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Upper Aero Digestive Tract Cancer: A Detailed Exploration Using Computer Vision Techniques

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Abstract

Biopsy is adopted as one of the most important procedure to diagnose the cancer. Detecting cancerous lesions at early stage and grading of malignancies present in upper aero digestive tract is a challenging task among histologists. Microscopic analysis provides a major role in finding the movements and invasions of the malignant tumour cells. A detailed study is carried out to understand the entire destination of the oral and nasal cavity cancer which is done by histology investigations. The paper provides a pathway to understand the attributes of anaplastic cells in the presence of retrospective microscopic images. The goal is to figure out the uniqueness and characteristics of UADT (Upper Aero Digestive Tract) cancer and to discuss about different computer vision techniques which can be applied to detect and classify various types and stages of tumor by analysing biopsy images.

Keywords: *Anaplastic, UADT, Epithelium, Tissue, Carcinoma, Classification.*

1. Introduction

The abnormal growth of tissues in the body is defined as tumour; the word tumour is derived from the term called Neoplasia [1]. The transformation of the normal cell in to anaplastic cell occurs either by radiation or by cancer-causing-agents. Generally, tumours are divided into two categories namely benign and malignant. In general, benign tumours are isolated at one place with the absence of invasions, whereas the malignant tumour cells invade and moves from one place to another place in the alive body either through lymph nodes or by bloodstream called as cancer and also known as metastasis. As per the investigation of WHO-2018, approximately seven million deaths occurring every year are due to the consumption of tobacco-related products. In this around six million people are direct consumers of tobacco and about one million people are the victims of passive smoking [2]. Worldwide, among all the deadly diseases, cancer grasps the second position for maximum deaths among humans [2]. The Upper Aero Digestive Tract is partitioned into Respiratory tract and upper digestive tract. The respiratory tract comprises of the Nasal cavity with (Para nasal sinus), larynx, pharynx, Trachea, and Bronchus. The upper digestive tract is attached to the pharynx, oesophagus and oral cavity with tongue, lips, palates, etc. Every patient's diagnostic status is reported using two methods namely clinical observation as the initial study and microscopic observation as the secondary and final decision. These studies portray the vital role of differentiating the tumour as either normal or lesion and stages of lesion tumours. Neoplastic cells are classified into benign and malignant based on two categories which are clinical and histopathology approach. As per clinical observations, benign tumours in nature are isolated and grow very slowly, whereas malignant tumour develops rapidly and has the property of invasive and navigating from one place to another through blood as one of the

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medium [1]. Such classifications are done based on the Based on the secondary changes like increased apoptosis and different cyst formations tumours may occur [3].

The rest of the paper is organized as follows; Nature of the cell is discussed in section 2. Classification of tumours is summarized in section 3. Different Upper Aero Digestive Tract sites are clearly mentioned in section 4. morphological analysis of UADT is explained in section 5. Finally, the paper is concluded with the importance of automated cancer detection system for proper prognosis of UADT cancers.

Nature of the cell:

In general, the human body is made up of cells, which are the fundamental components to generate tissues and organs. Basically, human cells are divided into two types: epithelial and mesenchymal. The epithelial cell generated at the ectoderm exists in nasal cavity as well as the oral cavity that has secretory function. Whereas the mesenchymal cells known as 'stroma' itself invade into different forms in the human body. The characteristics of characteristics of anaplastic cells, nucleus and cytoplasm. the cells are categorized in to three forms. They are structure, function, and differentiation of the cell.

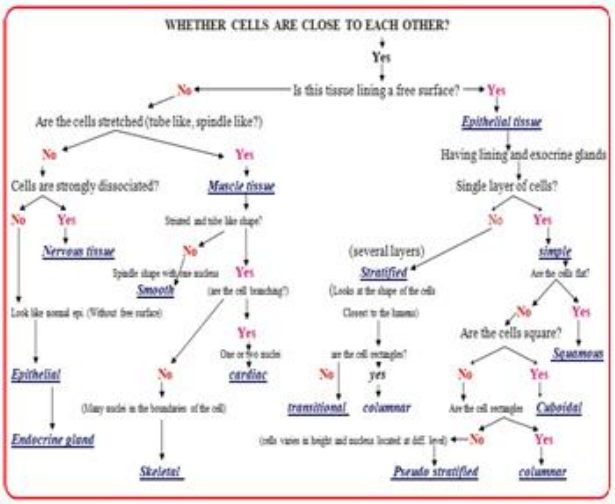

Figure 1: Classification of epithelial tissues

Table 1: Characteristics of epithelial cells

S.no	CELL/TISSUE TYPE	FUNCTION	CELL ARRANGEMENT	PATTERNS
1.	EPITHELIAL	1. Absorption 2. Protection 3. Secretion 4. Filtration	1. Simple 2. Stratified	Simple Cuboidal, Simple Squamous, Simple Columnar, Stratified Cuboidal, Stratified Squamous, Stratified Columnar.
SUBTYPES OF EPITHELIA		**FUNCTIONS**	**ORIGIN**	
1(a)	Simple cuboidal	1. Secretion 2. Absorption	Can be found in tubules, ducts, and glands.	
1(b)	Simple squamous	1. Diffusion	Can be found in the lining of alveoli and blood vessels.	
1(c)	Simple columnar	1. Absorption 2. Protection 3. Secretion 4. Lubrication	Can be found in the inner lining of the stomach.	
1(d)	Stratified squamous	1. Protection	Can be found in the oral cavity. Generated using keratins.	
1(e)	Pseudo stratified columnar	1. Absorption 2. Protection 3. Secretion 4. Lubrication	Can be found in the respiratory tract.	
1(f)	Transitional	1. Secretion	Can be seen in the urinary bladder. Formed by stratified cells.	

Classification of tumours:

Both the benign and malignant tumours have two basic components which are parenchyma and supportive stroma. The parenchymal tumour cells grow rapidly and are termed as epithelial tumours whereas the supportive

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stroma is poised with fibres tissues and blood vessels. An Mesenchymal tumours are termed as sarcoma [1]. The stages of tumour are classified as normal, hyperplasia, mild dysplasia, severe dysplasia (carcinoma-in-situ) and finally as cancer shown in figure 2. Parenchymal cell types of epithelial tumours are shown in table 2.

epithelial tumour is termed as carcinoma and malignant

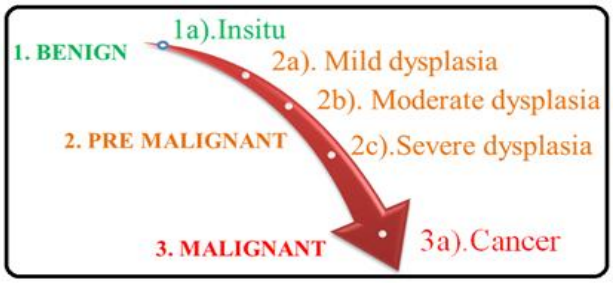

Figure 2: stages of tumours

Table 2: Epithelial tumor classification [1]

Epithelial Tumours	**Benign**	**Malignant**
Squamous epithelium	Squamous cell papilloma	Squamous cell carcinoma
Transitional epithelium	Transitional cell papilloma	Transitional cell carcinoma
Glandular epithelium	Adenoma	Adenocarcinoma
Basal cell layer skin	-	Basal cell carcinoma
Neuroectoderm	Naevus	Melanocarcinoma
Hepatocytes	Liver cell adenoma	Hepatocellular carcinoma
Placenta	Hydatidiform mole	Choriocarcinoma

Squamous cell carcinomas-(SCC):

These types of cancers occur on the top layer of the skin. The main cause of SCC is due to the exposure of sunlight to the lips, ears nose, hands, and legs. In America, comparatively men are the maximum sufferers of Squamous Cell Carcinoma even more than women [5]. It also occurs in the lining (inner surface) of the respiratory tract and upper digestive tracts. Squamous cells structures are thin and flat in nature [6].

Transitional cell carcinoma-(TCC):

Transitional cell carcinoma is treated as pseudostratified epithelial tissue which projects the characteristics of single layered cells and varies in cell height and having no specific shapes. Most of the TCC cancers have occurred in the inner lining of the bladder. Bladder cancer can be categorized into two forms: invasive cells - cancer cells grown deeper on the bladder and non-invasive cells stay in the inner layer of the bladder [7]. The stages of TCC are listed in the table 3. The stages of transitional cell carcinoma are based on the TNM system which was proposed by the American Joint Committee on Cancer (AJCC) where TNM stands for Tumor, Node, and Metastatic. Here, (T1, T2, T3, T4- has the invasive property; N0- does not have the extending of growing in the lymph node, and M0- does not navigate.

Table 3: Transitional cell carcinoma grading's [13]

Stage	**Group**	**Representation**
0a	Ta, N0, M0	Non-invasive papillary carcinoma [Ta], does not grow in the lymph node [N0], does not grow in the defined area [M0].
0is	Tis, N0, M0	Cancer is non-invasive [Tis], flat and carcinoma (in-situ), does not grow in the lymph node [N0], does not grow in the defined area [M0].
I	T1, N0, M0	Grow in the connective tissue [T1], does not grow in the lymph node [N0], does not grow in the defined area [M0].
II	T2a or T2b N0 M0	Grown in either inner or outer layer of the muscle [T2], N0- not grown in the lymph node [N0], does not grow in defined area [M0].
III-A	T3a, T3b or T4a, N0, M0	Grown in the muscle layer and fatty tissues [T3a, T3b or T4a], not grown in the lymph node [N0], does not grow in the defined area [M0].

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	T1-4a, N1, M0.	Grown in connective tissue [T1-T4, fatty tissue and muscle layer, grown in the lymph node [N1], does not grow in the defined area [M0].
III-B	T1-T4a N2 or N3 M0	T1-T4a- grown in the connective tissue or fatty tissue or muscle layer [T1-T4a], grown in more than two lymph nodes [N3], does not grow in the defined area [M0].
IV-A	T, N M1a	May or may not grow in the nearby organ through the bladder [T], may or may not spread to lymph node [N], present in the distinct organs [M1a].
IV-B	T, N, M1b	May or may not grow in the bladder wall [T], may or may not spread in to lymph node [N], may spread to one or more nearby organs [M1b].

Adenocarcinoma:
An epithelial malignant tumor, that occurs in the inner surface of glands. The malignant cells that are available in the organs become anomalous and initiate the route for navigating from one place to another place [8]. The adenocarcinoma tumor is present in different organs like the colon, breast, oesophagus, lungs, pancreas, and prostate. Here the grading's are made based on three factors low grade which is well- differentiated carcinoma, intermediate grade which is moderately differentiated carcinoma and high grade which is poorly differentiated carcinoma. The benign epithelial tumours are called adenoma.

Basal cell carcinoma:
Basal cell carcinoma is one of the most common skin cancer types with the cystic formation which hold the property of slow growth and low degree of transmutation. This can be clinically diagnosed [9]. There are different types of BCC- nodular, micro nodular, pigmented, superficial and mixed BCC. The nodular tumor usually occurs in the nose, forehead and ulcer formation is very high due to this. Micro nodular is a threatening second type of BCC with a clear boundary of tumor and less rate of ulcer formation [10].

Melanocarcinoma-melanoma:
Melanoma, a type of deadly skin cancer which occurs in the dermis or corium produces the melanin [11]. The melanoma cancer is classified in to five different stages from stage 0 to stage IV and it is shown in table 4.

Table 4: Classification of melanoma [12]

Stages	**Representation**
Stage-0	Melanoma in-situ occurs at the top layer of the skin.
Stage-I	Cancer spread at the epidermis level and not grown in the lymph node.
Stage-II	Tumor size between 2mm to 4mm and not grown in the lymph node.
Stage-III	Tumor sized above 4mm and grown in the lymph node and isolated.
Stage- IV	Tumor sized above 4mm and grown in the lymph node

Hepatocellular carcinoma:
The hepatocellular carcinoma is one of the most common malignant tumours which can be detected through clinical observations. Chronic liver diseases and hepatitis viral diseases are the origins of HCC. There are tumours like lesions that include cyst [14]. Maximum 90 percent of the HCC cases are primary liver cancers and the grading's of Hepatocellular carcinoma (HCC) are shown using TNM property in table 5 [15].

Table 5: TNM grading method for HCC

Grades	**Description**
I	Individual tumor without invasion [T1], no chances of occurring in the lymph node [N0], no chances of navigation [M0].
II	Multiple tumours with not greater than 5cm in size [T2], no chances of occurring in the lymph node [N0], no chances of navigation [M0].
III-A	Multiple tumours with greater than 5 cm in size [T3a], no chances of occurring in the lymph node [N0], no chances of navigation [M0].
III-B	Multiple tumours without any fixed size [T3b], no chances of occurring in the lymph node [N0], and no chances of navigation [M0].
III-C	Multiple tumours with higher chances of invasion [T4], no chances of occurring in the lymph node [N0], no chances of navigation [M0].
IV-A	Tumor cells may occur in different places [T], chances of occurring in the lymph node [N1], no chances of navigation [M0].
IV-B	Tumor cells may occur in different places [T], chances of occurring in the lymph node [N1],

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	and chances of navigation is high [M1].

Choriocarcinoma (CC):
Choriocarcinoma is a type of chorionic epithelium has the characteristic of rapid growth and higher metastatic rate. This type of tumor may navigate to different organs like the lungs, brain, liver and gastrointestinal tract. The cancer may also occur in uterus, cervix, ovary, and testes. CC is diagnosed by abnormal bleeding and isolated metastatic property [16].

Review on UADT:

The upper aero digestive tract is classified into two categories namely respiratory tract and digestive tract where the respiratory and digestive tracts are further divided into sub- categories as shown in figure 3 [17].

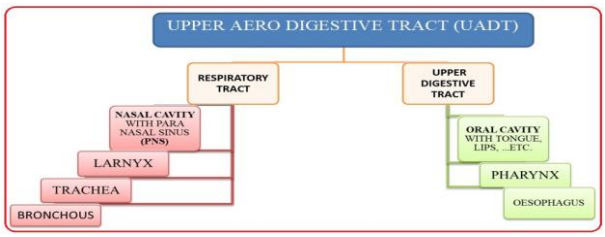

Figure 3: Classification of upper aero digestive tract (UADT)

Respiratory Tract:

A respiratory tract is classified in to two categories namely upper respiratory tract and lower respiratory tract. The upper tract extends as the larynx through the sinonasal region and the lower respiratory tract is extended to the lungs through the trachea. The upper respiratory tract falls under columnar cell that has cilia which are a type of epithelial tissue and lower respiratory tract combines trachea and bronchus. There are 4 different types of cells like ciliated columnar cell, goblet cell, basal cell and neuroendocrine cell [18]. The connecting sites of UADT explained in subdivisions a, b, c, d, e, f and g.

a) Nasal cavity with Para nasal sinus cancer (PNS):

The occurrence of Paranasal sinus cancer is rare but very threatening to life and the metastatic growth of this para nasal sinus cancer will be faster along with other organs like face, head, neck, brain, chest, etc. [19]. The paranasal sinus cancer holds only 3 percent occurrence compared to all head and neck cancers [20]. Types of Para nasal sinus tumours and its nature are discussed and shown in table 5 [1].

Table 6: Classification of PNS tumours

Tumor type	Tumor name	Risk	Neoplastic type
Benign	Capillary haemangioma	Low	Granulation
Benign	Sinonasal papilloma	Low	combination of epithelia
Malignant	Olfactory neuroblastoma	High	polypoid type which has the chances of invasion to (PNS)
Malignant	Sinonasal carcinoma	High	A type of squamous cell carcinoma has extensive metastasis and grows locally in bones and soft tissues.

b) Larynx:

A larynx is a special type of organ in the human body which separates the respiratory tract and digestive tract. This has the major responsibility of both breathing and swallowing activities [21].

The histology of the larynx falls under the mucosal layer that combines cartilages, ligaments, and muscles. There are three different sites of the larynx such as supraglottis, glottis and subglottis. Stages of laryngeal cancer are shown in table 7 [22,23].

Table 7. Gradings of laryngeal cancer

Supraglottis
Tumor is localized with normal vocal cord mobility-[T1]. Have an invasive property to lower base of the tongue and pyriform sinus-[T2] Ended with vocal card invades to epiglottic tissues and thyroid cartilages-[T3]. Has invasive property through thyroid cartilage below the larynx-[T4a]. Invades to the spaces on the neck called prevertebral space (pvs)-[T4b].
Glottis
Extends only up to vocal cords and has common growth-[T1].

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Extends with only one vocal cord-[T1a]. Extends with both vocal cords-[T1b]. Grows up to the separated vocal cord and spread to supraglottis-[T2]. Tumor invades to Paraglottis grows within the larynx-[T3]. Invades over the cartilage tissue which grows away from the larynx-[T4a]. Invades and navigates to the mediastinal system-[T4b].
Subglottis
Grows and extended up to subglottis-[T1]. Grows and extends up to vocal cord and chances of metastasis-[T2]. Extends up to the larynx with the vocal cord-[T3]. Tumor grows up to thyroid cartilage and invades over the larynx-[T4a]. Grows up to prevertebral and invasion extends up to the mediastinal system-[T4b].

c) Trachea

Trachea which is also known as windpipe, that extends up to the maximum of 2 cm in breadth and 15cm in length. Naturally, the windpipe contains around 20 fragmentary parts of hyaline cartilage, which is present in the walls of the trachea in producing mucus and it is termed as pseudo- stratified columnar epithelium [24]. The trachea is differentiated into two types namely intrathoracic and extrathoracic fragmentary parts which are the ring or c-shaped. The benign and malignant tumours of the trachea are discussed in table 8 [25].

Table 8: Characteristics of tracheal cancer

Measurement parameters	Sources
Tracheal length	This is measured from bottom end of cricoid cartilage where the trachea is divided in two parts.
Tracheal diameter	The diameter is measured by estimating the difference between two boundaries of the trachea.
Subcarinal angle	The angle is measured at the interval of main bronchi.
Main bronchi length	Measured from the beginning of the bronchus to till it reaches the dividing area.
Angles of main bronchi	The angle is measured from the primary axle to the main axe of the bronchi
Width of left main bronchi	The diameter of the bronchi is measured from the source.

Table 9: Characteristics of bronchus cancer

Tumor type	Tumor name	Study
Benign	Tracheobronchial papillomatosis (TP)	Occur to infants if the mother is affected with HPV (Human Papillomavirus). Grow down into trachea of about 5% of peoples who are affected with (Tp), grows down to lungs of 1 % and 2 % of the patients might end with malignant transformation.
Benign	Squamous cell papilloma	Occur in adults due to smoking habits.
Benign	Hamartoma	Grow slowly and has no invasion.
Benign	Chondroma	Occur with the middle-aged people, mostly appeared as well differentiated tumor.
Malignant	Squamous cell carcinoma (SCC)	Occur commonly on 50-60 years old peoples, commonly on the walls of trachea, and has the metastatic growth to oesophagus and lead to tracheoesophageal fistula.
Malignant	Adenoid cystic carcinoma (ACC)	Affect both men and woman which has the high metastatic rate through lymph node which affects bronchi.
Malignant	Mucoepidermoid carcinoma	This type of tumours is rare, and occurs on the soft tissues, which will be very closer to the other airway malignant tumours.

d) Bronchus:

Bronchus also known as primary bronchus is one of the most important organs which play a major role in the

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respiratory systems i.e. air circulation to and from lungs [26]. The bronchial tree is measured as follows; tracheal length, tracheal diameter, and subcarinal angle. The main bronchi length, angle of main bronchi and the width of left main bronchi is shown in the table 9 [27].

Upper digestive tract:

The Upper digestive tract comprises of the oral cavity, pharynx and oesophagus which falls under the mucous membrane that consists of squamous epithelium and connective tissue. Some of the epithelium produces keratin [1]. The oral cavity is combined with different parts like hard palate, lips, gingiva, buccal mucosa, tongue, mouth floor and retro molar region [28].

Hard palate:

The anatomy of hard palate exists at the inner roof of the mouth that divides the nasal and oral cavities covered by mucosa which is further covered with keratinized stratified squamous epithelium. There is a sub mucosa membrane behind the hard palate that contains small salivary glands [29]. The probability of occurrence of the adenoid cystic carcinoma is very less in small salivary glands and this can be diagnosed either with the clinical features or by histopathological features [30].

Tongue and lips:

The tongue is divided into two parts; the front-two third of the tongue remains the same and back third of the tongue is named as oropharynx. According to pathology the tumours of the tongue are differentiated in to two types namely white tumor and red tumours that are treated as lesions [31]. Lip cancer is considered to be a type of skin cancer that affects the head and neck, which is commonly found in the maxillary regions [32]. The combinations of oral and pharyngeal cancers are considered to be the sixth most frequently occurring cancer types throughout the world [33].

Pharynx and oesophagus:

A part of the respiratory system that begins from the nasal cavity and mouth and extends till the larynx. Both respiration and food passes through the pharynx and enters in to the oesophagus. The pharynx consists of three parts namely nasopharynx, oropharynx, and laryngopharynx and their walls are made up of muscles [34]. Oesophageal cancer is the deadliest among the whole upper digestive tract cancers [35]. The characteristics of the oesophageal cancer are fast and invasive and they navigate through the lymph node.

Morphological analysis of UADT:

Analysis, detection of occurrence and stages of cancer are done by magnifying biopsy slides. The cells in the slides are viewed as (40X) scanner view, (100X) low power and (400X) high power. All three magnifications are used to find the nature of the tissues for the proper prognoses which is explained in detail under subdivision a.

a) Feature Extraction and Classification

The clinical way of differentiating H&E stained epithelial and connective tissues are based on using four main characteristics which are Functionality, Arrangements, Components (presence of intracellular bridges) and Location (below or above the basement membrane) with 40X, 100X and 400X magnifications [36].

2. Literature Review

The survey focuses on analysing the existing methods that are with various techniques and procedures for detection and classification of Upper Aero Digestive Tract (UADT) cancer in histology images. The tumours types of artifact's present in the biopsy slides and solutions to overcome the artifact problem were provided by VO and G [37]. Which can assist technicians to handle the problems without any artifact's in the slides. This can lead to best diagnosing results.

A patient case study discussed by Paraskevi Giovani [38] provided a better understanding of the soft tissue benign tumor in oral cavity, named as Benign Fibrous Histiocytoma (BFH) which occurs in buccal mucosa. The benignity of the particular case was confirmed with repeated observation over a period of 12 months and concluded that BFH occurs on the spindle shaped cell structure through H&E stained biopsy images with 40 X microscopic magnifications. Further study was made with a 36-year-old patient and discussed the complexity of finding the exact grading which has the probability of both benign and malignant tumour occurrence in the Buccal Mucosa. The final result states that the benign tumours with the help of immuno-staining process which shows the presence of biphasic cells. It also further identifies the formation of granuloma (a clump of tissue formation). The pathological findings concluded by Paraskevi Giovani will be an ideal benchmark for the head and neck surgeons.

An automatic cancer detection model was proposed by Rajesh Kumar [39] using biopsy microscopic images. The four different parameters like connective, epithelial, muscular, and nervous tissues were considered for analysing the morphological features of the nucleus. Initially different techniques were used to extract features and k-means algorithm was used to segment the background details. Finally, classification was done using KNN (k-Nearest Neighbour) algorithm. Among all four different parameters, connective tissues alone have adopted the proposed technique and have produced 92 percentage of classification accuracy.

A new Computer-Aided system was designed to identify the benign tumours present in the gastrointestinal endoscopic images of 3000 in total by Ding Yun Liu [40]. It was evaluated using the enhanced PCA technique called (JDPCA) Joint Diagonalization Principle

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Component Analysis and this was used to reduce the dimensionality. The proposed technique has provided a solution for over fitting problem in high resolution images and has predicted whether tumour is a lesion or not. The image classification was done using the Tumour in Upper Aero Digestive Tract when compared to another lesion diagnosis.

The cell orientation congruence descriptor technique was proposed for the avoidance of abortion by Guannan Li [41]. The idea behind this process is to find and exclude the stromal cells present in the epithelial tissues. The proposed technique follows the segmentation process as the first step. This is to segment the background and lumen from the tissue using variance filter and to classify using random forest classifier. The technique achieved an accuracy of about 76 percent. But the proposed method still finds hard to handle the overlapped cells. Hyper spectral image analysis was done for detecting cancers in head and neck with 30 patients in total and different sites like pharynx, oesophagus, nasal cavity and oral cavity were taken for analysis.

Different imaging techniques were discussed for pre-processing and feature extraction by Guolan Lu [42]. Thirty-six intra and inter patients tissue samples were considered and compared with different classifier techniques using both normal and malignant samples of every individual patients and the proposed method has obtained average accuracy of about 88 per cent for both oral cavity and nasal cavity.

A deep learning method was proposed to classify the type of carcinomic tumours by Martin Halicek [43]. A dataset of twenty in total was generated using head and neck cancer suspected patients. A deep CNN architecture was designed to classify the squamous cell carcinomas of different sites and classification accuracy of about 90 per cent was achieved. The deep CNN model was compared to other traditional machine learning techniques and concluded that the proposed model produced the best result.

Kuy Hun Koh Yoo [44] designed a convolution neural network architecture to classify patients affected with human papilloma virus (HPV). A study was made with 520 patients affected by HPV. Each patients Whole Slide Image (WSI) was cropped and multiple patches (cropped portion) were collected from the image. The patches collected were used to create tiles and multiple offspring image were generated from the parent image. It was binarized with Otsu method for feature extraction and accuracy of about 80 per cent with two classes was achieved. The proposed method has worked well but still the issue discussed here was the system has utilized a smaller number of patients Whole Slide Images for evaluation and the tiles created has generated minimum number of images in the proposed dataset for this experiment.

modified SVM called ODR-BSMOTE-SVM and has achieved the average accuracy of 90.40. The proposed method concluded that the occurrence of false prediction among pathologists can be prevented in diagnosing the

A framework named density-based clustering technique was proposed by Mutlu Mete [45]. The intensity and distance between the neighbourhood pixels were used to detect the cell nuclei of squamous cell carcinoma in head and neck histopathology microscopic images of 20 X magnification. Using the proposed classification technique, the system achieved an average accuracy of 96 per cent. The issue here is the proposed method has considered the artifact image as a normal image without applying any pre-processing technique.

A detailed oral cavity biopsy study was discussed by Poh CF [46]. The importance of dysplasia with different gradings and oral malignancies were mentioned. The entire study focused on the principles of biopsies like selecting the appropriate site, extracting the right sizes of the tumor tissues and proper tissue staining process. A discussion was made about the characteristics of dysplasia and the need for regular investigation to avoid sudden critical changes in the stages of the tumor.

An enhanced deep learning model HNSCNet (Head and Neck Subtype Classification Network) was proposed for binary classification of HPV positive and negative states with 60000 patches in total by Wanyi Qian [47]. The comparative study made using the HNSCNet technique shown that the proposed method attained an accuracy of 75 per more than other two existing models like VGGNet (Visual Geometric Group) and InceptionV3.

Detection of glands in human tissue with H and E stained images were studied by Kawalkar and Talmale. [48]. The step by step process of the proposed study explains three basic methods such as pre-processing, segmentation, feature extraction and classification. Recently, multiple cancer prediction methods and classification methods were proposed with the help of machine learning techniques and have made a tremendous change in histopathology biopsy analysis.

3. Result

A dataset was collected from Government medical college hospital, Vellore, Tamilnadu, India. Totally 1698 tissue sample images were collected with three different magnifications 4X, 10X, 40X consist of seven different types of gradings and seven UADT sites.

Due to the complexity present in predicting and diagnosing the cancer among pathologists, an automated computer aided system which plays a major role in assisting the pathologists has been developed. The system is still improving and maintaining its flexibility with different cases. Some of the existing machine learning techniques for cancer prediction had been discussed in table 10.

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Table 10: Machine learning approach for cancer detection

Sl.no	Authors	Site & Dataset	Techniques	Accuracy
1.	Luis C. Garcia-Perata Herrera. et al [49].	Oesophagus Endoscopic image dataset generated from endoscopic video with 7046 frames.	A deep Embedded Class Activation Map (dECAM) proposed to generate the heat map data for squamous neoplastic detection.	92 %
2.	Yoshima Horie et.al [50].	Oesophagus Endoscopic images of both training and testing had 8428 and 1118 in total	One of the deep convolutional architecture called single shot multi box detector (SSMBD) was designed to work with the endoscopic images.	98 %
3.	Fatihah mohd et al [51].	Oral cavity Entire dataset was created as instances with 82 in total.	A weka tool is used to find the performance of 4 classification techniques called Naïve-Bayes, multilayer perceptron, support vector machine, and k-nearest neighbour classifier. Out of all, svm classifier performed well with 14 attributes using linear forward selection method and attained the best classification result. Author used synthetic minority over sampling technique to avoid under fitting problem.	96 %
4.	Mehdi Fatan serj et al. [52]	Lung CT images of 63890 malignant images and 171345 of non-malignant images.	Used Deep convolutional neural net with back propagation neural network for classification process.	95 %
5.	Albert chon et al. [53]	Lung CT images from kaggles Data science bowl	The proposed method follows two step processes; one is Marker driven watershed algorithm was used for segmenting lung nodules and secondly used deep U-Net CNN architecture for malignant classification.	83 %
6.	Rushil Aniruth et al. [54]	Lung AAMP-SPIE lung nodule dataset	3D CNN architecture was designed to classify the malignant and non-malignant nodules from the given images.	80 %
7.	Waffa Alakwaa et al. [55]	Lung Kaggles Data science bowl CT lung dataset, by the year 2017	Proposed a computer aided diagnosis U-Net system using deep 3D CNN and ensured the avoidance of local minima occurrences using stochastic gradient descent method.	86%
8.	Qing Wu and wenbing zhao. [56]	Lung CT images	A neural network-based entropy degradation method was proposed to detect small cell lung cancer with 12 CT images.	77.8%
9.	Waffa k. shams and Zaw z. Htike. [57]	Oral A ncbi registered microarray dataset of 86 patients.	Introduced a Deep Neural Network technique for detecting a premalignant oral cancer using microarray gene expression featured data using Fisher discriminant analysis.	96 %
10.	Jun Wang, Xia Liu et al. [58]	Lung CT- image dataset of 593 patients from LIDC-IDRI	A machine learning based (SVM with Genetic Algorithm). Cancer prediction system was developed to classify the benign and malignant tumours from CT images.	81 %

11.	QIU SHI et al. [59]	Lung CT-53 Lung Nodule Images from [I-ELCAP] Database	With the inspiration of Gestalt theory of psychology, author proposed the lung nodule segmentation algorithm for MIP Maximum Intensity Pixel images using SVM kernel functions "Support Vector Machine", an unsupervised classification technique was proposed	91.29%

4. Conclusion and future work

Most of the pathologists spend enormous time to diagnose and grade the stages of cancer in UADT by microscopic analysis of tissues. Still many challenges are faced by pathologists to conclude the dysplasia cases. Clinical technicians also face technical issues in staining and preparing the slides with artifacts. Considering the complexity and challenges faced by the clinical pathologists an automated computer aided system can be built to assist the pathologist in reducing the observation time and proper prognosis. The entire survey will provide a clear picture of UADT cancer and will throw a light for the researchers to focus on generating powerful CAD systems to support the department of pathology.

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