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REVIEW

Cranial nerve palsies following neuraxial blocks

Nöroaksiyel blokları takiben gelişen kraniyal sinir felçleri

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Summary

Spinal anesthesia is one of the most frequently performed regional anesthesia techniques for a variety of surgeries worldwide. Cranial nerve palsy is a rarely reported complication of central neuraxial block. The etiology varies; however, it is most often associated with nerve compression or traction due to intracranial hypotension. In October 2023, we searched PubMed and Google Scholar databases for English-language articles published between 1952 and 2023. The following search terms were used in the search strategy: olfactory, optic, oculomotor, trochlear, trigeminal, abducens, facial, vestibulocochlear, glossopharyngeal, vagus, accessory, hypoglossal nerve palsies, and epidural, spinal anesthesia, or dural puncture. The search was limited to humans and case reports written in English. We analyzed 89 articles and case reports in this review. In this article, a review of 105 cases published so far in the literature is presented. Cranial nerve palsies were more common in obstetric and gynecological cases. The 6th cranial nerve palsy was reported most frequently. Paralysis of more than one cranial nerve may develop simultaneously and may be bilateral or unilateral. In general, unilateral paralysis has been observed. The most common finding in 3rd, 4th, and 6th cranial nerve palsies was diplopia. In 8th cranial nerve palsy, hearing loss was the most observed symptom. PDPH is mostly associated with cranial palsies in most cases. It was observed that early recognition of patients with symptoms and utilization of diagnostic methods were effective in treatment. The most common cranial nerve injuries following spinal and epidural anesthesia and dural puncture are 6th and 3rd cranial nerve palsies. Symptoms are believed to occur mainly due to variations in cerebrospinal fluid (CSF) pressure. It is recommended to design treatment plans based on the mechanism.

Keywords: Cranial nerve palsies; cranial nerves; epidural anesthesia; neuraxial blockage; spinal puncture.

Özet

Spinal anestezi, tüm dünyada çeşitli ameliyatlar için en çok uygulanan bölgesel anestezi tekniklerinden biridir. Kraniyal sinir felci, santral nöroaksiyel bloğun nadiren bildirilen bir komplikasyonudur. Etiyolojisi değişkenlik göstermekle birlikte, en sık intrakraniyal hipotansiyona bağlı sinir sıkışması veya traksiyonu ile ilişkilidir. Ekim 2023'te PubMed ve Google Scholar veri tabanlarında, 1952 ile 2023 yılları arasında yayınlanmış İngilizce makaleler arandı. Bu derlemede, 93 makale ve olgu sunumunu analiz ettik. Bu makalede, literatürde şimdiye kadar yayınlanmış 105 vakanın bir derlemesi sunulmuştur. Kraniyal sinir felçleri obstetrik ve jinekolojik olgularda daha sık görüldü. En sık 6. kraniyal sinir felci bildirilmiştir. Birden fazla kraniyal sinirin felci aynı anda gelişebilir ve bilateral veya unilateral olabilir. Genel olarak tek taraflı paralizi gözlenmiştir. 3., 4. ve 6. kraniyal sinir felçlerinde en sık görülen bulgu diplopi idi. Sekizinci kraniyal sinir felcinde ise en fazla işitme kaybı görülmüştür. Semptomları olan hastaların erken tanınması ve tanı yöntemlerinin kullanılmasının tedavide etkili olduğu görülmüştür. Spinal ve epidural anestezi ve dural ponksiyon sonrası en sık görülen kraniyal sinir yaralanmaları 6. ve 3. kraniyal sinir felçleridir. Semptomların esas olarak beyin omurilik sıvısı (BOS) basıncındaki değişikliklere bağlı olarak ortaya çıktığı düşünülmektedir. Tedavi planlarının mekanizmaya göre tasarlanması önerilmektedir.

Anahtar sözcükler: Epidural anestezi; kraniyal sinir felçleri; kraniyal sinirler; nöroaksiyel blokaj; spinal ponksiyon.

Introduction

Today, spinal anesthesia is a regional anesthesia technique used for surgeries below and above the umbilicus, with many advantages and complications that should be well known. It is a technique commonly used in urology, gynecology and obstetrics, lower abdominal and perineal surgery, lower extremity orthopedics, and vascular surgery. It should be noted that both general and spinal anesthesia have advantages and disadvantages.[1]

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Table 1. Reported 2nd cranial nerve palsies and their characteristics in the literature

CN	Year/ author	Procedure/ indications/ gauge/ type	Headache	Presentation	Etiology	Tre.	Outcome
2.	1988/ De Lange[22]	SA/ CS/ 22G/ NA	Yes/non-positional	Visual black spots	Hypotension secondary to spinal block	NA	Permanent bilateral visual loss
	1988/ De Lange[22]	SA/ CS/22G	Yes/ non-positional	Visual black spots	CSF loss	NA	Permanent bilateral visual loss
	2002/ Gupta[2]	EA/ CS/ NA/ NA	No	Visual black spots	Hypotension secondary to spinal block	NA	Permanent unilateral visual loss

Tre: Treatment; CN: Cranial nerve; CS: Cesarean section; CSF: Cerebrospinal fluid; EA: Epidural anesthesia; NA: Not available; PDPH: Post dural puncture headache; SA: Spinal anesthesia.

Early and late complications can occur after spinal anesthesia. Physicians should know how to manage the complications that may occur, albeit rarely, with neuraxial blocks such as spinal anesthesia, which they will prefer, given the balance of benefits and harms to patients. Post-dural puncture headache (PDPH) is the most reported side effect following spinal anesthesia, yet diplopia, hearing loss, cortical blindness, and cranial nerve palsies are rare yet undesirable complications. The proposed mechanism of cranial nerve palsy is intracranial hypotension, resulting in nerve compression or traction due to cerebrospinal fluid leakage.[1,2] While these symptoms usually occur within the first three days after surgery and are usually reversible, they may become permanent infrequently. In this article, we will summarize cranial nerve palsies, a rare problem that can occur following spinal anesthesia, epidural anesthesia, and neuraxial blocks, along with the procedures that facilitate diagnostic approaches and applications for treatment.

Methods

We searched spinal anesthesia, epidural anesthesia, and dural block-related cranial nerve palsy cases published in PubMed and Google Scholar databases from 1952 to 2023. The following search terms were used in the search strategy: olfactory, optic, oculomotor, trochlear, trigeminal, abducens, facial, vestibulocochlear, glossopharyngeal, vagus, accessory, hypoglossal nerve palsies, epidural or spinal anesthesia, dural puncture, neuraxial blocks, pneumocephalus. The search was limited to humans and case reports written in English.

Results

We summarized the symptoms, diagnostic methods, and treatments of cranial nerve palsies after epidural, spinal anesthesia, and dural puncture confirmed in the literature that has been published from 1952 to October 2023. No case reports were identified for olfactory nerve palsy following spinal or epidural anesthesia. We analyzed 89 articles and case reports in this review. In this article, a review of 105 cases published so far in the literature is presented. The 6th cranial nerve palsy was reported most frequently.

Vision problems: Visual complaints after spinal anesthesia have been described long ago. In the retrospective investigations and case reports, patients referred to diplopia, blurriness, inability to read, sensitivity to light, spots in front of the eyes, and difficulties focusing. Additionally, almost all of these patients also complained of headaches. The literature describes paralysis of the optic, oculomotor, trochlear, and abducens nerves following spinal anesthesia. After neuraxial punctures, the abducens nerve is the most affected cranial nerve (92–95%). The long and sensitive intracranial route of the abducens nerve causes the condition.[3]

2nd cranial nerve (optic nerve): Cases of optic nerve paralysis following neuraxial block have been reported. The symptoms and findings observed are unilateral/ bilateral permanent or temporary vision loss and pericentral scotomas. In these case reports, the etiology of pigment changes in the macular area was evaluated as non-arteritic anterior ischemic neuropathy and ischemic optic nerve traction.[4,5] In Table 1, we summarized

the 2nd cranial nerve palsies published in the literature. 3rd cranial nerve (oculomotor nerve): Looking at the cases in the literature about oculomotor nerve palsy, which is the most affected after the 6th cranial nerve; blurred vision, ptosis, anisocoria, reduced ocular adduction, and infraduction can be observed. These findings are more common in the right eye; however, they can be monitored bilaterally. They may be isolated or associated with the 4th or 6th cranial nerves. Although it is transient in most cases, corrective surgery of the extraocular muscles has been required in 2 patients in the literature.[6,7] Although the best-defined mechanism is cranial hypotension due to CSF leak, there are also cases where oculomotor nerve palsy develops due to pneumocephalus.[8] Treatment of pneumocephalus is conservative, including 100% oxygen supplementation with a nonrebreather mask, flattening of the head of the bed, and avoidance of the Valsalva maneuver.[9]

4th cranial nerve (trochlear nerve): Despite traveling the longest intracranial distance and being the thinnest cranial nerve, paralysis following neuraxial block is rare. When affected, it causes upward eye deviation because the superior oblique muscle is involved. Also, vertical diplopia with a torsional component may be seen, mainly in a downward gaze and most commonly on the opposite side of the paralyzed muscle. Diagnosis may be delayed because the 6th cranial nerve is usually involved. Therefore, symptoms may be transient or permanent.[5,10,11]

6th cranial nerve (abducens nerve): The abducens nerve has the highest incidence of paralysis after spinal anesthesia. Its length is considered to make it susceptible to this type of traction, and it is relatively fixed at its entry into the cavernous sinus and at its junction with the pons. During its course, it may be subjected to pressure where it crosses the petrous crest of the temporal bone and adjacent to the anterior inferior cerebellar artery.[12] When affected, findings are observed that are related to the paralysis of the M. rectus lateralis. Unilateral involvement is more frequent. Diplopia was the most common finding. Bilateral involvement has been observed in only one case. Simultaneous involvement of the 6th and 4th has been seen in one case; also, involvement of both the 6th and 7th has been seen in one case. Previous headache was noted in all cases of N. abducens involvement. These patients were treated with an epidural blood patch (EBP), epidural saline, and IV mannitol. Only one patient required surgery. The mean time to recover from abducens nerve palsy was 30 days.[11] Cases of ocular motor nerve palsies after neuraxial block are summarized in Appendix 1.

5th and 7th cranial nerves (trigeminal and facial nerve): Cases of isolated trigeminal nerve palsy have been reported in the literature. These cases are detailed in Table 2. Patients describe numbness of the tongue and face without motor involvement as symptoms. Both the 7th cranial nerve and the 5th cranial nerve may be affected at the same time. This results in a peripheral type of facial paralysis. It is difficult to distinguish from Bell's palsy. The facial weakness may recover completely, yet there are cases of partial recovery in the literature.[13]

8th cranial nerve (vestibulocochlear nerve): In 8th cranial nerve palsy after neuraxial block, symptoms such as sensorineural hearing loss, dizziness, buzzing in the ear, and headache have been observed. Considering the pathophysiology, changes in cerebrospinal fluid pressure are thought to affect hearing function. After the dural puncture, intracranial CSF pressure decreases due to CSF leakage. The development of endolymphatic hydrops is possible. The hair cells in the inner ear are affected, and sensorineural hearing loss is observed. In these cases, diagnostic tests such as early audiological tests, MR, and CT scans have shown their importance in achieving a complete recovery with early intervention. The epidural blood patch is the first treatment to be considered in these patients. There is also evidence that oral, intravenous, and transtympanic steroids may be beneficial. Hyperbaric oxygen therapy may also be an adjunct to these treatments (Appendix 2).[14]

9th cranial nerve (glossopharyngeal nerve): The glossopharyngeal nerve receives mucosal and gustatory sensations from the posterior third of the tongue. It supplies motor fibers to the pharynx and tylopharyngeus muscle during speech and swallowing. There is a case report of a 9th cranial nerve palsy after an epidural injection (Table 3). On the third postoperative day, the patient experienced severe headache, dizziness, and lisping in speech when standing up. Shortness of breath, difficulty

Table 2. Reported 2nd cranial nerve palsies and their characteristics in the literature

CN	Year/ author	Procedure/ indications/ gauge/ type	Headache	Presentation	Etiology	Treatment	Outcome
5.	1978/ Lee J.[61]	SA/ Labor/ 25G/ NA	Yes/ PDPH	Left-sided numbness of tongue and face, initially postural	CSF loss	Intravenous fluid, abdominal binder	Resolved completely
5. and 7.	1998/ Carrero[62]	EA/ Labor/ 18G/ Tuohy	Yes/ PDPH	Right-sided 5:1,5:2,5:3 paresthesia/ numbness, 5:3 motor function preserved. R-sided 7. nerve palsy	Changes in CSF pressure	Conservative	PDPH resolved palsies improved by discharge. No follow-up
5. and 7.	2001/ Sanders[63]	EA/ Labor/ NA	Yes/ PDPH	Left-sided 7. CN palsy and L tongue numbness	Ischemic stretch on CN, CSF leak or Bell's palsy	EBP and prednisolone	Resolved completely
5.	2006/ Zeidan[64]	SA/ CS/ 26G/ Atraucan	Yes/ PDPH	Right-sided 5. Nerve palsy, R-sided limb weakness	SDH	Conservative	Resolved completely
5. and HS	2006/ Lynch[65]	EA/ Labor/ 17G Touhy	No	Decreased sensation to light touch on the left cheek in the distribution of the maxillary branch of the trigeminal nerve, miosis and ptosis on the left side.	NA	Conservative	Resolved after 30 minutes later
5. and 7.	2010/ Chambers[59]	CSEA/ CS/ 27G Whitacre, & 16G Tuohy	Yes/ PDPH	Left-sided tongue numbness and 7. Nerve palsy	SDH	EBP	PDPH resolved, partial resolution of CN palsy
5. and 7.	2010/ Fang[13]	CSEA/ CS/ 25G Whitacre & 16GTuohy	No	Intraoperative: abnormal R-sided face and tongue sensation.	Changes in CSF pressure	Steroids	Partial resolution at 6 weeks
5. and 7.	2015/ Richa[66]	EA/ NA	Yes/ PDPH	Left-sided 5. nerve distribution paraesthesia/ numbness and left-sided 7. nerve palsy	SDH	EBP	Resolved completely

CN: Cranial nerve; HR: Horner syndrome; CS: Cesarean section; CSA: Continue spinal anesthesia; CSEA: Combined spinal epidural anesthesia; CSF: Cerebrospinal fluid; DP: Dural puncture; EA: Epidural anesthesia; EBP: Epidural blood patch; EI: Epidural injection; LP: Lumbar puncture; NA: Not available; PDPH; Post dural puncture headache; SA: Spinal anesthesia; SDH: Subdural hematomata.

in swallowing, and loss of taste in the posterior 1/3 of the tongue were observed. When the patient was lying down, these symptoms decreased. The patient refused epidural blood patch treatment. Resting in a supine position was recommended, and ibuprofen treatment was given. To reduce the risk of DVT, she was assisted with physical therapy. She could walk asymptomatically on postoperative day 7, and no neurological sequelae were observed during the 3-month follow-up.[15]

10th cranial nerve (vagus nerve): Vagus nerve palsy is rarely reported, with only six cases to our knowledge (Table 3). All cases presented with transient vocal cord paralysis. Vocal fold paralysis (VFP) is often missed and under-reported due to the delayed onset of symptoms and dysphonia not attributed to spinal anesthesia. Guardiani and Sulica[16] published the results of laryngeal electromyography in a patient. They demonstrated denervation of the arytenoid muscle (innervated by the recurrent laryngeal nerve) and the cricothyroid muscle (innervated by the superior laryngeal nerve). This indicates partial vagus nerve injury rather than isolated recurrent laryngeal nerve palsy.[17] Currently accepted treatment options are observation, speech therapy, or surgery. Vocal cord medialisation with methylcellulose was performed in one case, steroid treatment was applied in two cases, and the other cases were followed conservatively. Temporary resolution was observed in all patients.[18]

11th cranial nerve (accessory nerve): The cranial part of the accessory nerve has a similar function with the vagus nerve. It carries motor innervation to the pharyngeal constrictors, laryngeal, and soft palate muscles (except for the tensor veli palatini). The spinal accessory nerve innervates both the trapezius and sternocleidomastoid muscles. There have been 12 case reports in the literature so far. Difficulty in swallowing and speech, decreased shoulder range of motion, and changes in phonation may be seen. Symptoms began during the procedure and resolved within 90 minutes in all but one case. For one patient who had undergone prostate resection, symptoms started on the fourth day after discharge. After two weeks of conservative treatment, no deficit and symptoms were resolved completely (Table 3).[19]

12th cranial nerve (hypoglossal nerve): There is one case in the literature in which the 12th and 6th cranial nerves were affected together 3–4 years after CSE. Because of the palsy of the 6th cranial nerve, the patient had difficulty in abduction of the right eye. Due to 12th cranial nerve palsy, dysarthria, minimal dysarthria, and tongue atrophy were observed. After the epidural blood patch, the findings of the 6th cranial nerve palsy regressed, but neural demyelination continued in the 12th cranial nerve. The muscle atrophy findings did not regress.[20] In another case, unilateral Horner's syndrome developed after the removal of the epidural catheter. Sensory and motor deficits in the arm and loss of facial sensation along the maxillary and mandibular tracts of the 5th cranial nerve were observed on the same side. The inability to move the tongue to the affected side was noted (Table 3).[21]

Discussion

The diagnosis of cranial nerve palsy is a diagnosis of exclusion. A process can make the diagnosis of exclusion of other potential causes due to intracranial hypotension after neuraxial block, spinal anesthesia, and epidural anesthesia techniques. In the pathophysiology, intracranial hypotension, subdural hematoma, and pneumocephalus are considered the most common causes, but there are also cases with unknown etiology. In the differential diagnosis, conditions such as neoplasm, ischemia, aneurysm, encephalitis, and trauma should be excluded. The type and size of the needle were found to be significant risk factors for CSF leakage. Large and sharp needles are thought to cause more damage to the dura. Brain MRI is superior in ruling out intracranial CSF inflammation or mass. Paralysis of more than one cranial nerve may develop simultaneously and may be bilateral or unilateral. In general, unilateral paralysis has been observed. The coexistence of some cranial nerve palsies is common. For example, the 3rd, 4th, and 6th cranial nerves may be affected together. There are also cases where the 5th and 7th cranial nerve palsies coexist. In some cases, permanent cranial nerve palsies persist despite treatment. PDPH is associated with cranial palsies in most cases, with exceptions. The type and size of the needle were found to be significant risk factors for CSF leakage. Large and sharp needles are thought to cause more damage to the dura. Cranial nerve palsies are more

Table 3. Reported 9th, 10th, 11th, 12th cranial nerve palsies and their characteristics in the literature

CN	Year/ author	Procedure/ indications/ gauge/ type	Headache	Presentation	Etiology	Treatment	Outcome
9.	2018/ Liao [88]	CSEA/ CS/ 18G Tuohy and 18 G	Yes/ PDPH	Dizziness, slurred speech, dyspnea, difficulty swallowing, and inability to feel taste in the posterior half of the tongue.	Accidental dural puncture with 18G needle and CSF loss	Ibuprofen and bed rest	Resolved completely
10.	2014/ Guardiani[16]	CSEA/Labor	NA	Recurrent VFP	Intracranial Hypotension	Steroids	Residual paresis
10.	2014/ Guardiani[16]	SA/ Arthroplasty/ NA	NA	Hoarseness and choking with liquids	Intracranial Hypotension	Conservative	Residual paresis
10.	2014/ Guardiani[16]	SA/ Knee surgery/ NA	No	Dysphonia	Intracranial Hypotension	Medialization with methylcellulose	Residual paresis
10.	2020/ Sharma[89]	SA/ CS/ 25 G Quincke	No	Hoarseness, Vocal cord palsy	CSF loss	Conservative speech therapy	Hoarseness: improved, vocal cord: normal movements
11.	2020/ Akhaddar[19]	SA/ TUR-P / NA/ NA	Yes/ PDPH	Dysphagia, dysphonia and spinal accessory nerve palsy	CSF loss	Conservative	Resolved completely
5. and. 12. CN and HS	2009/ Rowley[21]	EA/ CS/ 16G/ Tuohy	No	Left-sided Horner's syndrome with ptosis and miosis, decreased motor power on elevation of her left shoulder, decreased sensation over her face	CSF loss	Conservative	Resolved Completely
12.	2018/ Aytuluk[17]	SA/ Arthroplasty/ 25G/ Quincke	Yes/ PDPH	Dysphonia and hoarseness of the voice, dysphagia	Intracranial hypotension, CSF loss	Oral steroids	Resolved Completely
Lower CN	2019/ Saeks[15]	SA/ CS/ NA	Yes/ PDPH	Bilateral vocal fold paralysis, hoarseness and dysphagia	Intracranial hypotension, CSF loss	Conservative	Normal function of the right vocal fold and near-normal function on the left.
6. and 12.	2020/ Pirbudak[20]	SA/ CS/ 18G/ Tuohy and 27G Whitacre	Yes/ PDPH	Right-sided 6. Nerve palsy, difficulties in speaking	Intracranial hypotension, CSF loss	Hydration, analgesics, acetaminophen, propyphenazone, caffeine, Blood patch	Persistent hypoglossal nerve palsy

CN: Cranial nerve; HR: Horner syndrome; CS: Cesarean section; CSEA: Combined spinal epidural anesthesia; CSF: Cerebrospinal fluid; NA: Not available; PDPH: Post dural puncture headache.

common in obstetric and gynecologic cases. Early diagnosis and treatment were influential in the complete recovery of patients. Bed rest and supportive therapies have been effective in relieving symptoms. Caffeine, mannitol, and NSAIDs have also been used in a limited number of patients. Epidural blood patch and steroid therapy have been successful in relieving symptoms. Help from other medical specialties is essential for early diagnosis. Brain MRI and CT are practical in early diagnosis. The findings may appear late.

Conclusions

After neuraxial block, spinal anesthesia, and epidural anesthesia techniques, the most common cranial nerve palsies were the 6th and 3rd cranial nerve palsies. Paralysis of more than one cranial nerve may develop simultaneously and may be bilateral or unilateral. It is common for some cranial nerve palsies to occur together. PDPH has co-occurred in almost all cases of cranial nerve palsy. In the pathophysiology, intracranial hypotension, subdural hematoma, and pneumocephalus have been recognized as the most common causes. Cranial nerve palsies were more common in obstetric and gynecological cases. Needle type and size were found to be significant risk factors for CSF leakage. Current data are limited to case reports and reviews, and it is essential to better recognize these common complications and determine their treatment.

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