

Complications of Anterior Cervical Discectomy with Interbody Fusion or Arthroplasty

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Abstract

Background: Anterior cervical discectomy with fusion or arthroplasty is a common procedure and has been associated with satisfactory outcomes. However, the incidence of complications, although uncommon, needs to be taken into consideration.

Aim of Study: Our aim is to raise awareness on anterior cervical disc procedures associated complications, their prophylactic measures proper management.

Patients and Methods: Our prospective study conducted on 156 patients; 99 males (63.5%) and 57 females (36.5%); their age range was 26 to 65 years (mean, 45.2; SD, 12.5). The study started from January 2014 to December 2019. The follow-up was for at least 1 year, and we evaluated the clinical and radiographic signs of complications.

Results: Thirteen patients (8.3%) had transient dysphagia and three patients (1.9%) had adjacent segment syndrome. two patients (1.3%) each had a post-operative hematoma and a dural tear, and two of fusion (1.4%) cases had pseudoarthrosis. One patient (0.6%) each had an esophageal injury, Recurrent laryngeal nerve palsy, post-operative weakness, Horner syndrome, wound infection, and slippage of artificial disc prosthesis.

Conclusion: Punctilious knowledge and early recognition of the anterior cervical disc surgery-segment syndrome, hematoma, and pseudoarthrosis were the most common complications in our study, and their incidence relatively increases in multiple level cases associated with comorbidity. Appropriate management was done in the most majority of our cases with good functional outcomes.

Key Words: *Anterior cervical spine surgery – Complications – Outcome – Anterior cervical discectomy – Interbody fusion – Arthroplasty.*

Introduction

CERVICAL spine degenerative conditions affect up to 65% of the population and considered as one

of the most common causes of acquired disability above fifty years old [1]. These disorders commonly present with axial pain, myelopathy, radiculopathy, or myeloradiculopathy. The locations of symptoms depending on the level of the intervertebral disc herniation and cervical nerve root compression [2]. Several treatment options are available for cervical disc degeneration, ranging from a conservative approach to surgery. Conservative treatment often consists of patient education, rest, a cervical collar, nonsteroidal anti-inflammatory drugs, corticosteroid, and physical therapy [3]. When conservative treatment fails, surgical treatment is considered, the anterior approach to the cervical spine constitutes a well-established surgical strategy, and one of the most commonly performed spinal procedures. Smith and Robinson [4] first described the anterior cervical spine approach and later different surgeons published several modifications of this original technique [5].

Anterior cervical approaches allow the efficient and safe management of degenerative cervical pathologies, they are more popular and provide relatively easy access to the vertebral column, and are associated with a high percentage of good clinical outcomes [6]. Anterior cervical approach constitutes one of the most effective and satisfying spinal procedures [7].

Abbreviations:

ACDF : Anterior Cervical Discectomy and Fusion.
ASD : Adjacent Segment Degeneration.
CSF : Cerebrospinal Fluid.
DDD : Degenerative Disc Diseases.
PEEK : Polyetheretherketone.
PLL : Posterior Longitudinal Ligament.
RLN : Recurrent Laryngeal Nerve.
VA : Vertebral Artery.

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Despite the overall good outcome, occasionally possible complications may have done [8]. Most of them are temporary, self-limited, and managed conservatively. Very rarely it may need surgical intervention, but in few cases, if they remain untreated may lead to death [9,10], the possibility for it including anatomical injury to the esophagus, vascular injury as carotid, vertebral arteries, and internal jugular vein. Dysphagia is a particularly common adverse effect in the early post-operative period [11]. Rihn et al., [12] in their study reported 71% of their cases had post-operative dysphagia after anterior cervical spine surgery.

For surgical leveling of nervous injury, the injury of recurrent laryngeal nerves occurs for surgeries at levels C5 to T1, the superior laryngeal nerves for surgeries at C3 to C4, injury of the vagus nerve, and damage of the pharyngeal plexus for surgeries at spinal levels C2 to C5, and the hypoglossal nerve for operations above C3 [13]. Other possible rare complication includes, Wound infection and discitis, dural tear and CSF leak, tracheal injury, spinal cord and nerve roots injury, cervical sympathetic chain injury and very rarely thoracic duct injury [14,15].

Early identification and prompt management of these potential complications are imperative for accomplishing good outcomes in these patients. Appropriate management of any procedure-related complications require meticulous knowledge of previously reported ones, and proper identification of any factors that might predispose their development [16].

Material and Methods

A prospective multicentric case series study was performed in Egypt and Saudi Arabia where the authors working, it was done from January 2014 to December 2019, our study was approved by our Institutions Review Board. A written consent form was before surgery obtained from all participants. All the participants' data handling was performed according to the Helsinki and the Health Insurance Portability and Accountability acts and all of them fulfilled the inclusion criteria. Which include patients presented by 1 to 3 levels DDD undergoing de novo anterior cervical disc surgery with fusion or arthroplasty, after a failure of conservative management. Where they presented by radiculopathy, myelopathy, or myeloradiculopathy due to primary anterior pathology and undergoing anterior cervical disc surgery. The exclusion criteria were revision surgery, cervical tumors, cervical trauma, myelopathy with ossification of posterior

longitudinal ligaments, myelopathy with posterior stenotic pathology, previous neck surgery as thyroidectomy. All patients underwent detailed neurological examination preoperatively, while their imaging workup included cervical spine plain X-rays and MRI. In some specific cases, the pre-operative evaluation also included dynamic X-rays, CT scans, and EMG and nerve conduction velocity studies, depending on the underlying pathology.

Routine blood workup, including cell blood count and prothrombin and partial thromboplastin times, were routinely obtained.

All anterior Smith-Robinson surgical approaches were performed from the right side, under general endotracheal anesthesia, and fluoroscopic imaging to confirm the index level/s. After thorough exposure, the microscopic discectomies were completely done, with removal of posterior longitudinal ligament and osteophytes if present. Careful preparation of the endplate by curettes, or high-speed burr was done in a flat and parallel fashion. Determination of implant size by a sized trial measuring the prepared disc space. A PEEK cage or arthroplasty implants were used for single or two levels cases while in three levels we used A PEEK cages, also plating was used in some cases with PEEK cages.

Post-operatively detailed clinical examinations during the patients' hospital stay was done, anteroposterior and lateral radiographs were ordered, and removal of sutures was done after 10 days. Post-operatively, a soft collar was worn for 12 weeks in all cases, and then follow-up included meticulous evaluation in our outpatient clinic for any procedure-related complications at 2 and 4 weeks and then at 3, 6, and 12 months after surgery.

Perioperative complications mean complications occurring during surgery or in the initial 14 days while the remaining considered as delayed.

Results

Patients' demographic and clinical data (Table 1):

Our study included 156 patients, 99 males (63.5%) and 57 females (36.5%) with male to female ratio of 3.3:1.9, the age of our patients ranged from 26 to 65 years (mean, 45.2; SD, 12.5). They were presented with radiculopathy in 90 cases (57.7%), myelopathy in 20 cases (12.8%), and myeloradiculopathy in 46 cases (29.5%).

We had 221 levels involved in the surgery (96 single levels, 55 two levels and 5 cases were 3

levels), all of them were distributed from C3-C4 to C6-C7, in which C5-C6 was the most common level operated (99 levels, 44.8%).

Our procedures were fusion by cage alone in 120 cases (77%), while cage with plating was used in 20 cases (12.8%) and cervical disc arthroplasty in 16 cases (10.2%).

The comorbidities in our cases were as follows hypertension in 20 cases (12.8%), ischemic heart disease in 10 cases (6.4%), and Diabetes Mellitus (DM) in 15 cases (9%).

Table (1): Patients' demographic characteristics in our study.

Features	Number of cases (%)
Sex:	
Male	99 (63.5)
Female	57 (36.5)
Total	156 (100)
Age:	
20-30	2 (1.3)
31-40	50 (32.1)
41-50	62 (39.7)
51-60	34 (21.8)
>61	8 (5.1)
Presentation:	
Radiculopathy	90 (57.7)
Myelopathy	20 (12.8)
Myeloradiculopathy	46 (29.5)
Number of levels:	
Single level	96 (61.5)
Two levels	55 (35.3)
Three level	5 (3.2)
Levels of surgery:	
C3-4	7 (3.2)
C4-5	55 (24.9)
C5-6	99 (44.8)
C6-7	60 (27.1)
Spinal procedure:	
Cage alone	120 (77)
Cage with plating	20 (12.8)
Arthroplasty	16 (10.2)
Comorbidities:	
Hypertension	20 (12.8)
Ischemic heart disease	10 (6.4)
Diabetes mellitus	15 (9)

Perioperative complications (Table 2):

The patients developing perioperative complications are summarized in (Table 2). Accidental dural penetration occurred in two patients (1.3%). post-operative CSF fistula developed in one case and treated by a lumbar drain insertion. In the other case, it was a minimal leak and a small dural patch was applied and fixed by bio glue for dura sealing and to prevent a CSF leakage, a Valsalva maneuver

was done and there was no CSF leak. Both patients had no further consequences.

Thirteen of our patients (8.3%) complained of mild to moderate post-operative dysphagia (defined as pain with swallowing, difficulty in swallowing, coughing or choking with swallowing, new-onset heartburn, regurgitation of old food, feeling of throat blockage, and/or frequent throat clearing). Two patients undergoing 3-level anterior cervical discectomy, five patients undergoing 2-level, and six patients undergoing single-level anterior cervical discectomy, and regarding plating, ten from our patients undergoing plating. The observed dysphagic symptoms were not severe in any of these patients, it was more prominent in regard to solid foods than liquids and vanished within 2 to 7 days after surgery. Accidental esophageal perforation occurred in one patient (0.6%), and the opening of the esophagus was intraoperatively recognized and surgical repair of the esophageal tear was performed by a cardiothoracic surgeon. The patient maintained regimens with no oral intake for 6 days after surgery and recovered with no other consequences. His follow-up revealed no dysphagia or any other difficulties.

Two patients (1.3%) developed post-operative soft tissue hematoma within the first 24 post-operative hours, one patient presented with surgical site swelling due to mild hematoma, he was treated conservatively with close observation and hematoma was spontaneously absorbed, another patient presented with severe dysphagia with larger hematoma and undergoing emergent exploration and evacuation and drain was inserted for 2 days and the patient was discharged well.

Symptomatic post-operative Recurrent Laryngeal Nerve (RLN) palsy occurred in one patient (0.6%), presenting with severe hoarseness post-operatively, and the diagnosis was confirmed by using indirect laryngoscopy. The patient was treated with small doses of methylprednisolone for 5 days and improved with no further consequences.

One patient (0.6%) has to worsen of preexisting myelopathy, a cervical spine MRI, obtained immediately after the procedure, revealed a cord contusion at the level of the surgical intervention, which was apparently the result of an overzealous surgical maneuver. The patient was placed on intensive physical therapy and their neurologic examination was gradually improved within 6 weeks and returned to his pre-operative functional level 12 weeks after the procedure and had no neurologic

deficits or myelopathic signs at 12-month follow-up evaluation. In one case (0.6%), temporary unilateral Horner syndrome developed after surgery, ipsilaterally to the surgical site; this was spontaneously resolved within 6 weeks. Another patient (0.6%) developed a superficial surgical wound infection post-operatively, which was treated with oral antibiotics with no further consequences.

Delayed complications (Table 2):

One patient (0.6%) has extrusion of artificial disc prosthesis after 1 year in single-level C5-6 arthroplasty Fig. (1), the patient presented by dysphagia and radiological investigation shows extruded prosthesis, the patient undergoing surgery for its removal and ACDF by using the suitable size of the cage with plate fixation.

Adjacent segment disc degeneration was documented in three patients (1.9%), who undergoing a second ACDF procedure for managing their disease. Our study 140 patients undergoing ACDF, 2 of them (1.4%) have pseudoarthrosis in operated

levels (one case was single level C6-7 and another case was two levels C5-6 and C6-7).

Table (2): Review of complications.

Complications	Number of cases (%)
<i>Perioperative:</i>	
Dysphagia	13 (8.3)
Esophageal injuries	1 (0.6)
Post-operative hematoma	2 (1.3)
Dural tear	2 (1.3)
Recurrent laryngeal nerve palsy	1 (0.6)
Post-operative weakness	1 (0.6)
Horner syndrome	1 (0.6)
Wound infection	1 (0.6)
Total	22 (14.1)
<i>Post-operative:</i>	
Implant failure	1 (0.6)
Adjacent segment syndrome	3 (1.9)
Pseudoarthrosis	2 (1.4) from ACDF patients
Total	6 (3.8)
Total complication	28 (17.9)



Fig. (1): (A) Cervical disc arthroplasty of C 5-6 (B) Anterior slippage of artificial disc prosthesis (C) Interbody fusion of C5-6 with plate fixation.

Discussion

Our study represents 156 patients undergoing anterior cervical disc surgeries (discectomy and fusion or arthroplasty), similar to previous studies, most of them (66.7%) were more than 40 years of age, which is expected because the degenerative disease of the spine including cervical spine is more common in middle and old age groups [16]. Incidence of the degenerative cervical spine is more common in males than females as 63.5% were males in our study. the majority of operated patients (57.7%) presented by radiculopathy, while (12.8%) had myelopathy and (29.5%) had myelo-radiculopathy, the cause of the dominance of DDD

in males may relate to heavy work or smoking, which is more common in males and is a risk factor for DDD [17,18].

The most important findings from the current study are that the cumulative incidence of post-operative complications after anterior spinal surgery is as high as 17.9%. Complications at the early post-operative period are more common and in most instances do not require surgical treatment. In the majority of the previously published series, dysphagia and dysphonia are the most common postoperative complications, with rates ranging from 1-79% [19,20]. Dysphagia is routinely underestimated as a complication of anterior cervical

disc surgery and it leads to the wide variation of results [21]. There are reports on the incidence of post-operative dysphagia based on the surgeon's interpretation or the patient's interpretation. Thus, Johns et al. [22], reported that the incidence of dysphagia was 11 % when based on the physicians' notes, while it was 57% when the patients were surveyed. According to Dettori et al. [23], a patient's reported outcome has been shown to be more reliable, valid, and preferable. Tasiou, et al. [24], reported that the incidence of dysphagia was 1.7% but Khaki et al. [25] reported a 52% incidence of post-operative dysphagia in their patients. In our current series dysphagia was the most common postoperative complaint and represented in 8.3% of our cases. Our data showed that dysphagia was more common, among patients undergoing multiple levels of anterior discectomy, and its percentage was more common in multiple levels (2 and 3 levels) (11.7%) while it was (7.3%) in a single level, that finding might be explained by the fact that wider dissection and more soft tissue retraction are required in cases with multiple levels. Also, Oh et al., [26] reported significantly higher dysphagia rate for multiple-level ACDF (6.6%) than for single-level ACDF (4%). There is no significant difference between arthroplasty and ACDF, 1 case of arthroplasty (6.25%) and 12 cases of ACDF (8%), while McAfee et al., [27] documented a significant increase of dysphagia in ACDF (64%) more than arthroplasty (42%) and long term resolution of dysphagia in arthroplasty is better than ACDF. The development of delayed dysphagia should alarm the involved spinal surgeon in regards to the development of esophageal adhesion or strictures due to instrumentation failure. Isolated post-operative dysphagia was conservatively treated in all cases in our series with an excellent outcome. The incidence of esophageal perforation is 0.2%-1.15% [15]. In some cases, infectious spondylitis causes esophageal adhesions and it is considered the main cause of intraoperative esophageal perforation. However, perioperative and delayed esophageal perforations were caused by chronic irritation because of metal failure [28]. To avoid this complication, blunt dissection by the fingers is recommended for exposures below the superficial cervical fascia. Careful retraction to mobilize the esophagus can help to prevent injury. In our study, we have 1 case (0.6%) of esophageal injury repaired intraoperatively with no further consequences.

The development of post-operative wound hematoma was the second most common and potentially catastrophic, complication in our current series (occurring in 1.3% of our patients). Post-operative wound hematoma presented mainly as a

neck mass associated with dysphagia and occasionally as respiratory distress. Its incidence among previously reported series varied between 0.2% and 2.4% [24]. Meticulous hemostasis, avoidance of prolonged or vigorous soft tissue retraction, and sharp (instead of blunt) dissection may be a few measures that can prevent the development of a wound hematoma.

One rare but potentially serious complication is a dural tear causing a CSF leak. This is reported to occur in 0.2% to 0.5% of cases of ossification of the posterior longitudinal ligament up to 4.3% to 32% [17]. In our series, the accidental dural tear was 1.3%, no meningitis developed in our patients. Similarly, Bertalanffy and Eggert reported that the incidence of an accidental dural tear in their series was 1.8% [29]. Meticulous and careful microscopic dissection during the Posterior Longitudinal Ligament (PLL) opening, especially in chronic-standing disc extrusion cases, and/or in cases of ossified PLL is of paramount importance to decrease the incidence of the dural tear.

Injury or excessive pressure on the recurrent laryngeal nerve, superior laryngeal nerve, or hypoglossal nerves can lead to vocal cord paralysis, which occurs in less than 1% of cases [14]. In our series, the incidence of symptomatic RLN palsy was documented in 0.6% of our patients. It is documented that the incidence of spontaneous a symptomatic RLN palsy is approximately 8.3% in the early post-operative period, while another 10.8% of their patients remained asymptomatic despite the presence of RLN paresis or paralysis [30]. Contrariwise, Starmer et al., [31] found that post-operative vocal fold paralysis after anterior cervical disc surgery was only 0.1%. Causes of injury include neuropraxia by over-stretching, nerve division or ligature, ischemia by pressure, and oedema due to surgical trauma. Of these, ischemia is most common due to decreases in mucosal and neuronal capillary blood flow. Careful dissection and placement of the retractors under the longus colli muscle belly and avoidance of the tracheoesophageal groove are helpful to avoid vocal cord paralysis. The longus colli should not be shredded during elevation to maintain a firm anchor point for the placement of retractors. Sharp-toothed retractor blades are advised as they have better anchorage because blunt tooth blades can easily slip and compress the trachea and esophagus medially or carotid laterally.

Worsening of preexisting myelopathy may occur in any spinal procedure. Its incidence in our series was 0.6%. It is rare but is a risk in the presence of

significant stenosis. Injury is usually caused during osteophyte removal with Kerrison rongeurs or by drilling. Meticulous hemostasis, adequate illumination and visualization, experience, and proper technique are important to avoid this complication. Electrophysiological monitoring using somatosensory, and motor evoked potentials of the spinal cord is useful for monitoring during surgery and is especially useful in high-risk patients who have preexisting cord contusion or severe stenosis [14].

The incidence of Horner syndrome in anterior cervical disc surgery is approximately 4.2% [15]. In our study, 1 case (0.6%) developed temporary unilateral Horner syndrome after surgery, ipsilaterally to the surgical site; this was spontaneously resolved within 6 weeks. The cervical sympathetic chain is found between the carotid sheath and the longus colli, which is commonly mobilized during mid-cervical approaches to protect the sympathetic chain and prevent Horner syndrome, you should avoid aggressive retraction or dissection lateral to the longus colli [14].

Reports of post-operative infection in the anterior cervical spine range from 0.05% to 1.6% [32]. In our series, it was 0.6%. Tasio et al., [24] recorded 0.9% of their cases reported post-operative infection while Veeravagu et al., [33] found that post-operative surgical wound infection after anterior cervical discectomy and fusion was the most common cause for readmission [33]. Good surgical technique is fundamental for reducing infection. This includes meticulous dissection within avascular planes, potential dead spaces, the intermittent release of retractors, careful hemostasis with frequent irrigation and closure of potential dead spaces. Local application of vancomycin powder is also useful in reducing surgical site infections, especially in long posterior fusions [34].

No vascular injuries occurred in our current series. Vertebral artery injury during an anterior cervical disc surgery has been reported to be as high as 0.3%, it usually occurs during anterior foraminotomy. Packing of the bleeding site can usually control the hemorrhage; in the rare occasion that hemostasis cannot be achieved, proximal and distal dissection of the VA is necessary for ligation. Injury to the carotid artery can result from improper surgical dissection and excessive retraction, temporary clipping and surgical repair of the injured vessel's wall is the treatment option in cases of extensive carotid injuries [35].

Regarding late complication, we had one case (0.6%) of implant extrusion after 1 year, in previ-

ously published series with the development of implant, the rate of implant extrusion is ranging between 0% and 0.8%, and in most cases, it occurred in the first 30 days [36]. Good preparation of endplates to enhance fusion rate, a selection of the suitable size of the cage with good impaction and filling by enough amount of bone and also a selection of patients as non-osteoporotic, none renal failure and young age are generally preferred to prevent this complication.

Up to 15% of anterior cervical discectomy and fusion cases develop Adjacent Segment Disease (ASD) and the risk of its developing was 3% per patient per year [37]. In our study, we have 3 cases (1.9%) that developed ASD after 1 year of surgery. In another 21-year follow-up study of 409 procedures for 374 patients reported a 13.6% prevalence of symptomatic ASD at 5 years and 25.6% at 10 years [38]. Fusion-less surgery as arthroplasty is less likely to develop ASD. Plating can hasten ASD if it is placed within 5mm of the adjacent cranial disc segment and should be avoided [14].

The incidence of pseudoarthrosis varies widely from 0%-50% [39], in our study, 2 cases (1.4%) of ACDF developed pseudoarthrosis, risks include smoking, osteoporosis, increased fusion levels, poor surgical technique, use of antimetabolic agents including phenytoin, non-steroidal anti-inflammatory agents (some are avoided for at least 10 weeks as they reduce osteoblastic activity), collagen disorders and location of fusion. Bone substitutes like Bone Morphogenetic Proteins (BMP) are commonly used to improve fusion rates [40].

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مضاعفات الإستئصال الأمامي للقرص العنقي مع الدمج أو تقويم المفصل

يعد الإستئصال الأمامي للقرص العنقي مع دمج الفقرات أو تركيب مفصل مكان القرص المستأصل من أكثر الطرق شيوعاً في علاج إنزلاق القرص العنقي في حالة عدم إستجابة المريض للعلاج التحفظي كما أن نتائجه مرضية، لكن حدوث مضاعفات وإن كانت غير شائعة يجب أن تؤخذ في الإعتبار، هدفنا هو رفع الوعي حول المضاعفات المرتبطة بهذه الجراحة، والتدابير الوقائية الخاصة بها، والمناجزة السليمة لها. تضمنت الدراسة ١٥٦ مريض تراوحت أعمارهم بين ٢٦ و٦٥ عام خضعوا لإستئصال القرص العنقي من الأمام مع دمج الفقرات أو تقويم مفصل القرص العنقي وإستمرت متابعتهم لمدة عام على الأقل، وقمنا بتقييم العلامات السريرية والشعاعية للمضاعفات وكانت النتائج كالتالي: ثلاثة عشر مريضاً (٨.٣٪) عانوا من عسر بلع مؤقت (وهي أكثر المضاعفات حدوثاً) وثلاثة مرضى (١.٩٪) لديهم متلازمة تنكس الجزء (القرص العنقي) المجاور. مريضان (١.٣٪) كان لهما تجمع دموي بعد العملية الجراحية وأخران قطع في الأم الجافية، وإثنان من حالات الإندماج (١.٤٪) كان لديهم تمفصل كاذب. مريض واحد (٠.٦٪) كان يعاني من إصابة في المريء، وآخر من شلل مؤقت للعصب الحنجري، كما حدث ضعف حركي لأحد المرضى بعد إجراء الجراحة، ومتلازمة هورنر لمريض آخر، وحدثت عدوى سطحية بالجرح لأحد المرضى، كما حدث إنزلاق (خروج) القرص الإصطناعي في أحد المرضى. وتم مناجزتها دون ترك أثر دائم على المرضى.

الخلاصة: يساعد التشخيص المبكر للمضاعفات المرتبطة بجراحة القرص العنقي الأمامي على مناجزتها بشكل صحيح. وفي هذه الدراسة كانت احتمالية حدوث المضاعفات تزداد نسبياً في الحالات متعددة المستويات والمصاحبة بأمراض أخرى. وتم إجراء المناجزة المناسبة في معظم حالاتنا مع نتائج وظيفية جيدة.