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CAN HISTOPATHOLOGICAL FEATURES OF OUTER MEMBRANE OF HEMATOMA HELP IN PREDICTING THE PROBABLE OUTCOME IN CSDH PATIENTS? – AN ASSESSMENT STUDY BASED ON CLINICAL-RADIOLOGICAL FINDING AND POSTOPERATIVE RECURRENCE

Neurosurgery

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ABSTRACT

BACKGROUND: A chronic subdural hematoma is a frequently encountered entity in neurosurgical practice with highly variable incidence owing to availability of diagnostic facilities and demography of population studied. Chronic SDH is a collection of liquefied clots often encountered in aged individuals with atrophied brain where mild head injury can result in tearing of blood vessels resulting in gradual collection of blood and its degradation products over a period of days to weeks.

AIM: To determine the histopathological features of outer membrane of CSDH and its association with clinico-radiological findings and postoperative recurrence .

MATERIALS AND METHODS: 25 patients diagnosed of chronic SDH treated in the Department of Neurosurgery, Coimbatore Medical College Hospital were studied. Their clinical and radiological findings with histopathological features of the CSDH membrane were recorded and analysed. HPE of outer membrane of CSDH were classified into four types based on the maturity and intensity of the inflammatory reaction and haemorrhage and its association with the clinico-radiological findings was assessed.

RESULTS: The common histopathological membrane was Type I (Non-inflammatory) which accounts for 40% followed by Type IV (Scar inflammatory) for 36%. Type II and Type III membrane accounts for 12% each. Most of the patients with Type II membrane presented with GCS less than 8. They had layering type of CSDH and required craniotomy for complete evacuation of hematoma. The size of the hematomas was large in Type II and Type III membranes and they had high recurrence rate.

CONCLUSION: Type II and Type III membranes are at high risk for developing neurologic deficit and have high recurrence rate hence they require craniotomy or frequent follow up is necessary if burrhole tapping was done.

KEYWORDS

Chronic subdural hematoma, CSDH, Histopathology, Membrane

INTRODUCTION

A chronic subdural hematoma is a frequently encountered entity in neurosurgical practice with incidence rate of 1-2/ 100,000 population per year[1,2]. Incidence may be as high as possible up to 13.1/ 100,000 population per year attributable either due to early diagnosis or increase in the population age above 65 years[3]. The dawn of the new millennia ushered the complex pathophysiology involved in evolution of chronic SDH with various studies focusing mainly on the contents of the hematoma cavity and the analysis of outer membrane. In the studies involving outer membrane, histopathological data were summarized based on maturity and intensity of the inflammatory reaction and haemorrhage and were classified. We intend to study the histopathological features of outer membrane of CSDH and to use it as an early predictor for assessing the patient outcome.

AIM

To determine the histopathological features of CSDH and its association with clinico-radiological findings and postoperative recurrence of CSDH patients.

MATERIALS AND METHODS

This study was started after obtaining Institutional ethics clearance and written informed consent from the close relatives. Twenty five patients diagnosed of chronic SDH who underwent surgery in our department from April 2017 to September 2017 were included. Thorough clinical examination and investigations were done. Burr hole and tapping was done for all patients except two in whom craniotomy was done based on layering type of CSDH found in CT examination. During the surgical procedure a small piece of outer membrane of about 0.8cm to 1 cm size were taken and subjected to histopathological examination. Patients were followed up for a period of six months to evaluate outcome.

Based on the maturity and intensity of the inflammatory reaction and haemorrhage, membranes were classified into four types:

- Type – I (Noninflammatory membrane) containing immature fibroblasts and collagen fibres and associated with very minimal or sparse cell infiltration and neocapillaries. [FIG 1(A)]
- Type – II (Inflammatory membrane) consisting of single layer of immature connective tissue associated with marked cell infiltration and vascularization throughout the entire thickness of membrane.[FIG 1(B)]
- Type – III (Hemorrhagic inflammatory) is a structure of more than one layer with capillaries of large lumen on the side of the duramater and associated marked cell infiltration .On the side of the hematoma cavity extensive neovascularisation is noted on the membrane. Sometimes a layer consisting of only collagen fibres and fibroblasts between such layers is seen. Haemorrhage into the membrane is often observed. [FIG 1(C)]
- Type – IV (Scar inflammatory membrane) shows inflammatory cell infiltration, neovascularisation and haemorrhage in the outer membrane of cicatricial tissue. [FIG 1(D)]

Clinical and radiological findings were correlated with the histopathology of outer membrane of CSDH.

RESULTS

Of the 25 patients, 21 were males and 4 were females with sex ratio of 4:1. Among the study group one patient who had history of hyperthyroidism under treatment died during immediate postoperative period due to arrhythmia. Fourteen patients were above 60 years of age.

The most common symptom at presentation was headache which was observed in 56 % cases and hemiparesis in 44% followed by vertigo/giddiness and vomiting each about 20% of cases. Further, altered sensorium(16%), seizures(8%), incontinence(8%) and speech disturbances (4%) were also noted as presenting symptoms. History of head injury was elicited in 56% of cases as a significant risk factor followed by history of chronic alcoholism in 15% of patients. Multiple risk factors and co-morbidities were found in few patients (Table 1). Most of the patients (88%) at the time of presentation had GCS between 13 and 15. Only 2 patients (8%) presented with GCS less than 8. All patients included in the study underwent CT Brain Plain study. The most common site of chronic SDH was frontotemporoparietal region (68%) followed by frontoparietal (20%). About 92% of cases had unilateral while 8% of cases had bilateral hematoma. Hematoma is more common on the left side compared to the right side.

In our series of cases, the most common histopathological type of outer membrane was Type 1 (Non inflammatory) in 40 % of the cases followed by Type 4 (scar inflammatory) in 36 % of the cases. While Type 2 (inflammatory) and Type 3(hemorrhagic inflammatory) membranes were seen in 12% of cases each (Table 2).

HPE-CLINICAL CORRELATION

Inflammatory(Type II) and hemorrhagic inflammatory (Type III) membranes are more often associated with headache and motor weakness compared to non inflammatory and scar inflammatory membrane types (Table 3).

HPE-RADIOLOGICAL CORRELATION

Average hematoma thickness was more in Type III membranes of about 14mm (13-15 mm) with a significant midline shift of 8.3mm (7.7—8.9 mm) when compared to other types (Table 4).

Based on CT appearance haematoma were broadly divided into homogenous and mixed types. Homogenous type further subdivided into hypodense, isodense and hyperdense varieties. Mixed density type subdivided into laminar, layered (separated/gradation) and trabecular (multilocular) types. Thin, high density layers usually along the inner membrane was classified as laminar appearance. Two components of different densities with low density anteriorly and high density posteriorly is classified as layered type. In layered variety hematoma with distinct margin is labeled as separated and those with indistinct margin as gradation type. If hematoma appears as mixed density with high density septations usually with low or iso-intense background it is known as trabecular (multilocular) type. (Table 5)
In this series, all the inflammatory type of membranes had mixed density of CSDH in contrast to 80% of Non-inflammatory membranes (Type I) which had homogenous density of CSDH in CT scans. About 2/3rd of patients with inflammatory type of membrane (Type II) presented with GCS <8. The layering type of CSDH in these patients necessitated craniotomy to achieve satisfactory evacuation. Type II and Type III membranes had one recurrence each.

DISCUSSION

CSDH is widely prevalent among elderly populations and its pathogenesis is a matter of interest and controversies in the literature for decades. Several factors held responsible for the progression and recurrence of this chronic disease. Research on the outer membrane of CSDH[4-12] and its neovascularization in correlation with the evolution of CSDH[11,12] is given more importance. At any point during hematoma progression microscopic examination of fluid collection reveals fresh erythrocytes indicating clinically silent rehemorrhage or progressive ongoing fresh hemorrhage from CSDH membranes[13,14]. The newly formed blood vessels appear to be more permeable and fragile than pre-existing vessels. Abundant neovascularization with abnormal dilated sinusoids and rapidly growing microcapillaries along with eosinophilic infiltration are characteristic of CSDH membrane [15]. Inflammatory mediators present in CSDH fluid may potentiate chronic rebleeding of the fragile neovasculature[16,17]. Eosinophil degranulation in the outer membrane is a source of fibrinolytic factors and other potent inflammatory mediators[13].

In 20th century CSDH was simply seen as the chronic form of acute SDH. It was thought that its development was continuum from acute to subacute and then to chronic SDH. Eventhough 1-6%of patients with untreated acute SDH experience transformation to CSDH the latter develops its own dynamics[18,19].

Of the 25 patients, 21 were males and 4 were females with fourteen patients above 60 years of age. Previous studies had reported similar epidemiological pattern with numerous publications [3,5,9,20-26]. The most common symptom at presentation was headache which was observed in 56 % cases. Bokka et al and Potdar et al support the initial clinical presentation but differs in reporting down the clinical ladder with varied claims of gait disturbances, altered sensorium and motor weakness for the second common presentation[21,26]. About 92% of cases had unilateral while 8% of cases had bilateral hematoma. Hematoma is more common on the left side (64%) compared to the right side (28%). Correspondingly Kim et al has previously published on anatomical asymmetry of the cranium influencing left sided predilection of CSDH after investigating 182 patients[27].

In our series of cases, the most common histopathological type of membrane was the Type 1 (Non inflammatory) seen in 40 % of the cases followed by Type 4(scar inflammatory) seen in 36 % of the cases which is in sharp contrast to previous study reports of Gandhoke et al, Nagahori et al, Park et al, Bokka et al and Potdar et al [5,9,20,21,26] who reported none or only few cases of non inflammatory types. We had logical reasoning to classify membranes with very slight or minimal infiltration of only small dispersed cells with no other evidence of inflammation as non inflammatory rather than club it into inflammatory types.

Inflammatory(Type II) and hemorrhagic inflammatory (Type III) membranes are more often associated with headache and motor weakness compared to non inflammatory and scar inflammatory membrane types as in the study by Park et al[20]. In our series 2/3 rd of patients with inflammatory type of membrane (Type II) presented with GCS <8 and the layering type of CSDH in these patients necessitated craniotomy which is similar to the observation by Gandhoke et al and Park et al[5,20]. Type II and Type III had one recurrence each which is equipoised with study by Park et al stating type II had the largest number of recurrences in their study (75%) but type III was reported with low recurrence rate(33%).

Histopathological typing of outer membrane in chronic subdural hematoma is recommended as the results of this histopathological correlation with clinical and radiological features can be extrapolated for further plan of management. A retrospective analysis of the patient's clinical condition can be made if membrane report is known (especially for Type II and III membranes). Further the role of membrane in hematoma evaluation can be roughly assessed with these findings.

Histopathological study of the membrane widens the spectrum of chronic SDH in terms of severity of disease and overall prognosis of patient .This study may serve as an incentive to investigate the histopathology of CSDH membranes in predicting outcomes and recurrence of CSDH after surgery.

CONCLUSION

Based on the HPE of outer membrane of CSDH, Type 1(40%) was found to be the most prevalent followed by Type 4(36%). Patients with type 2 and 3 membrane had higher recurrence when compared to other types. Considering CT finding layered type appearance found to have higher recurrence. Further improvisations like electron microscopic study of the outer membrane and biochemical analysis of CSDH fluid in high volume of CSDH patients may throw new insights.

FOOTNOTES: The authors have no financial conflicts of interest.

TABLE 1 PROBABLE RISK FACTORS

RISK FACTORS	NO OF PATIENTS	PERCENTAGE
HEAD TRAUMA	14	56%
ALCOHOL ABUSE	6	15%
HYPERTENSION	5	20%
DIABETES MELLITUS	5	20%
STROKE	1	4%
CARDIAC DISEASES	3	12%
SEIZURE DISORDER	1	4%
PSYCHIATRIC	2	8%
HYPERTHYROIDISM	1	4%

TABLE 2 STRATIFICATION BASED ON HISTOPATHOLOGY OF MEMBRANE

	NO OF PATIENTS	PERCENTAGE
TYPE I	10	40%
TYPE II	3	12%
TYPE III	3	12%
TYPE IV	9	36%

TABLE 3 CLINICAL AND HISTOPATHOLOGY CORRELATION OF MEMBRANES

PATHO TYPE	HEADACHE	MOTOR WEAKNESS	MENTAL CHANGE
TYPE I	**50%**	**30%**	**20%**
TYPE II	**66%**	**33%**	**66%**
TYPE III	**66%**	**66%**	**33%**
TYPE IV	**44%**	**44%**	**21%**

TABLE 4 RADIOLOGICAL PARAMETERS IN VARIOUS MEMBRANE TYPES

PATHOLOGIC TYPE	AVERAGE HEMATOMA THICKNESS(mm)	AVERAGE MIDLINE SHIFT(mm)
TYPE I	9 mm	6.1mm
TYPE II	11mm	7 mm
TYPE III	14 mm	8.3mm
TYPE IV	9.3 mm	6.2mm

TYPE 5 CT APPEARANCE IN VARIOUS MEMBRANE TYPES

PATHO TYPE	HOMOGENOUS			MIXED DENSITY		
	ISO	HYPO	HYPER	TRABECULAR	LAMINAR	LAYERED (GRADATION/ SEPERATED)
TYPE I	2	6	-	1	1	-
TYPE II	-	-	-	-	1	2 (GRADATION)
TYPE III	1	1	-	-	1	
TYPE IV	-	4	-	1	4	-

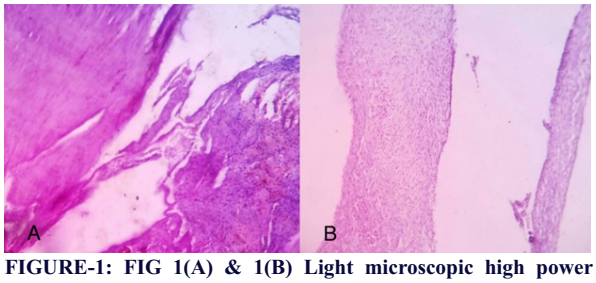

FIGURE-1: FIG 1(A) & 1(B) Light microscopic high power view(×100) of Type 1 and Type 2 membrane with H&E stain

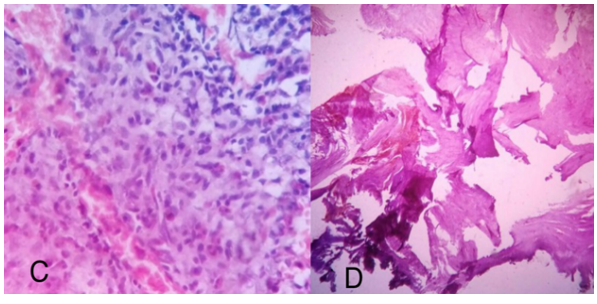

Figure-1 FIG 1(C) & 1(D) Light microscopic high power view(×100) of Type 3 and Type 4 membrane with H&E stain

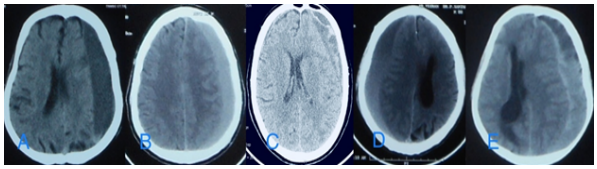

Figure-2 Varied CT Brain appearances of CSDH in the study(A)Homogenous hypodense (B)Homogenous isodense (C)Trabecular(D)Layered –Gradation Type(E) Laminar

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