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Epidemiological Evaluation of Intracranial Epidermoid Tumor

Divye Tiwari, Kulwant Singh, Vivek Sharma

*Department of Neurosurgery, Institute of Medical Sciences, Varanasi, India

Abstract

Introduction Epidermoid tumor are benign slow growing lesions of ectodermal origin that present approximately 1% of all primary intracranial neoplasm.

Material and Method This observational study was conducted at Department of Neurosurgery, Institute of medical sciences, Banaras Hindu University, Varanasi. The design of study was both prospective and retrospective. In Prospective study newly diagnosed histologically proved patients who attended the out patient department between August 2009 to August 2011 were included. Patients who had radiologically proved but refused to give consent for operation were not included in the study. For retrospective study registered cases between august 2004 to august 2009 from medical records with confirmed radiological diagnosis and histopathological ***Result*** were included. Results Epidermoid constituted 1.7% of total intracranial tumors. The mean age of all patient's were 38.26+_12.87 (range24-64 years).The most common location was cerebellopontine angle present in 23(67.64)patients. Headache was most common symptom at the time of presentation. The duration of symptoms range from three months to 14 years with mean of 35 months. Patients who presented with only Trigeminal neuralgia had a mean duration of symptoms of 29.4 months as compared to 38.4 months for those who did not have trigeminal neuralgia.

Conclusion Epidermoid are uncommmon benign intracranial lesions. They have characteristic presentations and specific radiological findings. While gross total resection of epidermoid (radical removal of cyst content and lining wall)is the definitive treatment to prevent recurrence and aseptic meningitis but sometimes subtotal resection may be necessary to preserve neurological function. It should be strongly suspected in young patients presenting with features of trigeminal neuralgia not responding to medical therapy, these patients should be investigated radiologically for early detection and better management.

Address for correspondence and reprint requests to:
Dr.Divye Prakash Tiwari 175/4 Kalinga Colony, Araghar, Hardwar Road, Dehradun-248001 Uttanchal, India Email kamlatiwari7@gmail.com

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Introduction

Epidermoid tumors are benign, slow-growing lesions of ectodermal origin that represent approximately 1% of all primary intracranial neoplasms [Guidetti B et al, 1977, Russell DS et al, 1989]. They are also known as a congenital cholesteatoma or

pearly tumor, epidermoid cysts (E Cs) typically remain clinically silent and may not present until adulthood due to a protracted, linear growth rate. [Love JG et al, 1936, MacCarty CS et al, 1959, Ulrich J, 1964]. Epidermoids most frequently occur at the cerebellopontine angle, parasellar region, middle cranial fossa, craninal diploe, and spinal canal. The cerebellopontine angle (37.3%) and the parasellar region (30%) are the most common [Russell DS et al, 1989, laconetta G et al, 2001, Netsky MG, 1988] location.

Epidermoid cysts generally appears as well-circumscribed, homogenous, lobulated, hypodense masses on Computerised Tomo graphy (CT) scans. Due to their avascular nature, epidermoids are generally nonenhancing. [Akar Z et al, 2003, Sirin S et al, 2005, Vinchon M et al, 1995]. However, minimal rim enhancement along the periphery has been demonstrated in approximately 25-35% of cases. Diagnosis of epidermoid cysts through CT alone is difficult, as they are often in close proximity to the skull base and maintain a similar radiographic appearance to cerebrospinal fluid. As such, Magnetic Resonance Imaging (MRI) is considered superior to CT scanning due to its increased resolution and the absence of artifact originating from the skull base [Ichimura S et al, 2008, Lunardi P et al, 1992]. On T1-weighted MRI, epidermoid cysts generally appear hypointense, whereas T2-weighted MRI demonstrates a hyperintense lesion [Morishita T et al, 2009, Ichimura S et al, 2008].

However, standard MRI is often insufficient to reliably confirm a definitive diagnosis of epidermoid cyst, as several other lesions may present with similar radiologic findings [Zada G et al, 2010]. As such, diffusion-weighted imaging (DWI) and fluid-attenuated inversion recovery (FLAIR) imaging should be utilized, as epidermoids appear characteristically hyperintense on both of these sequences [Nakao Y at al, 2010, Morishita T et al, 2009, Aribandi M et al 2008, Ichimura S et al, 2008, Dechambre S et al, 1999].

The treatment for epidermoid tumors is gross total surgical resection and general carries a good prognosis. While spontaneous remission of symptoms has been known to occur secondary to cystic rupture and decompression, this provides only temporary relief [Fiume D et al, 1988, Ziyal IM et al, 2005, Tancredi A et al, 2003, Yamakawa K et al, 1989].

The present study aims to evaluate intracranial epidermoid tumors with respect to clinical symptoms and signs in different age groups, location, radiologic features, different surgical option, postoperative complications and outcome.

Materials and Methods

This observational study was conducted at Department of Neurosurgery, Institute of Medical Sciences, Banaras Hindu University, Varanasi. The design of study was both prospective and retrospective.

Prospective Study

In prospective study, histologically proved newly diagnosed patients of both sexes in all age groups, who attended the outpatient department between August 2009 to August 2011 was included in the study. Patients who had radiologically proved but refused to give consent for operation were not included in the study. An informed consent was taken from all the patients. They were further assured that their identity would be kept confidential. A complete history thorough clinical examination was done in all the patients and recorded in predesigned proforma.

Table 1 : The qualitative (MRI) finding of epidermoid cyst

Case No.	Age/ sex	Lesion location	Mass effect	T1 W SE (600/12)	T2 W FSE (4500/82)	FLAIR (9000/124)	Diffusion trace EPI
1	32/F	Lateral ventricle	Minimal	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
2	36/M	Cerebellopontine angle cistern	Extensive	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
3	44/F	Cerebellopontine angle cistern	Extensive	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
4	24/F	Cerebellopontine angle cistern	Extensive	Homogenous isointensity	Homogenous isointensity	Homogenous hyperintensity	Hyperintense
5	64/F	Cerebellopontine angle cistern	Minimal	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
6	34/M	Cerebellopontine angle cistern	Modrate	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
7	38/F	Cerebellopontine angle cistern	Modrate	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
8	45/M	Fourth ventricle	Extensive	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
9	26/M	Cerebellopontine angle cistern	Minimal	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
10	36/F	Cisterna magna	Extensive	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
11	54/M	Perimesencephalic cistern	Modrate	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
12	45/F	Cerebellopontine angle cistern	Modrate	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
13	30/M	Cerebellopontine angle cistern	Modrate	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
14	53/M	Cerebellopontine angle cistern	Modrate	Inhomogenous isointensity	Inhomogenous isointensity	Inhomogenous hyperintensity	Hyperintense
15	33/M	Perimesencephalic cistern	No	Homogenous isointensity	Homogenous isointensity	Homogenous hyperintensity	Hyperintense

All the patients were counseled about the natural course of disease, various treatment modalities and outcome of the disease. Following clinical data were collected: patient's age at surgery, sex presenting symptoms and signs and tumor location based on CT scan or MRI. Tumor location was divided into two groups: supratentorial and infratentorial. Computed tomography (CT) scan or magnetic resonance imaging (MRI) was also evaluated for contrast enhancement and associated hydrocephalus.

All the patients underwent surgery. Patients were grouped as who underwent shunt operation followed by tumor resection and who underwent tumor resection directly. The extent of surgery was evaluated by extensive review of all operative protocols. Surgical resection was classified as: total resection, near total resection and partial resection. Postoperative complications like cranial nerve palsies, chemical meningitis etc. were evaluated. All patients were followed up on 3 monthly basis. CT scan/MRI brain was done for evaluation of recurrence.

Retrospective Study

In retrospective study, we collected medical record of all patients with confirmed radiological diagnosis registered between August 2004 to August 2009 were included in the study.

The patient data was collected from the patient follow up records regarding radiological (CT/MRI) diagnosis of intracranial epidermoid, age, sex, presenting symptoms and sign, tumor

Table 2: CT Findings (n-34)

Location	Hypodense	Peripheral/ Central enhancement	Surrounding oedema	Secondary Dystrophic calcification	Hydrocephalus
Suprasellar	1	-	-	-	-
Sylvian	2	-	-	-	-
Perimesencephalic	5	-	-	-	-
Interhemispheric	1	-	-	-	-
Cerebellopotine angle	23	1	-	-	11
Cisterna magna	1	-	-	-	1
Fourth ventricle	1	-	-	-	1

location, completeness of resection, operative complications, histopathological diagnosis and follow up regarding recurrence.

Results

Total 2000 patients of intracranial tumor were reviewed out of which 1500 were supratentorial and 500 were infratentorial respectively. Out of these 34 patients were diagnosed as intracranial epidermoid based on CT/MRI. This constituted 1.7% of total intracranial tumors. The mean age was 38.26 ±12.87 (range 24-64 years) and the male: female ratio was 1.5:1. The most common location was cerebellopontine angle present in 23 (67.64%). Headache was most common symptom at the time of presentation. MRI brain was done in 15 patients and CECT brain was done in all 34 patients (Table 1 & 2).

The duration of symptoms range from three months to 14 years with mean of 35 months. Patients who presented with only trigeminal neuralgia had a mean duration of symptoms of 29.4 months as compared to 38.4 months for those who did not have trigeminal neuralgis.

Obstructive hydrocephalus was mild in six, moderate in five and severe in 2. Routine MR imaging was done in 15 patients. All epidermoid were isointense or nearly isointense with CSF on T1-and T2-weighted images without contrast enhancement. On FLAIR sequences, tumors were slightly to moderate hyperintense. On DWI, epidermoids were seen as hyperintense lesions. As expected, MRI demonstrated the extent of tumor and deformation of brain stem better than CT.

Four patients underwent ventriculoperitoneal shunting preoperatively. In case of cerebellopontine angle epidermoid, primarily 22 patients

Table 3: surgical Approach and Extent of Removal

Supratentorial	**No. of patients (n=9)**
Surgical approach	
Craniotomy and total excision of cyst under microscope	9
Infratentorial	**No. of patients (n=25)**
Surgical approach	
Retrosigmoid	22
Combined (Retrosigmoid+Subtemporal)	1
Midline Suboccipital	2
Extent of Removal	
Total	24
Near Total	8*
Partial	2

* One patients underwent subsequent surgery for the residual epidermoid, which could be near-totally removed.

Table 4 : Postoperative complications and persistence of preoperative neurological deficit

Supratentorial (N=9)	**Total removal (n=9)**		
• Suprasellar • Sylvian • Perimesencepheric • Interhemispheric	1 2 5 1		
1. Focal defict 2. Post operative seizure 3. Chemical meningitis	None None None		
Infratentorial	**Total Removal (n=15)**	**Near-Total Removal (n=8)**	**Partial Removal (n=2)**
Cerebellopontine Angle Epidermoid (n=23)			
Cisterna magna Epidermoid (n=1)			
Fourth ventricle Epidermoid (n=1)			
1.Cranial nerve dysfunction Vth (n=1) VIIth (n=4) VIIIth (n=2) VIIth and VIIIth (n=3) VIIth, VIIIth, IXth, and Xth (n=1)	 1 2(1) 2(1) 2 1	 - 1 - 1 -	 - 1 - - -
Total (n=11)	8(2)	2	1
2.Cerebellar dysfunction (n=2)	-	1	1
3. Chemical meningitis (n=2)	-	-	2
[a] Numbers in parentheses indicate permanent paresis. Not, applicable			

underwent retrosigmoid craniectomy. At the initial surgery, microscopic total excision was performed in 12 patients, near-total excision in 8, and partial excision in 2 (Table 3).

Eleven patients experienced deterioration of their cranial nerve functions in the postoperative period. Two patients who developed nerve injury during surgery did not show improvement in their nerve function. For the remaining nine, the deterioration was transient and improved by the time of discharge (Table 4).

No patients died during the hospital stay. All of the patients who had trigeminal neuralgia and hemifacial spasm were relieved of their symptoms. The two patients with postoperative worsening of nerve paresis improved by the time of discharge. Cranial nerve paresis improved by the time of discharge in all except the two patients in whom it occurred preoperatively. Of the 34 patients who were discharged from the hospital, nineteen experienced improved neurological statuses, two remained unchanged, and two experienced persistent cranial nerve paresis.

Postoperative elective CT was performed for 13 patients, either at time of discharge or during the follow-up examination. Eight of the 13 patients had undergone total excision of the tumor, four had undergone near-total removal, and one had undergone subtotal removal. The hypodense areas, although less than in the preoperative state, persisted at the site of the surgery, as revealed by CT, even when the tumor was completely or near-totally removed. For one patient, who had undergone a total excision, the hypodense area persisted even 5 years after surgery. MRI did not reveal any tumor recurrence but indicated CSF filling.

Discussion

Epidermoids are uncommon and represent 0.2 to 1% of all primary intracranial tumors reported by [Russel et al in 1989, Yamakawa K et al in 1989] reported incidence of epidermoid tumor between 0.3% to 1.8% of all primary intracranial neoplasms. [Wasenko JJ et al in 1991 & Nakao Y in 2010, Hao S in 2010, Morishiata T in 2009] reported the incidence between 0.2 to 1.8% .

Present study reported an incidence of 1.7% which is in accordance with other authors.

Epidermoid cysts are typically asymptomatic until the third to fifth decades of life with presentation at a mean age of 40 years. Although the tumor effects are dependent upon lesion location, tumor extension and mass effect on adjacent vital structures, their presentation ranges from mild headaches to seizures and rare fatal events [Forghani R et al, 2007, Ge P et al 2009, Goel A et al, 2010, Akar Z et al, 2003, Kambe A et al, 2003, Laster DW et al, 1977].

In the present study involving 34 patients, the mean age of presentation was 38.26±12.87 years. There is no specific sex predominance reported in literature although in our study male: female ratio was 1.5:1, statistical analysis could not be done due to small sample size.

They are usually benign extracerebral intradural lesions and are commonly located in the cerebellopontine angle (CPA) and sellar, parasellar, and intraventricular regions. Uncommonly, they may be located purely intracerebrally or in the region of the pineal gland [Martinez Lage JF et al, 1985, Ge P et al, 2009, Takahashi M et al 2007]. They can extend in both supratentorial and infratentorial compartments, either along the basilar artery or assuming an hourglass configuration in the paramedian position [Nakao Y et al, 2010]. Of all the epidermoids, 40% occur in the CPA, making it the most common site. The incidence of epidermoids among all the CPA tumors is approximately 5% [Zada G et al, 2010]. In the present study cerebellopontine angle was the most common site (73.53%) followed by parasellar region (23.53%). Epidermoid cysts can occur anywhere in the intracranial cavity, but most are located intradurally and in a paramedian position within the cerebellopontine angle (40-50%) or the parasellar region (30%) [Berhouma M et al, 2006, Forghani R et al, 2007 Zada G et al, 2010, Sener RN et al, 2004]. [Berhouma M et al in 2006, Forghani R et al in 2007, Zada G et al in 2010, Sener R N in 2004].

Epidermoids have an extremely slow linear growth rate [Morishita T et al, 2009]. Hence, the duration of symptoms is often prolonged and the patients present late in the course of the illness. The most common presenting clinical manifestation was headache (100%). However, as depicted in this study, patients often present relatively early when the predominant symptom is trigeminal neuralgia, probably because of the associated pain.

The symptoms and signs are caused by displacement of the adjacent neural and vascular structures. Trigeminal neuralgia was seen in 80% (10 to 13 patients) and hemifacial spasm in 8% (1 of 12 patients) of the patients with posterior fossa epidermoids reported by [Revilla Kambe A et al, 2003]. Painful tic convulsion (hemifacial spasm with ipsilateraly trigeminal neuralgia) occurs rarely [Nishiura I et al, 1989] and was present in one of our patients. Direct compression of the nerve at the root entry zone [Aribandi M et al 2008, Nagashima C et al, 1982, Akar Z et al, 2003, Diraz A et al, 1992], displacement of the trigeminal nerve and compression against a blood vessel [Osborn AG et al, 2006, Maeda Y et al, 1990, Liu P et al 2003] at the root entry zone, of a combination of the two [Smirniotopoulos JG et al 1995] have been postulated to be the cause.

Destruction of the petrous apex can occur because of slow compression of the hourglass epidermoid and was seen in one of our patients. High resolution CT and MRI are currently the investigative modalities of choice and are considered by

some to be complimentary to each other [Ciappetta P et al, 1990]. As revealed by CT, epidermoids are characteristically hypodense nonenhancing lesions (Berhouma M et al, 2006).however, they occasionally are hyperdense on plain computed tomographic scan [Cornell SH et al, 1977]. Enhancement with contrast is uncommon and often indicates a malignant transformation [MacKay CI et al, 1999, Goel A et al 2010]. Enhancement can also occur because of perilesional inflammatory granulation as a result of leakage of the irritative cyst fluid. In the present study, contrast ring enhancement was present in one patient. However, a histological examination did not reveal any evidence of malignant change. Direct coronal sections at the level of the tentorial hiatus can demonstrate the extension into the tentorial incisura and helps in the presurgical planning and approach,

MRI reveals epidermoid tumor to have long T1 and T2 relaxation times, possibly because of the presence of keratin in a solid crystalline state [Kaido T et al, 2003]. The CSF present in the interstices of the tumor can also cause long T1 and T2 relaxation times [Kadio T et al, 2003]. The proton density sequences can differentiate between the CSF and the tumor and, hence, can differentiate epidermoid from arachnoids cysts [Sener RN et al 2004, Laster DW et al 1977]. Conventional MRI offers minimal tumor-to-CSF contrast ratio and it is inferior to FLAIR and Diffusion Weighted (DW) imaging in detecting intracranial Ecs. Our study shows that primary Ecs and postoperative residual tumors can be easily depicted from the brain parenchyma and the surrounding CSF spaces on DW trace images. FLAIR sequence is superior to the conventional sequences in demonstrating the ECs. However, CSF artifacts together with the heterogeneous inner pattern of ECs limit the ability of FLAIR and conventional sequences in showing the borders of these tumors. DW-EPI sequences are highly sensitive in detecting the tumors with indistinct borders and which cannot be differentiated from the other intracranial cystic lesions. DW imaging sequences provide us with the additional information in detecting postoperative residual tumors and delineating their borders [Hakyemez et al, 2005].

Hydrocephalus is said to be uncommon because of the long-standing nature of the lesion and also because CSF can permeate through the crevices of the lesion. However, in the present study, 38.24% of the patients obstructive hydrocephalus and four (11.76%) of them required preoperative CSF diversion procedures. One patient (2.94%) required such a procedure in the postoperative period because of development of hydrocephalus as a sequelae of chemical meningitis. In a previously reported series, 12 of 30 patients with CPA epidermoid required shunt surgery for hydrocephalus [Sari A et al, 2005].

The surgical approach is generally determined by the location and the extend of the lesion. The lesion, when confined to the CPA, is approached by a retrosigmoid crainectomy, whereas significant supratentorial extension needs a combined retrosigmoid and subtemporal approach or a stages procedure. However, the tumor commonly extends into the hiatus and this incisural part can be completely removed with the posterior fossa approach [Smirniotopoulos JG et al, 1995, Roka YB et al, 2009]. In one patient who had supratentorial extension, the lesion could be removed completely through the retrosigmoid approach, whereas in another one patient with significant supratentorial extention, a second surgery by subtemporal route was required.

There is a controversy regarding the extent of removal. Although the aim of surgery is for complete removal, few authors advocate total removal of the tumor. [Hao S et al, 2010, Niikawa S et al, 1992, Roka YB et al, 2009]. It has been suggested that the microscopic meticulous sharp dissection, every bit of the capsule should be removed to prevent a recurrence, [Niikawa S et al, 1992] . However, adherence of the capsule to the important neurovascular structures in and around the brain stem often leads to its incomplete removal, [deSouza CE et al, 1989]. A conservative approach with decompression and the removal of the nonadherent portion of the capsule has been suggested by others. [Berger MC et al, 1985, deSouza CE et al, 1989, Lunardi P et al, 1990, Sami M et al, 1996, Vinchon M et al, 1995]. Coagulation of the residual capsule is also advocate to minimize recurrence [deSouza CE et al, 1989]. But is not widely practiced. It also may be dangerous to coagulate the remnant adherent capsule near the exquisitely sensitive cranial nerves, brain stem, or important vessels in the CPA. The occurrence of the high incidence of postoperative cranial nerve dysfunction (32.35%) in the present series is probably because of our initial aggressive approach in removing every bit of the capsule from the cranial nerves. A relatively high incidence of cranial nerve dysfunctions has been mentioned in the previously reported series, the majority of which, however, improve by the time of discharge or during the follow-up period. [Ciappetta P et al, 1990, Laster DW et al, 1977, Roka YB et al, 2009]. In all of our patients, except two in whom nerve function was damaged at surgery, the cranial nerve function improved. The risks and benefits of total removal should be considered on an individual basis, and when the capsule is densely adherent, it may be left behind because the lesion is benign and has extremely slow growth rate.

Chemical meningitis caused by spillage of the cyst contents occurs in the postoperative period, which usually is transient and self-limiting. [Roka YB et al, 2009]. It occurred in two patients and could be managed successfully with steroids. Excision of the capsule by sharp dissection. [Forghani R et al, 2007]. Irrigation of the CPA cisterns with hydrocortisone solution during the surgery. [Osborn AG et al, 2006], and delayed withdrawal of steroids in the postoperative period [Kurosaki K et al, 2005, Niikawa S et al, 1992, Furuhata S et al, 1993] have been advocated as possible measures for preventing chemical meningitis. The same procedure was practiced in the present study. Communicating hydrocephalus can develop as a sequelae to meningitis and might require CSF shunt procedure as required in one of our patients.

Partial removal of a lesion leads to recurrence which often occurs after a prolonged period as a result of the slow growth rate of the tumor. [Yasargil MG et al, 1989]. As the hypodense areas revealed by CT persist for a prolonged period, even after complete removal of the tumor, possibly because of a long-standing deformation of the neural structures, a diagnosis an early recurrence at an early stage is often not possible. MRI is useful to diagnose an early recurrence. [Niikawa S et al, 1992, Sener RN et al, 2004, Ciappetta P et al, 1990]. However, Subsequent surgery is often indicated only when the recurrent lesion is symptomatic.

Conclusion

Epidermoid cysts are uncommon benign intracranial lesions. They have characteristic presentations and specific radiologic findings which play an invaluable role in the diagnosis of these tumors. New MR techniques like Diffusion Weighted Imaging, FLAIR are most helpful tools

available at present helping neurosurgeon in preoperative specific diagnosis which in turn influences surgical timing and extent of surgical approaches for the best results. While the gross total resection of epidermoids (radical removal of cyst content and lining wall) is the definitive treatment of choice to prevent recurrence and aseptic meningitis however, a subtotal resection may be necessary to preserve neurological function. Contemporary microsurgical techniques with a more extensive exposure increase the possibility of obtaining safe total or near total cyst removal with near-zero mortality, acceptable morbidity and definite cure. Currently, adjuvant therapy for the treatment of benign epidermoid tumors is poorly documented in the literature and represents an important opportunity for future studies and progress.

Author's Contributions

DT, KS, VS: Conceived and designed the study and prepared the manuscript.

Conflict of Interest

The authors declare that there are no conflicts of interests

Ethical Considerations

The study was approved by the institute ethics committee.

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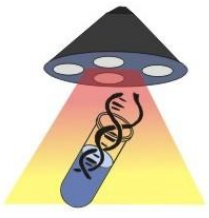

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