficiency. He used warfarin for six months and recovered without any symptoms.

Urinary tract infection

Five patients (1.2%) had an uncomplicated urinary tract infection. They were all diagnosed after discharge from our department.

Number of operated levels versus rate of complication

There was no difference in complication rate between single- or multi-level discectomy.

Fusion method and rate of complications

Graft dislocation was more frequent in patients fused with a tricortical iliac crest graft than with a PEEK cage, but the difference was not statistically significant using Fishers exact test ($P > 0.05$). Nine of the patients fused with autologous iliac crest graft had complications related to the harvest region on the iliac crest (donor site morbidity). There was a tendency to have more compli-

cations in the iliac crest group than the PEEK cage group but the difference was not statistically significant using the Pearson Chi-squared test ($P > 0.05$).

Donor site morbidity

Nine of the 37 complications were related to the bone harvest site on the right iliac crest. Six of them were diagnosed immediately (three iliac crest hematoma and three lesion of the lateral cutaneous nerve of the thigh); three infections were diagnosed in the late period. The patients with postoperative hematoma or infection recovered without persisting problems, whereas the patients with nerve damage all developed a permanent anaesthesia on the lateral side of the thigh.

All patients fused with an iliac crest graft were scored for right iliac crest pain before surgery and at six months after surgery using a visual analogue scale 1 is no pain and 10 is extreme pain. The mean preoperative VAS score was 1.38 (95% CI: 1.20–1.55), while the mean six month postoperative score was 1.64 (95% CI: 1.40–1.88).

Discussion

The introduction of minimal invasive techniques and total intravenous anaesthesia have made it possible to perform anterior cervical discectomy and fusion on an outpatient basis [31, 34, 36]. However, surgery in an outpatient setting requires knowledge of procedure-related complications, especially for those complications presenting within the first 72 h after surgery [1, 3–10, 12, 14, 16–18, 23, 24, 26, 31–33].

Outpatient setting versus inpatient setting

Nine percent of the patients experienced one or more complications that could be related to the surgical procedure. Of the 18 complications detected before discharge, 17 were detected within the first 6 h after surgery. These included the five potentially life-threatening neck hematomas. These findings indicate that an observation period of 6 h is sufficient to detect severe, except a few less severe complications occurring within the first 3 days after anterior cervical decompression and fusion. Accordingly a discharge from neurosurgery can be made after this time.

Postoperative hematoma

Postoperative hematoma in the neck is a serious and life-threatening complication. This occurred in 1.2% of our operations, each within 2–5 h after surgery and before the planned transfer to the ordinary neurosurgical ward. The hematomas were diagnosed with clinical examination alone and the hematomas were immediately evacuated. A 1.2% rate of postoperative hematomas is well within the rate reported by others [4, 11].

Surgery performed on wrong disc level

One patient had surgery at the wrong disc level. Major efforts have been made in order to prevent this from happening again. Intraoperative X-ray radiographic verification of correct disc level with a marker in the disc-space is mandatory in our department before disc removal and fusion.

Vocal cord paralysis

Permanent vocal cord paralysis is a serious complication and occurred in 0.2% (1/390) of our patients who were all operated from a right sided approach Others report the rate of this complication as from 1.2 to 4.5% [1, 2, 23, 24, 26].

Neurological deterioration

Neurological deterioration was diagnosed in five patients (1.2%). All five patients with a neurological deterioration had neurological deficits at six months. Studies indicate that neurological deficits present after six months are permanent [27].

Dysphagia

Mild transient dysphagia is most often due to irritation after intubation and tissue retraction [2, 32]. More seldom causes are anterior graft dislocation and severe esophageal injury. We had four patients (1.8%) with anterior graft dislocation. Only two of them had dysphagia, which was transient and moderate. In our series, we had no severe injury of esophagus or large blood vessels.

Fusion with autologous iliac crest graft or PEEK cage

ACDF with an autologous iliac crest graft or PEEK cage are both well-established procedures for treatment of cervical disc disease [9]. In our series, there was a tendency for the iliac crest group to have more complica-

tions than the PEEK cage group, but the difference was not statistically significant.

The difference was mainly due to donor site morbidity and anterior graft displacement in the iliac crest group. Donor site morbidity from the iliac crest has also been reported by others [19].

Strengths and limitation

This is a consecutive series of ACDF done in one neurosurgical unit with a defined catchment area. Thus, the patients in this series should be representative for patients with CDD in need of ACDF. However, even though we in this study had no life threatening complications presenting after the immediate postoperative phase, we cannot exclude the possibility that such complications might occur after 6 h postoperative observation in a larger series of patients.

Interpretation and application

The reported complication rates are based upon the routines and procedures at our department. Each department treating ACDF should monitor its own complications, and this is especially important when procedures are changed. All our patients were observed in the neurosurgical unit for 48–72 h. Although our series is reasonably large, it is not large enough to be completely confident that the risk of serious complications presenting after a six hours observation is low enough to allow discharge after 6 h. This should be explored in a larger prospective study.

In addition to absence of complications, early discharge requires a cooperative patient, adequate pain relief, no troublesome postoperative nausea, observation by non neurosurgical health professionals, family or friends for at least the first 24 h after discharge and arrangements for return to the neurosurgical department if needed.

Conclusion

Our study provide a basis for exploring, through further observations, the safety of discharging patients operated with ACDF from the neurosurgical unit after a 6 h observation period.

The extrapolation of these data to other departments must be done with caution. Each department must study their own complication rate and types of complications before changing to early discharge after ACDF and carefully monitor the effects of such a change.

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Comments

In our time with increasing economic restrictions in many hospitals, it is understandable why the authors have undertaken this prospective study, concentrating mainly on procedure-related complications in the early and late postoperative period. As all potentially life-threatening neck haematomas encountered in this series were detected within 6 h (5/390), the authors propose that anterior cervical discectomy with fusion is feasible and safe in an outpatient setting if a 6 h postoperative observation period is included.

It remains doubtful if this single-institution study can be extrapolated to all institutions since the low complication rate may well be related also to the clinical experience and facilities typical for a university hospital.

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The authors present data concerning a prospective assessment of 390 patients undergoing anterior cervical disc removal and fusion. The purpose of the paper is to assess the pattern of presentation of the various complications associated with this type of surgery and to relate this pattern to the time of patient discharge from hospital. This took place in a single centre over a two year period.

In itself the paper provides up to date data concerning the risks associated with this type of surgery and for this reason alone it could be considered as a useful exercise for the interested reader. The size of the study at 390 patients is significant and to be clear, the complications in question are those associated directly with the surgical procedure rather than the underlying pathology and fusion process.

Their results were such that slightly less than half of the complications involved were diagnosed prior to the patient's discharge at or before 72 hours following the surgery. Of these the great majority were in fact diagnosed within six hours of the surgical procedure. On this basis the authors indicate that discharge from hospital following this type of surgery is feasible after six hours have elapsed following the surgical procedure.

Surgery for this common type of degenerative pathology generally excites considerable discussion due to the diverse range of opinion and therapeutic endeavor that is brought to bear on cervical spondylosis.

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