RSNA Intracranial Hemorrhage Detection

Competition Overview

Intracranial hemorrhage, bleeding that occurs inside the cranium, is a serious health problem requiring rapid and often intensive medical treatment. For example, intracranial hemorrhages account for approximately 10% of strokes in the U.S., where stroke is the fifth-leading cause of death. Identifying the location and type of any hemorrhage present is a critical step in treating the patient.

Diagnosis requires an urgent procedure. When a patient shows acute neurological symptoms such as severe headache or loss of consciousness, highly trained specialists review medical images of the patient's cranium to look for the presence, location and type of hemorrhage. The process is complicated and often time consuming.

What am i predicting?

In this competition our goal is to predict intracranial hemorrhage and its subtypes. Given an image the we need to predict probablity of each subtype. This indicates its a multilabel classification problem.

Competition Evaluation Metric

Evaluation metric is weighted multi-label logarithmic loss. So for given image we need to predict probality for each subtype. There is also an any label, which indicates that a hemorrhage of ANY kind exists in the image. The any label is weighted more highly than specific hemorrhage sub-types.

Note: The weights for each subtype for calculating weighted multi-label logarithmic loss is **not** given as part of the competition.

Dataset Description

The dataset is divided into two parts

1. Train
2. Test

1. Train Number of rows: 40,45,548 records. Number of columns: 2

Columns:

Id: An image Id. Each Id corresponds to a unique image, and will contain an underscore.

Example: ID_28fbab7eb_epidural. So the Id consists of two parts one is image file id ID_28fbab7eb and the other is sub type name

Label: The target label whether that sub-type of hemorrhage (or any hemorrhage in the case of any) exists in the indicated image. 1 --> Exists and 0 --> Doesn't exist.

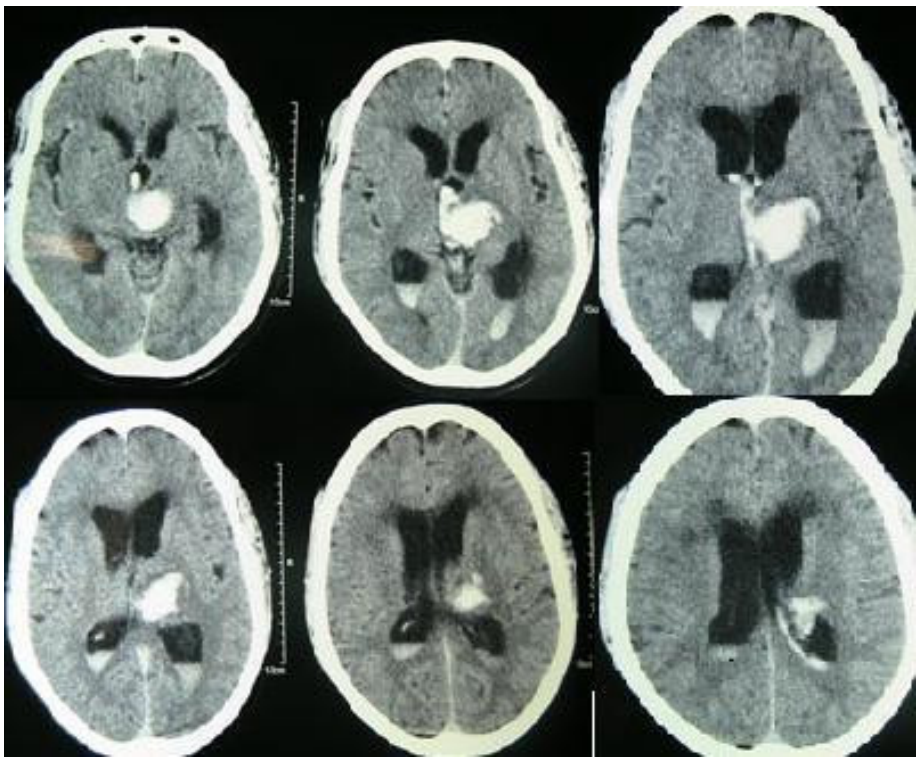
2. Test Number of rows: 4,71,270 records.

Columns:

Id: An image Id. Each Id corresponds to a unique image, and will contain an underscore.

Example: ID_28fbab7eb_epidural. So the Id consists of two parts one is image file id ID_28fbab7eb and the other is sub type name

Intracranial Hemorrhage



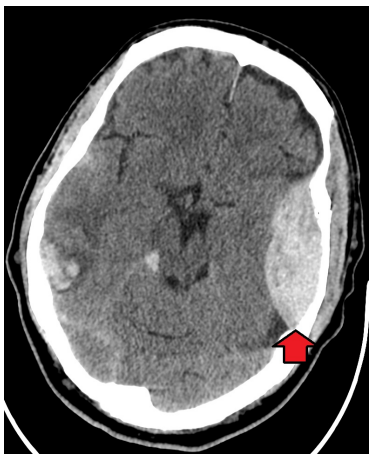
An intracranial hemorrhage is a type of bleeding that occurs inside the skull. Symptoms include sudden tingling, weakness, numbness, paralysis, severe headache, difficulty with swallowing or vision, loss of balance or coordination, difficulty understanding, speaking , reading, or writing, and a

change in level of consciousness or alertness, marked by stupor, lethargy, sleepiness, or coma. Any type of bleeding inside the skull or brain is a medical emergency. It is important to get the person to a hospital emergency room immediately to determine the cause of the bleeding and begin medical treatment.

Types

1. Epidural
2. Intraparenchymal
3. Intraventricular
4. Subarachnoid
5. Subdural
6. Any

1. Epidural



A hematoma is a collection of blood, in a clot or ball, outside of a blood vessel. An epidural hematoma occurs when blood accumulates between your skull and the outermost covering of your brain.

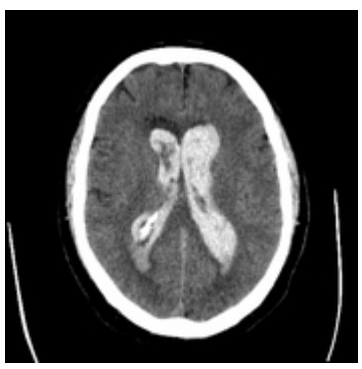
It typically follows a head injury, and usually with a skull fracture. High-pressure bleeding is a prominent feature. If you have an epidural hematoma, you may briefly lose consciousness and then regain consciousness.

Source: https://www.healthline.com/health/extradural-hemorrhage#type (https://www.healthline.com/health/extradural-hemorrhage#type)

2. Intraparenchymal

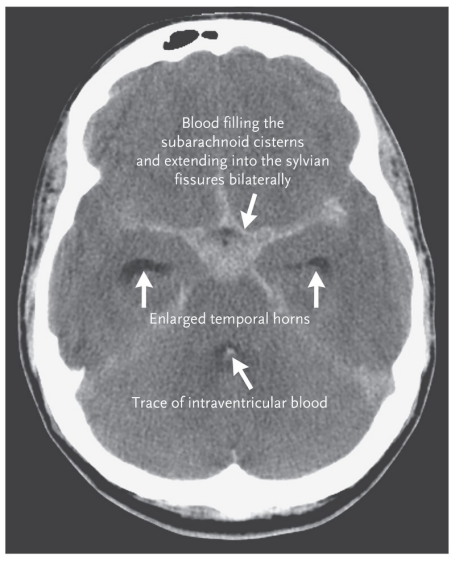
Intraparenchymal hemorrhage (IPH) is one form of intracerebral bleeding in which there is bleeding within brain parenchyma. The other form is intraventricular hemorrhage (IVH). Intraparenchymal hemorrhage accounts for approx. 8-13% of all strokes and results from a wide spectrum of disorders.

3. Intraventricular



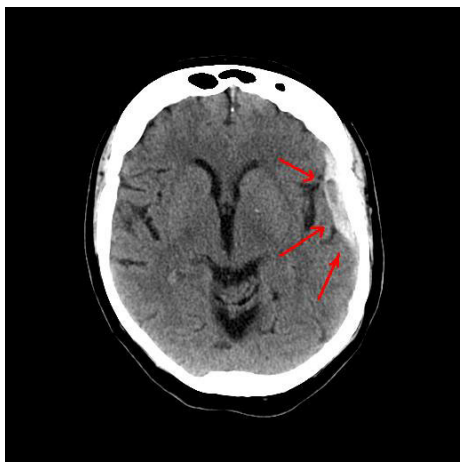
Intraventricular hemorrhage (IVH), also known as intraventricular bleeding, is a bleeding into the brain's ventricular system, where the cerebrospinal fluid is produced and circulates through towards the subarachnoid space. It can result from physical trauma or from hemorrhaging in stroke.

4. Subarachnoid



Subarachnoid hemorrhage (SAH) is a life-threatening type of stroke caused by bleeding into the space surrounding the brain. SAH can be caused by a ruptured aneurysm, AVM, or head injury. One-third of patients will survive with good recovery; one-third will survive with a disability; and one-third will die. Treatment focuses on stopping the bleeding, restoring normal blood flow, and preventing vasospasm.

5. Subdural



A subdural hemorrhage (or hematoma) is a type of bleeding that often occurs outside the brain as a result of a severe head injury. It takes place when blood vessels burst between the brain and the leather-like membrane that wraps around the brain (the dura mater).

Note A nice video explaining all the types can be found here (https://www.youtube.com/watch?v=Kb_wzb7-rvE).

Basic EDA

In [1]:
```
import numpy as np
import pandas as pd
import pydicom
import cv2
import os
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
input_folder = '../input/rsna-intracranial-hemorrhage-detection/'
```

In [3]:
```
path_train_img = input_folder + 'stage_1_train_images/'
path_test_img = input_folder + 'stage_1_test_images/'
```

Loading Data

In [4]:
```
train_df = pd.read_csv(input_folder + 'stage_1_train.csv')
train_df.head()
```

Out[4]:

	ID	Label
0	ID_63eb1e259_epidural	0
1	ID_63eb1e259_intraparenchymal	0
2	ID_63eb1e259_intraventricular	0
3	ID_63eb1e259_subarachnoid	0
4	ID_63eb1e259_subdural	0

In [5]:
```
# extract subtype
train_df['sub_type'] = train_df['ID'].apply(lambda x: x.split('_')[-1])
# extract filename
train_df['file_name'] = train_df['ID'].apply(lambda x: '_'.join(x.split('_')[:2]) + '.dcm')
train_df.head()
```

Out[5]:

	ID	Label	sub_type	file_name
0	ID_63eb1e259_epidural	0	epidural	ID_63eb1e259.dcm
1	ID_63eb1e259_intraparenchymal	0	intraparenchymal	ID_63eb1e259.dcm
2	ID_63eb1e259_intraventricular	0	intraventricular	ID_63eb1e259.dcm
3	ID_63eb1e259_subarachnoid	0	subarachnoid	ID_63eb1e259.dcm
4	ID_63eb1e259_subdural	0	subdural	ID_63eb1e259.dcm

In [6]:
```
train_df.shape
```

Out[6]:
```
(4045572, 4)
```

In [7]:
```
print("Number of train images availabe:", len(os.listdir(path_train_img)))
```

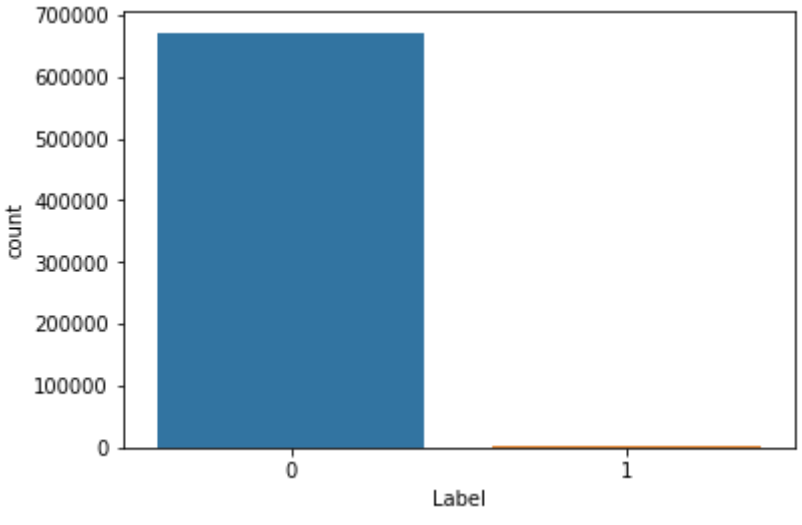
```
Number of train images availabe: 674258
```

Epidural

In [8]:
```
train_df[train_df['sub_type'] == 'epidural']['Label'].value_counts()
```

Out[8]:
```
0    671501
1      2761
Name: Label, dtype: int64
```

In [9]:
```
sns.countplot(x='Label', data=train_df[train_df['sub_type'] == 'epidural'])
plt.show()
```



Comments

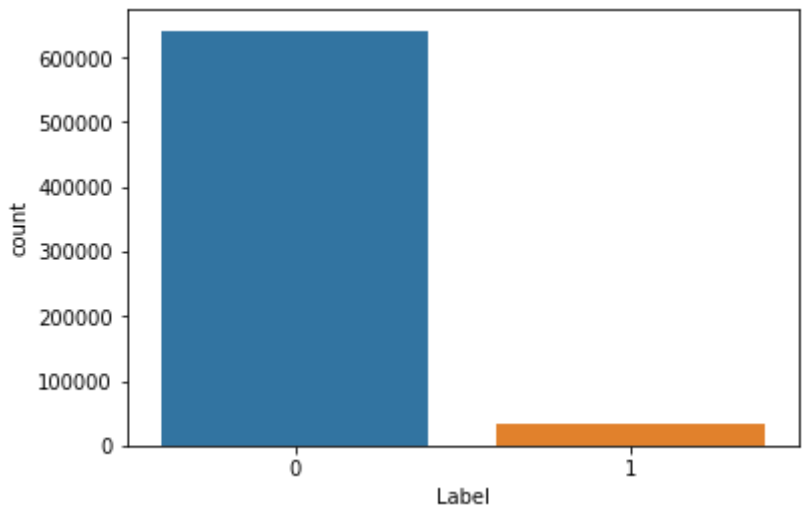
For epidural sub type we have 6,71,501 images labeled as 0 and 2,761 labelled as 1.

Intraparenchymal

In [10]:
```
train_df[train_df['sub_type'] == 'intraparenchymal']['Label'].value_counts()
```

Out[10]:
```
0    641698
1     32564
Name: Label, dtype: int64
```

In [11]:
```
sns.countplot(x='Label', data=train_df[train_df['sub_type'] == 'intraparenchymal'])
plt.show()
```



Comments

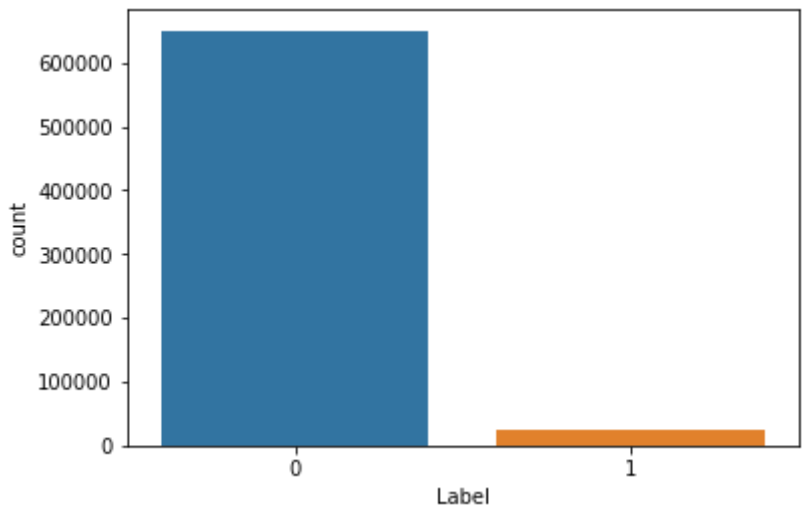
For intraparenchymal sub type we have 6,41,698 images labeled as 0 and 32,564 labelled as 1.

Intraventricular

In [12]:
```
train_df[train_df['sub_type'] == 'intraventricular']['Label'].value_counts()
```

Out[12]:
```
0    650496
1     23766
Name: Label, dtype: int64
```

In [13]:
```
sns.countplot(x='Label', data=train_df[train_df['sub_type'] == 'intraventricular'])
plt.show()
```



Comments

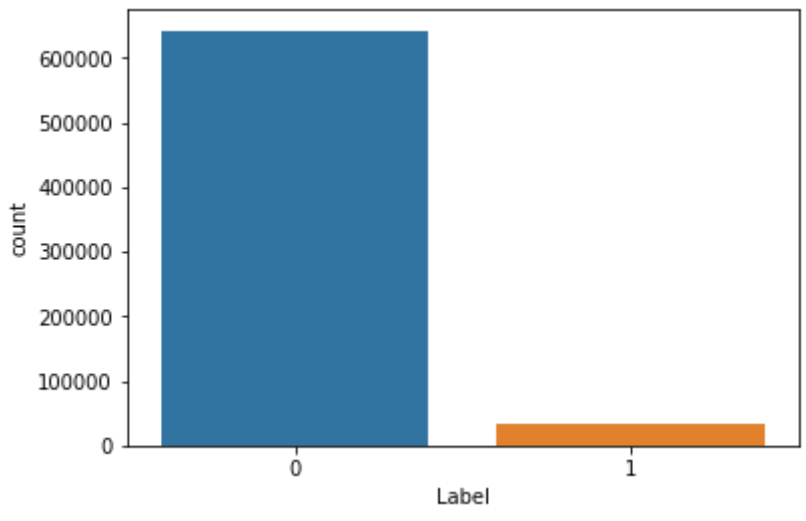
For intraparenchymal sub type we have 6,50,496 images labeled as 0 and 23,766 labelled as 1.

Subarachnoid

In [14]:
```
train_df[train_df['sub_type'] == 'subarachnoid']['Label'].value_counts()
```

Out[14]:
```
0    642140
1     32122
Name: Label, dtype: int64
```

In [15]:
```
sns.countplot(x='Label', data=train_df[train_df['sub_type'] == 'subarachnoid'])
plt.show()
```



Comments

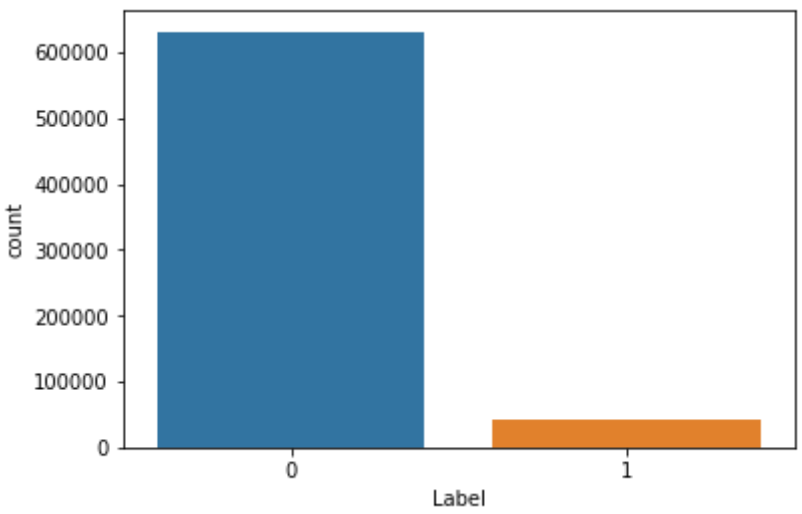
For subarachnoid sub type we have 6,42,140 images labeled as 0 and 32,122 labelled as 1.

Subdural

In [16]:
```
train_df[train_df['sub_type'] == 'subdural']['Label'].value_counts()
```

Out[16]:
```
0    631766
1     42496
Name: Label, dtype: int64
```

In [17]:
```
sns.countplot(x='Label', data=train_df[train_df['sub_type'] == 'subdural'])
plt.show()
```



Comments

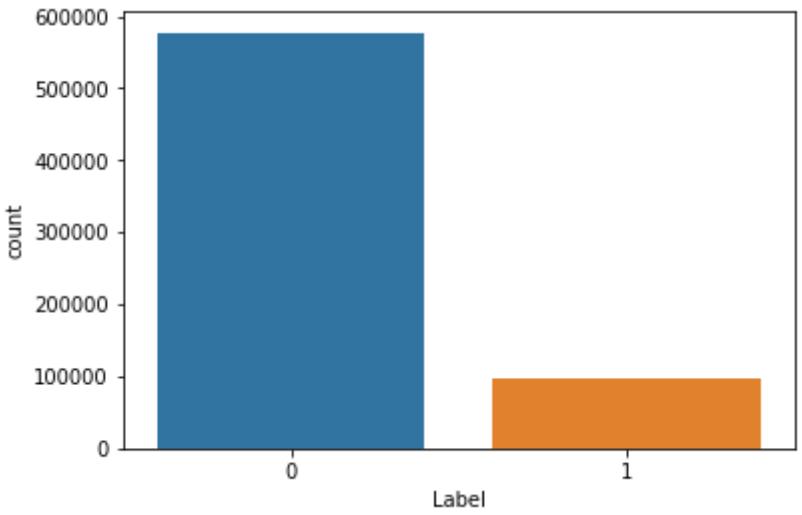
For Subdural sub type we have 6,31,766 images labeled as 0 and 42,496 labelled as 1.

Any

In [18]:
```
train_df[train_df['sub_type'] == 'any']['Label'].value_counts()
```

Out[18]:
```
0    577159
1     97103
Name: Label, dtype: int64
```

In [19]:
```
sns.countplot(x='Label', data=train_df[train_df['sub_type'] == 'any'])
plt.show()
```



Comments

For any sub type we have 5,77,159 images labeled as 0 and 97,103 labelled as 1.

Final Dataset

In [20]:
```
train_final_df = pd.pivot_table(train_df.drop(columns='ID'), index="file_name", \
                                columns="sub_type", values="Label")
train_final_df.head()
```

Out[20]:

file_name	sub_type	any	epidural	intraparenchymal	intraventricular	subarachnoid	subdural
ID_000039fa0.dcm		0	0	0	0	0	0
ID_00005679d.dcm		0	0	0	0	0	0
ID_00008ce3c.dcm		0	0	0	0	0	0
ID_0000950d7.dcm		0	0	0	0	0	0
ID_0000aee4b.dcm		0	0	0	0	0	0

In [21]:
```
plt.figure(figsize=(16, 6))

graph = sns.countplot(x="sub_type", hue="Label", data=(train_df))
graph.set_xticklabels(graph.get_xticklabels(),rotation=90)
plt.show()
```