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# Seasonal Variations In Incidence And Severity Of Spontaneous Intracerebral Hemorrhage In Hadoti Region

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**Abstract**

**Introduction and objetives** : Spontaneous intracerebral hemorrhage (ICH) is defined as intra parenchymal bleeding in the absence of trauma or surgery. Seasonal variation in incidence of ICH had been studied for long time but with variations in results. The aim of this study was to find association, if any, between incidence and severity of spontaneous ICH as per standard scoring system during summer and winter seasons in Hadoti region of Rajasthan.

**Material and Methods**: Our study was done in largest tertiary care hospital of Hadoti region during May 1st to June 30th in 2020 which was the summer season and December 15th 2020 to February 14th 2021 which was winter season in Hadoti region. Diagnosis of ICH was made based upon symptomatology, clinical examination and NCCT(Non-contrast Computed Tomography) of head. Severity of ICH was determined as per standard ICH scoring system(Dr.J.ClaudeHemphill, 3rd).

**Observations and results** : In our study, we found that occurence of spontaneous ICH was quite higher during winter season(115 patients) when compared to summer season(24 patients). In our study, incidence of ICH during summer was found to be higher in males(75%) and higher in females(54.7%) during winter. As per severity of ICH- 12.5%(3) patients had more severe ICH during summer, while during winter, 42.6%(49) patients had more severe ICH. While comparing the outcomes of ICH, only 16.66%(4) patients expired in summer season when compared to winter season, 36.5%(42) patients expired during hospital stay.

**Conclusion** : Our study showed incidence of spontaneous ICH was higher during winter season as compared to summer season. This higher incidence was more common in females and in patients who presented with high blood pressure at the time of admission. More severe form of ICH as per standard ICH scoring system and mortality were more common during winter as compared summer season.

**Keywords**: Spontaneous Intracranial hemorrhage (ICH), Seasonal variations

## Introduction

Cerebro vascular disease (CVD), stroke is classified as ischemic and hemorrhagic, out of which 85% is ischemic and remaining is hemorrhagic[1]. Spontaneous intracerebral hemorrhage (ICH) is defined as intra parenchymal bleeding in the absence of trauma or surgery[2]. Both types of stroke are significantly associated with risk factors like diabetes mellitus, hypertension, increasing age, and other demographic features. Also there is some associations between occurrence of stroke and habits of smoking and alcoholism.

Most studies agreed that there is a significant correlation between seasonal variation and incidence of vascular disease, both coronary and cardiac. Many studies concluded that there is significant increase in myocardial infarction and ischemic stroke in winter season. It is already reported that sudden submersion in cold water may provoke Myocardial Infarction. Furthermore neurological disorders such as transient global amnesia have been reported after swimming in cold water. It was found that drop in 5 degree temperature was associated with a increased stroke incidence of 7%[3].

Here, we sought to demonstrate an association between incidence, severity and prognosis of ICH with seasonal variation in summer and winter taking in account parameters such as age, sex, other demographic profiles and risk factors of ICH.

**Objectives**

The aim of this study was to find association, if any, between incidence and severity of spontaneous ICH as per standard scoring system during summer and winter seasons in Hadoti region of Rajasthan. Also it was aimed to find out the role of different classical risk factors such as hypertension, diabetes mellitus, smoking, alcohol intake etc. with such seasonal variations in patients of spontaneous ICH.

**Methods**

MBS hospital associated with Government medical college, Kota is the largest and main tertiary care facility of the Hadoti region of Rajasthan. Our study was done during May 1st to June 30th in 2020 which was the summer season and December 15th 2020 to February 14th 2021 which was winter season in Hadoti region. We collected the data of the patients admitted in the hospital with clinical history of sudden onset of altered sensorium, hemiparesis, seizure without history of trauma and clinical examination favouring the diagnosis of stroke. All these patients underwent NCCT(Non-contrast Computed Tomography) of head and ICH was identified. We excluded children age <18 years and secondary types of ICH such as arteriovenous malformations, trauma, tumors, drug induced and others.

In our study we found 24 patients of ICH in summer and 115 patients in winter. Blood pressure was measured in all patients at the time of presentation and complete clinical history was taken including history of hypertension, diabetes mellitus, alcohol abuse and smoking. Severity of ICH was determined as per standard ICH score(Dr.J.ClaudeHemphill, 3rd). The patients were followed up in the study till discharge from hospital or death.

**Results**

Total 139 patients of spontaneous ICH were admitted in MBS hospital during the study period. Out of 139 patients, 24 were in summer and 115 in winter, 70 were males and 69 were females. During summer season out of 24 patients, 18 were males and 6 were females while during winter season out of 115 patients, 52 were males and 63 were females.{Figure 1 and 2}

Gender wise incidence of ICH was different during both the seasons, a statistically significant(P value-0.0008) male predominance(75%) was observed in summer season while in winter season incidence of ICH was higher in females (54.7%). But we couldn't find any age group related significant results during both the seasons in our study, the mean age of patients in summer was 61.8 (age 30-90), and in winter was 63.9 (age 31 – 102).{Figure 1,2 and table 1}

**Table 1: Comparison of socio-demographic characteristics of patients in summer and winter months (N=139)**

| Variable | Summer (n=24) | Winter (n=115) | P value |
|---|---|---|---|
| Age | | | |
| Range | 30 - 90 | 31 – 102 | |
| Mean (SD) | 61.8 (16.0) | 63.9 (14.4) | 0.529* |
| Sex | | | |



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| | | | |
|---|---|---|---|
| Male | 18 (25.7) | 52 (74.3) | 0.008** |
| Female | 6 (8.7) | 63 (91.3) | |

*Student's t-test **Chi-square test

In our study we compared blood pressure at the time of presentation, in summer we found mean systolic blood pressure(SBP) 154.1mmHg and diastolic blood pressure(DBP) 92.3mmHg while in winter mean SBP and DBP were 181.6mmHg and 106.2mmHg respectively which was found to be statistically significant(<0.001). These observations signifies that a rapid increase in blood pressure during winter causes increased incidence of ICH even in previously normotensive patients.{table 2}

**Table 2: Comparison of blood pressure at the time of presentation in summer and winter months (N=139)**

| Variable | Summer (n=24) | Winter (n=115) | P value* |
|---|---|---|---|
| SBP | | | |
| Range | 110 – 180 | 60 – 260 | |
| Mean (SD) | 154.1 (20.2) | 181.6 (31.5) | <0.001 |
| DBP | | | |
| Range | 60 – 120 | 20 – 150 | |
| Mean (SD) | 92.3 (12.1) | 106.2 (17.0) | <0.001 |

While analyzing risk factors associated with ICH following observations were found; 21(87.5%) out of 24 patients in summer and 50(42.6%) out of 115 patients were hypertensive which was found to be statistically significant(<0.001). These suggests hypertensive bleeds are common in summer compare to winter in which the bleed may be due to sudden raise in blood pressure. These results were statistically significant between each other (P value <0.05).{table 3}

**Table 3: Comparison of Hypertension among patients presenting in summer and winter months (N=139)**

| Hypertension | Summer (n=24) | Winter (n=115) | P value* |
|---|---|---|---|
| Present | 21 (29.6) | 50 (70.4) | <0.001 |
| Absent | 3 (4.4) | 65 (95.6) | |

*Student's t-test

When comparing to other risk factors like DM, 9 patients (37.5%) had Diabetes mellitus in summer compared to 46 patients (40%) in winter. This observation shows there were no correlation between DM with ICH patients in summer and winter in our study. Likewise an alcoholism and smoking habit of the patients also doesn't correlate with occurrence of spontaneous ICH in our study (P value > 0.05).{table 4}

**Table 4: Comparison of co-morbidities among patients presenting in summer and winter months (N=139)**

| Variable | Summer (n=24) | Winter (n=115) | P value* |
|---|---|---|---|
| Diabetes Mellitus | | | |
| Present | 9 | 46 | >0.05 |
| Absent | 15 | 69 | |



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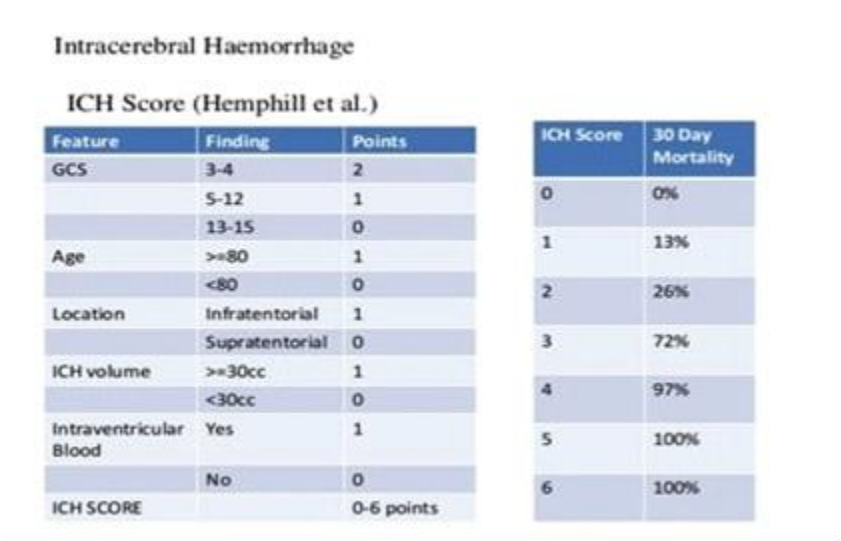
| | | | |
|---|---|---|---|
| History of smoking | | | |
| Present | 16 | 71 | >0.05 |
| Absent | 8 | 44 | |
| History of alcohol abuse | | | |
| Present | 14 | 75 | >0.05 |
| Absent | 10 | 45 | |

*Chi square test

The severity of ICH was determined with ICH score(Dr.J.ClaudeHemphill, 3rd), between (0-2) was taken as less severe and (≥3) was more severe.



Intracerebral Haemorrhage

ICH Score (Hemphill et al.)

| Feature | Finding | Points |
|---|---|---|
| GCS | 3-4 | 2 |
| | 5-12 | 1 |
| | 13-15 | 0 |
| Age | >=80 | 1 |
| | <80 | 0 |
| Location | Infratentorial | 1 |
| | Supratentorial | 0 |
| ICH volume | >=30cc | 1 |
| | <30cc | 0 |
| Intraventricular Blood | Yes | 1 |
| | No | 0 |
| ICH SCORE | | 0-6 points |

| ICH Score | 30 Day Mortality |
|---|---|
| 0 | 0% |
| 1 | 13% |
| 2 | 26% |
| 3 | 72% |
| 4 | 97% |
| 5 | 100% |
| 6 | 100% |

We found following observations regarding the severity of ICH, 21(87.5%) patients were less severe and only 3(12.5%) were more severe during summer while during winter, 66(57.4%) patients were less severe and 49(42.6%) patients were more severe. While comparing outcome of ICH, only 4 patients(16.66%) were expired during hospital stay and 20 patients(83.33%) were discharged from hospital with mild morbidity in summer season but when compared to winter season, 42 patients(36.5%) were expired during hospital stay and 73 patients( 63.5%) were discharged from hospital with some morbidity. These observations show there were significant increment in the severity and mortality in patients of ICH during winter season when compared to summer season(P value < 0.05).{table 5 and 6}

**Table 5: Comparison of ICH Scores of patients presenting in summer and winter months (N=139)**

| Variable | Summer (n=24) | Winter (n=115) | P value |
|---|---|---|---|
| ICH Score | | | |
| Range | 0 – 4 | 0 – 6 | |
| Median | 1 (0 - 1) | 2 (1 - 4) | <0.001* |
| ICH Score Category | | | |
| Less Severe (0-2) | 21 (24.1) | 66 (75.9) | 0.005** |
| More Severe (≥3) | 3 (5.8) | 49 (94.2) | |



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*Student's t-test **Chi-square test

**Table 6: Comparison of final outcome of among patients in summer and winter months (N=139)**

| Outcome | Summer (n=24) | Winter (n=115) | P value |
|---|---|---|---|
| Survived | 20 (83.33) | 73(63.5) | 0.027* |
| Expired | 4 (16.66) | 42 (36.5) | |

*Chi square test

## Discussion

Although many studies described the seasonal variations in incidence of ICH cases around the world, but many of them gave conflicting data. Some studies didn't differentiate amongst the types of stroke and some studies had varying results, though maximum studies showed maximum occurrence of ICH in winter. The inconsistency of these results may be a reflection of one or more problems in the study design like small sample size, insufficient time, focus on small areas, etc. Some studies which didn't differentiate types of stroke misrepresent the effect of season on specific type of stroke as the pathophysiology of both hemorrhagic and ischemic stroke are different.

In our study, we found that occurence of spontaneous ICH was quite higher during winter season(115 patients) when compared to summer season(24 patients), especially when there was sudden fall in temperature during winter. It was observed that there was a trend of increased occurence of ICH towards the low ambient temperature. This is also consistent with prior investigations and clinical observation of a peak ICH occurrence in the winter due to trigger effect of low ambient temperature on the risk of ICH onset at particular time of the day[4]. This finding was consistant with Zheng D et al[5] which also concluded the same and Tsementzis et al[6]. The findings were similar to our study where peak incidence of ICH were found in winter compared to other seasons. Mechanism underlying the increased ICH risk in colder climate have not been resolved but exposure to low temperature causes activation of sympathetic nervous system and sudden release of catecholamines into the blood vessels leading to acute increase in heart rate, and increase in peripheral resistance thereby increase in blood pressure. These changes are more significant when there is sudden fall in temperature which cause acute raise in blood pressure which is the most plausible trigger of ICH[7]. These findings can be correlated in our study as the mean blood pressure at the time of presentation was more in winter season(181/106mmHg) when compare to summer season(154/92mmHg). Endothelium dependent mechanisms could also be involved in the relationship between temperature and vasodilation as suggested by a recent study on rat[8]. Repeated cold exposure of rats at 4 degree for 4 hours for 1 week led to development of hypertension and impaired endothelial vasodilator function in isolated arterial tissue[8], even though human studies were not conducted. Han et al,[9] also showed strongest negative correlation with incidence of ICH with mean temperature.

In our study, incidence of ICH during summer was found to be higher in males(75%) and higher in females(54.7%) during winter. As per severity of ICH- 87.5%(21) patients had less severe ICH and 12.5%(3) had more severe ICH as per ICH score during summer, while during winter, 57.4%(66) patients were in category of less severe and 42.6%(49) patients had more severe ICH. While comparing the outcomes of ICH, only 16.66%(4) patients expired during hospital stay and 83.33%(20) patients were discharged from hospital in summer season. When compared to winter season, 36.5%(42) patients expired during hospital stay and 63.5%(73) patients were discharged from hospital. These observations show there were significant increment in the severity and mortality in patients of ICH during winter season when compared to summer season(P value < 0.05). The finding was consistant with study done by Latha ganti et al[10], which showed female predominance in winter and also more morbidity and mortality in females when compared to males in winter. It has been reported that progesterone and estrogen may be neuroprotective agents in ischemic stroke[11]. Many researchers had suggested that estrogen may serve the purpose of attenuating inflammations, free radical scavenging, anti apoptotic



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measures etc[12]. This shows the reduced incidence of ischemic stroke in females but this gender difference outcome is not present in hemorrhagic stroke. Females sex hormones might not present a survival adventage in ICH and this area is for further extensive research. In our study we found female sex had significant early mortality and bad outcomes when compared to males in winter. In our study the severity of ICH was more in winter especially in females when compared to summer when males had more severe ICH. This was similar to study done by Latha ganti et al[10]. Although the mean age of patients of ICH in both summer and winter was almost similar but incidence of ICH found to be high in age>55 years during both the seasons. The finding was consistant with study done by Basheer H. sallman et al[13] which showed increased incidence of ICH with increaseing age.

In our study during winter season only 42.6% patients were hypertensive while during summer season, 87.5% patients were hypertensive with ECGs showing LVH findings in many. Although incidence of ICH in winter was 115 patients and in summer season was 24 patients. This shows that during winter factors other than hypertension also might be operating for increased incidence and severity of ICH. Other risk factors namely, diabetes mellitus, smoking and alcohol abuse etc didn't correlate with seasonal variations. However it may require larger sample size to establish any such correlation.

## Summary And Conclusion

1. Our study showed incidence of spontaneous ICH was higher during winter season as compared to summer season. This higher incidence was more common in females and in patients who presented with high blood pressure at the time of admission.
2. More severe form of ICH as per standard ICH scoring system and mortality were more common during winter as compared summer season.
3. In our study it was found that during summer more number of patients were found to be hypertensive(87.5%) while in winter only 42.6%of patients were hypertensive. This shows factor other than hypertension might also be operating to cause higher incidence and severity of ICH during winter. However other classical risk factors operated in similar fashion irrespective of seasonal variations.

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