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Optic Disc and Blood Vessels

Review of the Automatic Methods

Highlights

Diffusion MRI of Human Brain

Computed Tomography Examination

Discovering Thoughts, Inventing Future

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Computed Tomography Examination Reveals Brain Lesions in Guangzhou AIDS Patients

By Ming-ya Zhang, Meng Liu, Hui Zhao, Song-feng Jiang, Shuai Li, Liang-ping Luo & Xuesong Yang

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Abstract- Cranial computed tomography (CT) plays an important role in the diagnosis of AIDS. However, our understanding of the CT scan images on the diagnosis or evaluating treatment results has not yet been completed. In this study, we conducted an investigation on the usefulness of cranial CT examination in diagnosing HIV patients. Among them, 34 AIDS patients tested positive for brain lesions indicated by cranial CT scan examination. Patients who had AIDS with brain lesions were primarily diagnosed with tuberculous meningitis (TBM), HIV encephalitis (HIVE), cerebral toxoplasmosis (CT) and cryptococcal meningitis (CM). Furthermore, we thoroughly compared the characteristics of various brain lesions in CT images so that it could be helpful for future diagnoses and treatment evaluations of AIDS with brain lesions. Additionally, we demonstrated that a count of less than 50 CD4+ T lymphocytes primarily occurred in the TBM and HIVE groups, thus resulting in higher mortality.

Keywords: AIDS brain lesions, CT scan, tuberculous meningitis, HIV encephalitis, cerebral toxoplasmosis and cryptococcal meningitis.

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Computed Tomography Examination Reveals Brain Lesions in Guangzhou AIDS Patients

Ming-ya Zhang [1#], Meng Liu [2#], Hui Zhao [3], Song-feng Jiang [4], Shuai Li [5], Liang-ping Luo [6] & Xuesong Yang [7]

Abstract- Cranial computed tomography (CT) plays an important role in the diagnosis of AIDS. However, our understanding of the CT scan images on the diagnosis or evaluating treatment results has not yet been completed. In this study, we conducted an investigation on the usefulness of cranial CT examination in diagnosing HIV patients. Among them, 34 AIDS patients tested positive for brain lesions indicated by cranial CT scan examination. Patients who had AIDS with brain lesions were primarily diagnosed with tuberculous meningitis (TBM), HIV encephalitis (HIVE), cerebral toxoplasmosis (CT) and cryptococcal meningitis (CM). Furthermore, we thoroughly compared the characteristics of various brain lesions in CT images so that it could be helpful for future diagnoses and treatment evaluations of AIDS with brain lesions. Additionally, we demonstrated that a count of less than 50 $CD4^+$ T lymphocytes primarily occurred in the TBM and HIVE groups, thus resulting in higher mortality.

Keywords: AIDS brain lesions, CT scan, tuberculous meningitis, HIV encephalitis, cerebral toxoplasmosis and cryptococcal meningitis.

I. Introduction

Acquired immune deficiency syndrome (AIDS) is caused by an infection of the human immunodeficiency virus (HIV); hence, it is also known as HIV disease/infection[1,2]. Since being discovered, AIDS has caused the deaths of millions of people's deaths all over the world. Unfortunately, AIDS is far from stable in the world[3, 4]. In fact, AIDS itself does not cause death; it interferes dramatically with the human immune system because of the progression of the infection, and it causes HIV-infected people to be considerably more susceptible to common infections, thus enhancing mortality in such conditions[5].

The human immunodeficiency virus and acquired immunodeficiency syndrome can result in several types of complications in the central or peripheral nervous system, which comprise nearly 15 to 40 percent of all AIDS or HIV complications[6]. Tuberculous meningitis (TBM) is one of two brain tuberculosis manifestations. The diagnoses of tuberculous meningitis often relies on image features supplied by CT and MR (magnetic resonance) scans; however, it is desirable if a histological examination is available. An operation is required if there is hydrocephalus associated with TBM[7, 8]. HIV encephalitis (HIVE) refers to a complex of neuropathological alterations induced by the infiltration of HIV-infected macrophages in the early stages of HIV infection9, 10. It should be noted that antiretroviral therapy (HAART) has quickly altered HIV related neuropathology and neurological manifestations, which could lead to confusion in the treatment of AIDS[9]. Cryptococcal meningitis (CM) presents in brain lesions of AIDS patients because cryptococcus neoformans tend to be present in cerebrospinal fluid. The manifestations of cryptococcal meningitis are characterized by non-specific symptoms, such as headache, fever, nausea, or altered mental state/behaviour. To confirm the CM diagnosis, a lumbar puncture appears to be vital[11]. Cerebral toxoplasmosis (CT) is one of the most frequent pathogenies that causes brain lesion complication in AIDS patients, especially in developing countries. CT is fatal if not treated properly, although there is possibility for complete recovery as long as the patient is treated legitimately[12, 13].

To diagnose the neurological complications of AIDS, the imaging data supplied by computed tomography (CT) and magnetic resonance (MR) are indispensable. The CT scan is more useful in the diagnosis and evaluation of focal brain lesions, particularly when a MRI facility is not available in under-equipped hospitals. For example, a CT scan is able to specifically diagnose cerebral toxoplasmosis in approximately 80% of cases[14]. The accumulating evidence indicates that by mastering the characteristics of the neurological complications of AIDS in CT scans, we can further diagnose these complications and evaluate treatment results. In this study, we performed an investigation of 35 CT scan images of AIDS patients with neurological complications at the 8th Guangzhou People's Hospital.

II. Materials and Methods

a) Patients

General: From 2004 to 2009, 65 AIDS patients were diagnosed using clinical and laboratory examinations at the 8th Guangzhou People's Hospital. Among the 65

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patients, there were 45 male and 20 female patients, whose ages ranged from 11 to 65 years old; the average age was 39.3 years old. All of the patients were scanned using cranial computed tomography (CT) (MX 8000 CT, Philips).

b) Diagnosis

AIDS diagnosis: AIDS could be diagnosed if the patients had epidemiological history (Table 2), HIV positive results in laboratory examination, and any one of the following: fever for more than one month without specific reason, chronic diarrhoea (>3 times/day) for more than one month, over 10% weight loss within half a year, repeated oral candidiasis, repeated herpes simplex/herpes zoster virus infection, pneumocystis pneumonia, repeated bacterial pneumonia, active tuberculosis/mycobacterium tuberculosis, deep fungal infection, occupancy lesions in the central nervous system, middle-age dementia, active cytomegalovirus infection, toxoplasma cerebropathy, penicillium infection, repeated sepsis and Kaposi's sarcoma in the skin or viscera.

AIDS complication diagnosis: The diagnosis of tuberculous meningitis (TBM), HIV encephalitis (HIVE), cryptococcal meningitis (CM) and cerebral toxoplasmosis (CT) was followed by the respective standards of the Chinese Medical Association Branch of Infection Diseases in 200415.

III. Results

a) General information on patients suffering from AIDS

The 65 patients suffering from AIDS, proven by their clinical and laboratory examination results, were examined using computed tomography (CT) scan at the 8th Guangzhou People's Hospital from 2004 to 2009. Among the 65 AIDS patients, 45 patients are male (69.2%) and 20 patients are female (31.8%). The patients range in age from 11 to 65 years old, and the average age is 39.3 years old (Table 1).

Table 1 : General information about the 65 AIDS patients

Patients	Percentage(%)
Sex	
male	45(69.2%)
female	20(31.8%)
Age group	
(mean 39.3 yrs, range 11-65 yrs)	

b) CT scan indicated that there were various brain lesions in certain AIDS patients

In the 65 patients suffering from AIDS, several AIDS complications, such as tuberculous meningitis (TBM), HIV encephalitis (HIVE), cerebral toxoplasmosis (CT) and cryptococcal meningitis (CM) were presented, and the incidence of these complications were 35.4% (n=23/65) in TBM, 29.2% (n=19/65) in HIVE, 16.9% (n=11/65) in CT and 18.5% (n=12/65) in CM (Figure 1A). Among the same 65 patients who had been diagnosed with AIDS, numerous brain lesions could be seen in the CT scans of 34 patients. They will be denoted as brain lesion positive in the remainder of this report. These brain lesions included low density foci, local mess effect, ventricle extension, hydrocephaly and encephalatrophy, as illustrated in Figure 2A-D. We determined that the CT scan revealed that 53.3% (n=34/65) of the AIDS patients had brain lesions whereas 47.7% (n=31/65) of the patients did not (Figure 1B). In the CT-indicated positive brain lesion cases, there were 50.0% (n=17/34) HIV+TBM, 23.5% (n=8/34) HIVE, 14.7% (n=5/34) HIV+CT and 11.8% (n=4/34) HIV+CM (Figure 1C). Additionally, low density foci was the most predominant syndrome observed in CT scans for patients with AIDS combined with tuberculous meningitis (TBM) (Figure 1A1). Encephalatrophy was the most apparent syndrome observed in CT scans for patients with AIDS combined with encephalitis (HIVE) (Figure 1B1). Furthermore, encephalatrophy was observed relatively more often in CT scans compared to other syndromes in AIDS combined with cryptococcal meningitis (CM) (Figure 1C1). Low density foci and local mess effect were more common syndromes compared to others in AIDS combined with cerebral toxoplasmosis (CT) (Figure 1D1).

Furthermore, we conducted a questionnaire survey on the personal lifestyle of the 34 AIDS patients with CT-indicated brain lesions. Among these patients, 12 visited prostitutes (35.5%), 10 abused drugs (29.4%), 3 possessed multiple sexual partners (8.8%), 4 patients' spouses suffered from AIDS (11.8%), 2 visited prostitutes and abused drugs (5.9%), 2 visited prostitutes and had blood transfusions (5.9%), and 1 abused drugs and had blood transfusions (2.9%) (Table 2).

Table 2 : Epidemiological statistics

History taking	Number	Percentage
visiting prostitutes	12	35.3%
drug abuse	10	29.4%
multiple sexual partner	3	8.8%
spouse with AIDS	4	11.8%
visiting prostitutes & drug abuse	2	5.9%
visiting prostitutes & blood transfusion	2	5.9%
drug abuse & blood transfusion	1	2.9%
total	34	100%

The $CD4^+$ T lymphocyte numbers were counted in the four AIDS complications (TBM, HIVE, CM and CT) (Table 3), in which a $CD4^+$ T lymphocyte count of less than 50 occurred in 61.8% (n=21/34) of AIDS with complications, and they occurred more often in the TBM and HIVE groups; almost none of the complications had $CD4^+$ T lymphocyte numbers higher than 200, thus

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suggesting that CD4+ T lymphocyte numbers dramatically reduced after the AIDS infection was combined with these complications.

Table 3 : CD4+ T lymphocyte count

CD4+ count	TBM	HIVE	CM	CT	Total(%)
<50	7	6	4	4	21(61.8%)
100-199	5	1	0	1	7(20.6%)
50-99	3	1	0	0	4 (11.8%)
≥200	2	0	0	0	2 (5.9%)

The combination of AIDS with these complications might increase the death rate of the AIDS patients. Here, we demonstrate that the highest mortality of AIDS patients with those complications occurred in the TBM group (Table 4).

Table 4 : Mortality of AIDS with different brain disease

	TBM	HIVE	CM	CT
number of deaths	4	3	2	1
total	17	8	4	5
mortality	11.8%	8.8%	5.9%	2.9%

IV. Discussion

Neurological complications account for approximately 40–80% of patients with the human immunodeficiency virus (HIV) infection, especially at a higher frequency in the late stages of severe acquired immune deficiency syndrome (AIDS)[16, 17]. To diagnose AIDS-related brain complications, physicians typically use brain imaging information, including internal bleeding, white matter irregularities, and other brain abnormalities based on the patients' medical history and laboratory examination. Furthermore, the diagnosis can be made by combining the general neurological exam to assess various nervous system functions with the brain imaging data, which are primarily supplied by CT and MRI scans. Furthermore, the majority of brain image information is obtained through CT examination due to the expensive costs of MRI examinations in most counties. Thus, precise and thorough CT scans for AIDS-related brain complications are absolutely indispensable. In this study, we conducted cranial CT scans for 65 AIDS patients who visited doctors from 2004 to 2009 at the 8th Guangzhou People's Hospital. A cardinal CT scan revealed that 34 AIDS patients had various brain complications among the 65 patients. Although there were a few differences in the patients' gender and age, we did not determine any significant impact of gender and age difference on the CT scan images of AIDS-related brain complications (Table-1). However, the positive CT scan AIDS complications in epidemiological statistics indicated that 35% of patients had a history of visiting prostitutes, and 29% of patients had a history of drug abuse among the positive CT scan cases, suggesting that visiting prostitutes or abusing drugs certainly enhanced the risk of having AIDS brain complications (Table-2). Clearly, we could also see other factors, such as multiple sexual partners and spouses with AIDS, contribute to AIDS related brain complications.

Out of 65 AIDS patients, the percentages of tuberculous meningitis (TBM), cryptococcal meningitis, cerebral toxoplasmosis (CT) and HIV encephalitis were 35.4%, 18.5%, 16.9% and 29.5%, respectively. Furthermore, the percentages of the percentages of tuberculous meningitis (TBM), cryptococcal meningitis, cerebral toxoplasmosis (CT) and HIV encephalitis became 50.0%, 11.8%, 14.7% and 23.5%, respectively in the 53% of CT scan-indicated AIDS-related brain complications, thus demonstrating that AIDS with tuberculous meningitis (HIV+TBM) accounted for half of the brain complications (Fig. 1). This observation is similar to reports by other authors18. It should be noted that AIDS with brain lesions could present as various clinical manifestations or multiple nervous system manifestations simultaneously, or one clinical manifestation could be derived from different pathogenesis. The primary cause for AIDS patients in later stages to see doctors in this study was because of neurological symptoms induced by AIDS-related brain lesions. There are different image characteristics for various AIDS-related brain lesions in CT scans. Additionally, these image features in the CT scan could be useful for diagnosing different AIDS-related brain lesions. For example, low density foci in a tuberculous meningitis (TBM) CT scan indicates an enlarged brain ventricle, hydrocephaly and encephalatrophy. The CT scan images of HIVE encephalitis (HIVE) indicate the presence of broadening subarachnoid space and bilateral ventriculomegaly. The CT scan images of cryptococcal meningitis (CM) present a significant enhancement of bilateral cerebral hemisphere meninx intensity. Furthermore, more low density foci with adjacent oedema and local mess effect appear in CT scan images of cerebral toxoplasmosis (CT).

Additionally, we determined that the CD4+ T lymphocyte count, one indicator for evaluating HIV infection and treatment effect, dramatically dropped (<50) in the TBM and HIVE groups (Table-3). Similarly, a higher mortality of patients who had AIDS with brain lesions could be found in the TBM and HIVE groups, suggesting that it is noteworthy that our physicians should pay more attention to the progress of AIDS with various brain lesions because they could result in a risk to human life. Clearly, a more precise combination of clinical syndromes and CT scan imaging is required in the future to explore the correlation of the types of AIDS brain diseases and their progress.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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V. Acknowledgments

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Figure Legends

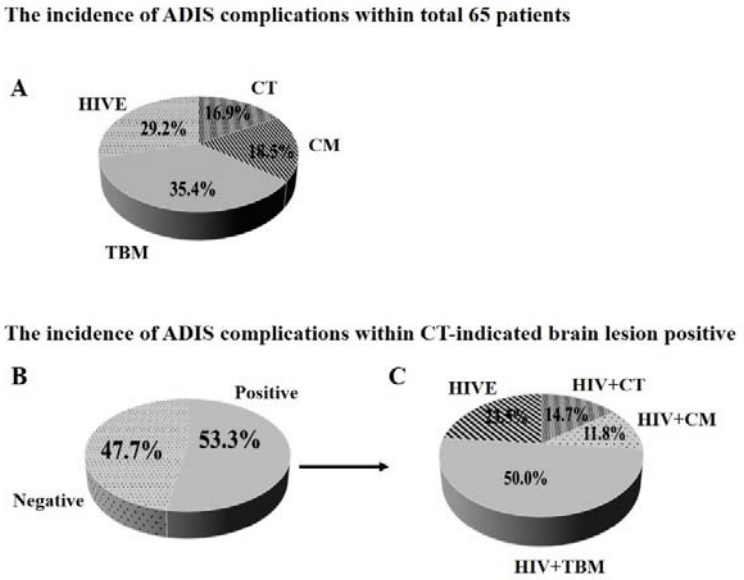


Fig. 1 : Typical CT images for brain lesions in AIDS complication patients

A-D: Typical CT images for brain lesions in AIDS complications, including TBM, CM, HIVE and CT among 65 AIDS patients. A1-D1: The bar charts depict the incidences of brain lesions in AIDS complications, including TBM, CM, HIVE and CT, respectively. Abbreviations: TBM: tuberculous meningitis; CM: cryptococcal meningitis; HIVE: HIV encephalitis; and CT: cerebral toxoplasmosis.

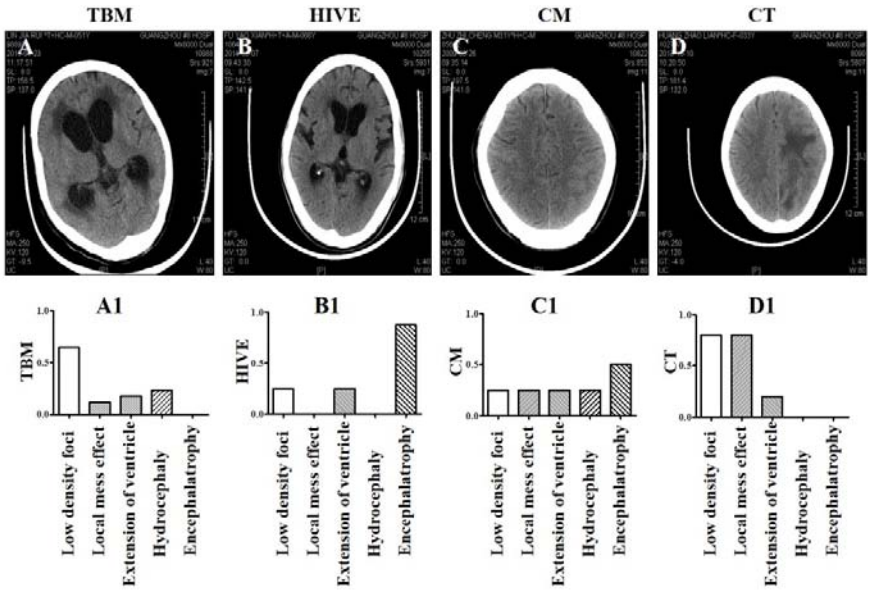


Fig. 2 : Incidences of AIDS complications or CT-indicated brain lesion cases

A: A pie chart depicting the percentage of AIDS complications, including TBM, CM, HIVE and CT in a total of 65 AIDS patients. B: The pie chart depicts the percentage of CT examination-indicated brain lesion negative and positive cases in a total of 65 AIDS patients. C: The pie chart depicts the percentage of AIDS complications, including TBM, CM, HIVE and CT in positive CT examination-indicated brain lesion cases. Abbreviations: TBM: tuberculous meningitis; CM: cryptococcal meningitis; HIVE: HIV encephalitis; and CT: cerebral toxoplasmosis.

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Primary Hydatic Cyst of the Spleen

By Abraham Gampel Cohen, Fabiola Romero Ruperto, Maria Luz Parrra Gordo,
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Abstract- A 87 years old woman, natural and from a rural area of the province of Cordoba, Spain. Personal history of depressive disorder (treated with lorazepam, bupropion, triazolam and escitalopram), hypertension and transient ischemic attack 10 years ago (in treatment with acetylsalicylic acid) and advanced glaucoma for 4 years (treated with latanoprost and timolol).

Visits with abdominal pain of insidious onset, diffuse, intermittent, with a month of evolution, located in the stomach region without irradiation, associated with nausea and intermittent vomiting. Patient refers long-standing loss of appetite. She denies urinary clinic. The last deposition was 2 days ago, with usual constipated habit.

During the clinical examination she maintains its stable vital functions and remains conscious and oriented. The abdomen is soft and depressible, tenderness in the stomach region to touch without mass or organ enlargement or peristalsis. The rest of the exam without significant alterations.

GJMR-D Classification : NLMC Code: WH 600

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Primary Hydatic Cyst of the Spleen

Abraham Gampel Cohen [α], Fabiola Romero Ruperto [σ], María Luz Parra Gordo [ρ], María Jesús Sánchez García-Altares [ω], Francisco Javier González Sendra [¥], Claudio Laganà [§], Josima Luchsinger Heitmann [χ] & Estela Bentolila de Gampel [ν]

Abstract- A 87 years old woman, natural and from a rural area of the province of Cordoba, Spain. Personal history of depressive disorder (treated with lorazepam, bupropion, triazolam and escitalopram), hypertension and transient ischemic attack 10 years ago (in treatment with acetylsalicylic acid) and advanced glaucoma for 4 years (treated with latanoprost and timolol).

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The blood count values are: hemoglobin 16.7, VCM 85.7, HCM 28, platelets 302,000, 11,000 leukocytes, neutrophils 78.2%, 16.4% lymphocytes and eosinophils 0.5%. Biochemical values are within normal parameters.

In the posteroanterior and lateral chest radiographs (Figures 1 and 2) can be seen a nodular lesion with left infradiaphragmatic peripheral calcification. In plain abdominal radiography (Figure 3) abundant stool and gas in the colon, distal presence of gas are evident; the presence of a round 5 cm in diameter calcified lesion, located in the left upper quadrant is confirmed.

It is given metamizol, metoclopramide and ranitidine in 100 ml of physiological saline and 0.5 mg sublingual alprazolam. Clinical response is favorable and the pain disappears.

Home treatment consists ina soft laxative diet regimen, chamomile tea, rectal enema to achieve effectiveness, and she is referred to his family physician for control.

A month later, the patient was referred to a doctor specialist in digestive tract with a presumptive diagnosis of calcified hydatid cyst. During the consultation an abdominal ultrasound is done in which was not identified the lesion displayed on the radiograph, so computerized tomography (CT) scan was requested for further study.

The radiologist previously performed a new abdominal ultrasound (Figure 4), confirming the presence of a splenic injury, therefore he completes the study with abdominal CT with and without intravenous contrast. There is confirmation of the presence of a localized mass in the upper pole of the spleen, with rounded morphology, 49 mm in length, heterogeneous solid-cystic, grossly calcified and well-defined edges, which is not enhanced with contrast (Figure 5). The rest of the study does not show significant alterations.

The patient is discharged with a diagnosis of calcified splenic hydatid cyst. Periodic clinical and imaging controls are scheduled.

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I. Comment

Hydatid disease is a parasitic zoonosis caused by Echinococcus granulosus. It can affect any organ of the host. Primarily infects the liver (approximately 75% of cases), followed by lung (25%), kidney (4%) and peritoneum (4%); splenic location constitutes 1% of cases.

Due to its low frequency, the clinical diagnosis of splenic hydatid disease can be challenging, especially in non-endemic areas. However, when the size of the cyst is large enough, the patient may feel a painful mass in the left upper quadrant; it can even compress the renal artery and cause systemic hypertension. Sometimes, there can be complications and breakage thereof, accompanied by bleeding or infection later.

Diagnosis is mainly done through Imaging studies (ultrasound or CT). Usually, the image can be described as a single cystic lesion or multiple, well defined. Some show membranes or daughters vesicles inside, or they can present their walls calcified.

Immunological tests are a support for the diagnostic but their efficiency is variable. The most sensitive and specific are ELISA, indirect immunofluorescence and double diffusion arc 5 Capron (DDA5). However, a negative serological result does not exclude infection.

The treatment of choice is surgery, often related with increased risk of complications derived to the cyst breakage, which can produce peritoneal dissemination. Not all cases are eligible for surgery, as our patient, either by baseline conditions of the own patient or the characteristics of the cyst. Calcified cysts (Dead cyst), with diameter less than 5cm, negative serological test and / or casual diagnosis during a radiological study, are sufficient justifications to rule out surgery, but is not anexemption from clinical and radiological control over the years.

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Figure 1 and 2 : Posteroanteriorand lateral chest radiographs. Aleft calcified nodular lesion seen infradiaphragmatic (arrows).



Figure 3 : X-ray of the abdomen. A 5 cm in diameter calcified lesion in the left upper quadrant (arrows).

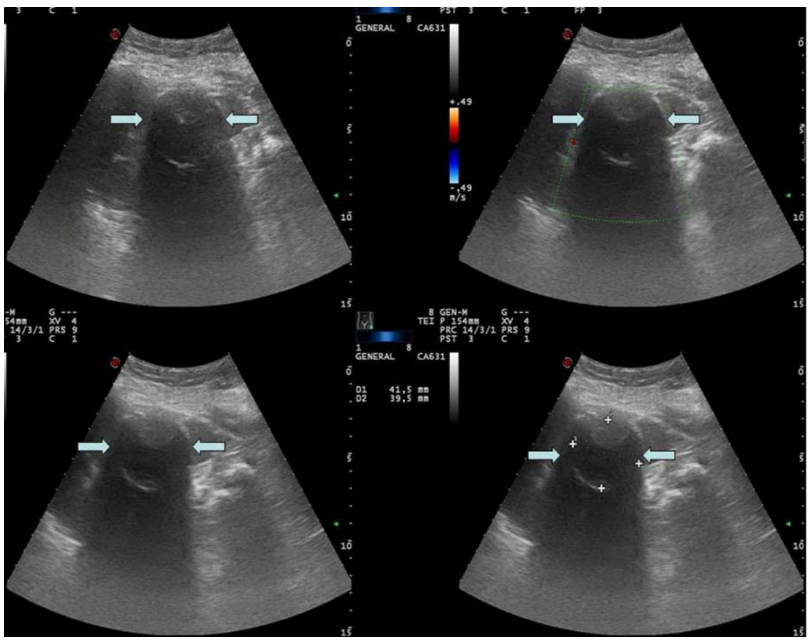


Figure 4 : Abdominal ultrasound. Confirms the presence of an avascular hypoechoic splenic injury with peripheral calcification (arrows).

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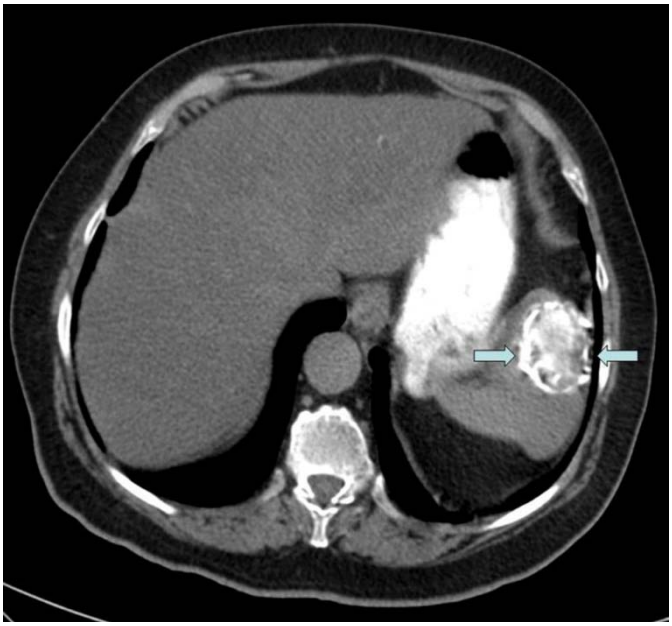


Figure 5 : Abdominal CT scan. Mass in the upper pole of the spleen, of rounded morphology and 49 mm in length, solid-cystic, calcified coarsely edges and well defined (arrows).

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Diffusion MRI of Human Brain: Key Points and Innovations

By Alessandro Arrigo MD, Alessandro Calamuneri PhD & Enricomaria Mormina MD

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Abstract- MRI-based investigations represent, to date, very powerful approaches for the study of the brain. One set of tools, provided by diffusion MRI, allows the non-invasive analysis of structural aspects of gray and white matter, by analyzing how water molecules diffuse within the brain. Although number of clinical studies employing diffusion MRI has grown in last years, some aspects still result poorly known or poorly understood by unfamiliar researchers and clinicians, due to their technical complexity. The main goal of the present work is to resume the main landmarks of diffusion MRI investigation and to show the current state as well as future perspectives of related methodologies.

Keywords: magnetic resonance imaging, diffusion-weighted imaging, diffusion models, diffusion tensor imaging, constrained spherical deconvolution, tracto-graphy.

GJMR-D Classification : NLMC Code: WL 348



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Diffusion MRI of Human Brain: Key Points and Innovations

Alessandro Arrigo MD [α], Alessandro Calamuneri PhD [σ] & Enricomaria Mormina MD [ρ]

Abstract- **MRI-based investigations represent, to date, very powerful approaches for the study of the brain. One set of tools, provided by diffusion MRI, allows the non-invasive analysis of structural aspects of gray and white matter, by analyzing how water molecules diffuse within the brain. Although number of clinical studies employing diffusion MRI has grown in last years, some aspects still result poorly known or poorly understood by unfamiliar researchers and clinicians, due to their technical complexity. The main goal of the present work is to resume the main landmarks of diffusion MRI investigation and to show the current state as well as future perspectives of related methodologies.**

Keywords: magnetic resonance imaging, diffusion-weighted imaging, diffusion models, diffusion tensor imaging, constrained spherical deconvolution, tracto-graphy.

I. Introduction

Diffusion MRI (dMRI) represents nowadays a powerful tool for the non-invasive investigation of the brain. It allows to perform both qualitative and quantitative evaluation of brain features as well as of its alterations, with particular regards to white matter ones. All diffusion-based techniques are dedicated to the analysis of signals provided by the diffusion process of water molecules within brain tissues. Goal of this manuscript is two-fold: firstly, we want to provide a summary of the state of the art for researchers unfamiliar with dMRI models and related techniques; secondly, we want to address some of future perspectives in the field.

II. Diffusion Models

Diffusion models consist in a set of algorithms attempting to estimate how water molecules diffuse within each voxel (imaging unit). The mostly known model is diffusion tensor, which is the basis of Diffusion Tensor Imaging (DTI) (Basser et al., 2000); however a cohort of other models which overperform DTI have been developed over the years, such as Q-ball imaging (QBI) (Tuch, 2004), Diffusion Spectrum Imaging (Wedeen et al., 2008), Constrained Spherical Deconvolution (CSD) (Tournier et al., 2007), multi-compartments models (see for instance Panagiotaki et al., 2012). All above mentioned techniques return back a geometrical object (e.g. the tensor for DTI) which encodes diffusion process for each analyzed voxel; the sensitivity as well as the type of information which can be extracted from such objects vary according to the algorithm/model used. Based on these objects, qualitative and quantitative analyses can be performed.

a) Qualitative analysis

One of the most explored applications of diffusion MRI is tractography (Soares et al., 2013), i.e. the reconstruction of the path followed by a given white matter bundle. This can be achieved by means of both deterministic (one direction assigned for each voxel) and probabilistic (the most probable path obtained after a given number of attempts) tractographic algorithms (Soares et al., 2013; Behrens et al., 2007). Tractography reconstruction outcomes strongly rely on the underlying diffusion model used In this context, several issues can affect the reliability of tractographic results, e.g. the presence of voxels with multiple fiber directions (Farquharson et al., 2013). DTI cannot handle multiple fiber directions, as it can only provide a unique diffusion direction. This is the reason why other more advanced approaches outperform DTI based tractography, like CSD (Tournier et al., 2008; Farquharson et al., 2013). An exemplificative case showing how tractographic output can be different according to the model used, namely DTI and CSD, is shown in Figure 1, where corticospinal tract and optic radiations were reconstructed with both methods.

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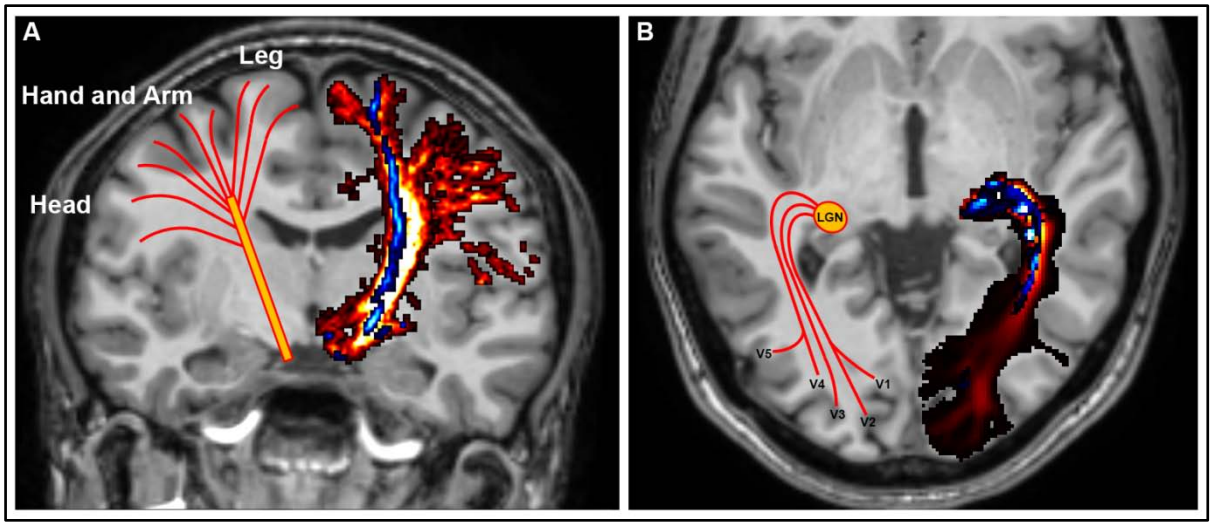


Figure 1 : Tractography of left corticospinal tract (A) and left optic radiations (B). Reconstructions of these two eloquent white matter bundles were obtained by means of probabilistic CSD model (red) and DTI one (blue), which were overlapped in order to show qualitative differences. On the right side, the schematic representation of anatomical features of these bundles, as well as their end points in the cortex, are shown.

b) Quantitative analysis

From each diffusion model a number of useful features can be extracted in a given voxel. Those features can be used to quantify WM and perform investigation both in normal and pathological conditions. It is important to clarify that nature and validity of features extracted depend on a number of factors, e.g. quality of scans used. Here we want however to keep focus on what different diffusion model can offer. If based on tensor model, quantitative analysis can provide information regarding how much anisotropic is the signal within a voxel, through a number of parameters among which fractional anisotropy (FA) and mean diffusivity (MD) are the most used (Soares et al., 2013). Those measures have been considered indirect measures of axonal integrity (Alexander et al., 2007; Soares et al., 2013). Due to the ability of other models to better reconstruct WM bundles, it was suggested to sample tensor features on voxels reached by tractographic reconstructions obtained by other methods, like CSD (Mormina et al., 2014; Arrigo et al., 2014; Mormina et al., 2015; Arrigo et al., 2015; Arrigo et al., 2016).

FA measures level of anisotropy in the voxel: the higher this number, the higher the probability that a single predominant fiber direction is appearing in that voxel. It has to be noticed however that (Jeurissen et al., 2013), if we were to compare FA values obtained by averaging within voxels sampled by means ofCSD-based tractographic reconstruction with the same average performed on the basis of DTI tractography, we would observe a FA reduction. This happens because, with CSD, voxels with multiple dominant fiber directions are involved; as result, water diffusion anisotropy is spread across different directions, and tensor model is able to fit an overall anisotropy decreasing. Due to the huge number of voxels showing this behavior in WM (Jeurissen et al, 2013), new features were developed to the better describe diffusion models. As an example, based on CSD, Apparent Fiber Density (AFD) (Raffelt et al., 2012), was developed to measure contribute of each dominant direction. Figure 2 illustrates the situation.

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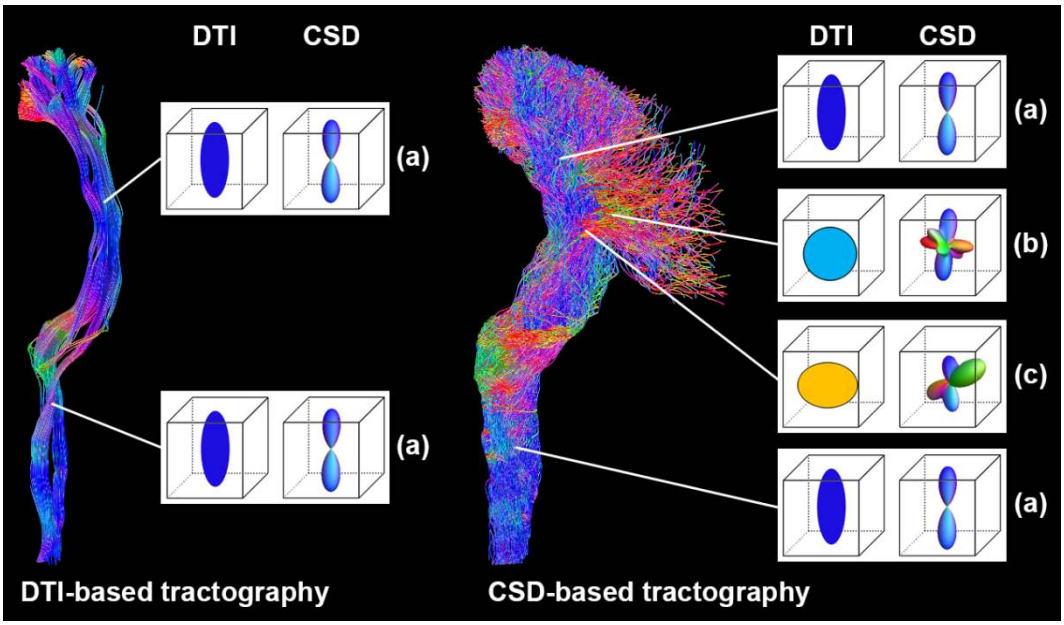


Figure 2 : Tractography of the left corticospinal tract obtained by means of DTI and CSD models. Some exemplificative voxels showed differences regarding calculation of diffusion signals, if using tensor model or CSD, in the following cases: monodirectional (a), multidirectional (b) and crossing fibers (c) voxels. The presence of (b) and (c) affects tensor model, thus causing poor qualitative reconstruction. Moreover, also quantitative analysis is affected, since only voxels with a well-represented principal direction are considered.

III. Limitations, Validations and Future Perspectives

Diffusion MRI results, particularly tractography, are often criticized due to a number of limitations potentially affecting outputs. Moving beyond the intrinsic limitation represented by the impossibility to discriminate directionality of afferent or efferent signal transmission (Parker et al. 2013; Chung et al. 2011), as previously described, tractographic output strongly depends on the algorithm used for diffusion signal modelling (Farquharson et al., 2013).Several inaccuracies caused by possible artefactual effects as well as false positive tracts should be also taken into account (Jones and Cercignani, 2010). Furthermore, since tractography represents the reconstruction of white matter paths provided by a mathematical computation (deterministic or probabilistic), it is often criticized by declaring that dissection is preferable due to its ability to definitely assess the real existence of a given connection. However, a number of studies have validated DTI tractographic output through histological investigations (Seehaus et al., 2013; Gao et al., 2013; Seehaus et al., 2015). The adoption of more advanced algorithms have allowed a better detection of white matter bundles; those techniques have obtained histological validations as well (Dirby et al., 2007; Azadbakht et al., 2015). Recently, in vivo neurite orientation dispersion and density imaging (NODDI) (Zhang et al., 2012) was proposed: this technique allows a multi-compartmental analysis of the brain, i.e. separately considering glial, axonal and extracellular components, thus restituting a detailed profile of brain microstructure. Although technical requirement are not easily reachable, this represents a promising investigative technique for a deeper study of the brain both in healthy and pathological conditions.

Interesting future perspectives will be to make more feasible these innovative approaches for clinical settings as well as to integrate them with other investigative techniques, such as electrophysiology and transcranial magnetic stimulation.

IV. Conclusion

In this paper the main key points of diffusion MRI investigations have been neatly described. We wanted to provide a brief and simplified description of the complex methodological aspects, in order to offer necessary pills for better understanding diffusion-based studies.

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Tunnel Hemodialysis Catheter Placement using the Supra-clavicular Approach to Overcome Stenosis of the Internal Jugular Vein at its Origin

By Magbri A MD, Brandt M CV RT, Mock L RT, Colosimo V RN, Zurawsky R RN & McCartney P BSN, RN

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The case is 68 years Caucasian male with end stage renal disease secondary to renal cell carcinoma and hypertension. He had three tunnel hemodialysis catheters (TDC) placed in the right internal jugular vein and failed radial-cephalic arterial-venous fistula in the left forearm.

Keywords: supraclavicular vein cannulation, end-stage renal disease, tunnel dialysis access, arterial-venous fistula, pneumothorax, subclavian vein.

GJMR-D Classification : NLMC Code: WG 625.J8



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The case is 68 years Caucasian male with end stage renal disease secondary to renal cell carcinoma and hypertension. He had three tunnel hemodialysis catheters (TDC) placed in the right internal jugular vein and failed radial-cephalic arterial-venous fistula in the left forearm. He had recently placed brachial-cephalic AVF in the left arm which was not matured to be used in HD. He was referred to the Dialysis Access Center of Pittsburgh, PA for placement of right internal jugular vein tunneled hemodialysis catheter. Three attempts were made to place TDC in the right IJ vein were without avail due to stenosis in the origin of the right IJ at its junction with the sub-clavian vein as illustrated in the angiogram. A decision was made to place the TDC using the supra-clavicular approach as described below to overcome the stenosis in the right IJ. The procedure was accomplished without difficulty using the ultra-sound- guided cannulation of the subclavian vein and the supra-clavicular approach. Supra-clavicular placement of tunnel dialysis catheter is easy and safe method to overcome stenosis in the internal jugular vein.

Keywords: supraclavicular vein cannulation, end-stage renal disease, tunnel dialysis access, arterial-venous fistula, pneumothorax, subclavian vein.

I. Sedation

- Explain the procedure, benefits, risks, and complications, and obtain signed informed consent.
- Sedate the patient using versed and fentanyl injected into the central veins. Vital signs were monitored by the nurse for the entire period of the procedure.

II. Technique

- The skin at the cannulation site is infiltrated with local anesthesia (1% lidocaine), then using real time ultra-sound guidance, the subclavian vein (SCV) was cannulated using a 45° bisection of the approximately 90° angle formed by the superior aspect of the clavicle and the lateral border of the sternocleidomastoid.
- Under continuous aspiration with the syringe the needle is directed parallel to the chest wall in the coronal plane aiming for the contra- lateral nipple or the supra-sternal notch 10-15° to the sagittal plane and 35° posteriorly from the coronal plane (1, 2).
- When blood is freely aspirated the 0.018 inch guide wire was inserted in the needle and then co-axial 3 and 5 Fr dilators were placed. The puncture site to the SCV is achieved easily using the direction explained earlier, 1.5 cm lateral to the heads of the sternocleidomastoid muscle and about 1 cm above the clavicle.
- The 0.018 wire is advance into the vein and the needle is exchanged for the co-axial dilators. A 0.035 inch Bentson (Merit-Medical system Inc Jordan, Utah, USA) guide wire is placed with its distal tip in the inferior vena cava under fluoroscopy.
- A 1 cm incision was made at the venotomy site and the area was bluntly dissected with a pair of hemostat. A tunnel was created following a subcutaneous infiltration with 1% lidocaine along the expected course of the tunnel. The tunnel should be at least 8-10 cm in length. A # 11 blade is used to create a 5 mm incision on the chest wall at the desired entry site on the chest.
- The tunnel was then dilated with a pair of hemostat as well as the catheter-tunnelet combination from the exit site towards the venotomy site.
- The desired catheter length was advanced from the exit site in the anterior chest wall to the venotomy site and the SVC under direct fluoroscopy without the peel-away sheath.
- The tip of the catheter is placed between the junctions of the SCV with the right atrium. Making sure there is no evidence of malposition, kinks of the catheter or complication.
- The catheter ports are then tested by flushing them with 10cc syringe. The ports of the catheter are flushed with heparin and the catheter was sutured in place with 2-0 non-absorbable suture.

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III. Complications and Advantages of the Supra-clavicular Approach for Tunnel Hemodialysis Catheter Insertion

1. The rate of all procedure- related complications has dropped significantly with image-guided insertion. Arterial puncture (0.8-3.36%), pneumothoraces (0.48-0.56%), and catheter malpositioning are virtually non-existing with image guided insertion (3-12).
2. Venous laceration that often occurs with the traditional method can also happen in this approach. Puncture or laceration of the subclavian artery is theoretical possibility. Also this approach should be avoided in patients who are anticoagulated because the subclavian vein cannot be compressed.
3. The supra-clavicular approach is easy to accomplish and avoids stenosis at the origin of the internal jugular vein as in this case. It is underused procedure for gaining access to the central veins. It offers several advantages over the other methods because the SCV at the insertion site is quite superficial and the right side offer straight path to the SCV. In obese patients this anatomical area is less distorted.
4. Air embolism is caused by the negative intra-thoracic pressure created with the inspiration into an open hub. Placing the patient in Trendelenburg position and making sure the hubs are always occluded would lower this risk.
5. The overall complication rate is significantly less compared to the other methods (4). The success rate is 92% as reported by Czamik et al (6) even in those being mechanically ventilated. The use of the US guidance to locate the vessel prior to cannulation remains an option and lessens the complication rate (7-10).

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Optic Disc and Blood Vessels Screening in Diabetes Mellitus using Otsu's Method

By Ms. Jyoti Patil & Dr. S.R. Chaudhari
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Abstract- Diabetes Mellitus (DM) has type-1 & type 2. So in diabeties type-2 is very severe disease which creates complications and effect on various part of body. Most sensitive part of body is Eye which is affected by DM responsible in progression of Diabetic Retinopathy (DR). DR is a slowly effects on eye & come to focus when the changes on the retina have progressed to a level at which treatment turns complicate, so an early diagnosis and referral to an ophthalmologist or optometrist for the management of this disease can prevent 98% of severe visual loss. The aim of this work is to automatically identify Diabetic Retinopathy (DR), and Background Retinopathy using fundus images. Our results show a classification accuracy of 92%, with sensitivity and specifity of 95%.

Keywords: diabetic retinopathy, thresholding, otsu.

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Abstract- Diabetes Mellitus (DM) has type-1 & type 2. So in diabeties type-2 is very severe disease which creates complications and effect on various part of body. Most sensitive part of body is Eye which is affected by DM responsible in progression of Diabetic Retinopathy (DR). DR is a slowly effects on eye & come to focus when the changes on the retina have progressed to a level at which treatment turns complicate, so an early diagnosis and referral to an ophthalmologist or optometrist for the management of this disease can prevent 98% of severe visual loss. The aim of this work is to automatically identify Diabetic Retinopathy (DR), and Background Retinopathy using fundus images. Our results show a classification accuracy of 92%, with sensitivity and specifity of 95%.

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I. Introduction

The Diabetes Mellitus (DM) is nothing but it is a set of chronic and degenerative disorders that involves alterations in the metabolism of carbohydrates, lipids, and proteins, as a consequence of a decreasing in the production of the hormone insulin for the β cells from the pancreas, and a resistance to the hormone's action in the different tissues [1]. One of the most serious complications of the DM is the DR [2], which is the main cause of worldwide blindness in the economically active population, because it affects people between 20 to 74 years old [3, 4]. Two types of clinical DR exist: Non-Proliferative Diabetic Retinopathy (NPDR), also called Background Retinopathy and Proliferative.

Diabetic Retinopathy (DR), this work aims to detect the optic disc (OD) and the blood vessels; these are very important & sensitive part from anatomy of eye. Also, the optic disc and the exudates are the bright area of the image. Detection of optic disc and the blood vessels can help the ophthalmologists to detect the diseases earlier and faster. With help of using mathematical morphology methods such as closing, filling, morphological reconstruction and Otsu algorithm Optic disc and the blood vessels can be detected and eliminated.

Main cause of Diabetic Retinopathy is increase in high sugar level in the small blood vessels in retina. This increase in glucose level attacks on tiny blood vassals and optic disk in eye causes increase in ocular pressure in eye. Due to increase in pressure vassals may leak, or swelling may be observed in severe stage of retinopathy.

We in this research work using the screening method of diabetic retinopathy which can reduce the risk of blindness by 50% [1]-[2]. Therefore, early detection could reduce the severity of the disease and treating the disease more efficiently. It is very important to detect the optic disc so that after optic disk detection we can identify the other fundus features. The optic disc looks like as the elliptical shape in the eye fundus image. Its size varies from human eye to eye, between one-tenth and one-fifth of the image [3]. In color image, it appears as the bright yellowish region as the exudates. The optic disc is the normal feature of the image but the exudates are the abnormal case. Detection the optic disc can be used to reduce the false positive in the detection of the exudates [4] [5].

A number of methods for optic disc detection and blood vessels detection have been published. Osareh et al. [6] located the optic disc center by means of template matching and extracted its boundary using a snake initialized on a morphologically enhanced region of the optic disc. Lowell et al. [7] also localized the OD by means of template matching as well as also selected a deformable contour model for its segmentation. Another deformable model-based approach was presented in [8]. Another template-matching approach for OD segmentation is the Hausdorff-based template matching presented by Lalonde et al. [9]. Initially, they determined a set of OD candidate regions by means of multi resolution processing through pyramidal decomposition. For each OD region candidate, they calculated a simple confidence value representing the ratio between the mean intensity inside the candidate region and inside its neighborhood. As final step, using the Hausdorff distance between the edge map regions and circular templates with different radii, they decided the OD among all the candidates. There are some methods for blood vessels detection in retinal fundus images such as region growing technique [10], morphological and thresholding techniques [11], neural network based approaches [12], statistical classification based methods [13-14] and hierarchical methods [12].

We introduce different algorithms. Our work has explain about two methods of the optic disc detection and blood vessels detection like Otsu's thresholding method based on mathematical morphology on the

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fundus images because it requires lower computing time. In second of filtering we have removed a Noise of grayscale image & then applied adaptive Averaging filter by estimating the local mean and variance around area of detection in which we can detect each pixel. The detail of pre -processing steps and detection of optic disc are described below.

II. Otsu's Method of Thresholding

We have removed a Noise of grayscale image & then applied adaptive Averaging filter to detect Optic Disk & Blood Vessals; by estimating the local mean and variance around each pixel, then selected damage nerve fibers & optic disk using otsu's Method. Otsu's thresholding method is based on selecting the lowest point between two classes (peaks). Frequency and Mean value:

Frequency:

$$\omega = \sum_{i=0}^{T} P(i) \qquad P(i) = n_i / N$$

Mean:

$$\mu = \sum_{i=0}^{T} iP(i) / \omega$$

N: total pixel number, ni: number of pixels in level i Analysis of variance (variance=standard deviation-2) Total variance.

$$\partial_i^2 = \sum_{i=0}^{T} (i - \mu)^2 P(i)$$

Between-classes variance (δb2): The variation of the mean values for each class from the overall intensity mean of all pixels:

$$\delta b2 = \omega 0\ (\mu 0 - \mu t)\ 2 + \omega 1(\mu 1 - \mu t)\ 2,$$

Substituting $\mu t = \omega 0\ \mu 0 + \omega 1 \mu 1$, we get:

$$\delta b2 = \omega 0 \omega 1(\mu 1 - \mu 0)2$$

ω0, ω1, μ0, μ1 stands for the frequencies and mean values of two classes, respectively. The criterion function involves between-classes variance to the total variance is defined as:

All possible thresholds are evaluated in this way, and the one that maximizes η is chosen as the optimal threshold.

III. Algorithm for Otsu's Method

Step 1: Convert the RGB values in Grayscale values

Step 2: Use a 2-D Laplacian of the Gaussian

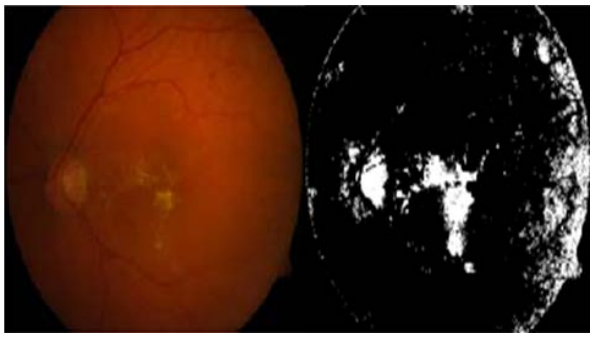
Step 3: Convolving the image with output from kernel

Step 4: Subtract the image with a constant value to reduce noise.

Step 5: Noise removal by adaptive wiener filtering by estimating the local mean and variance around each pixel.

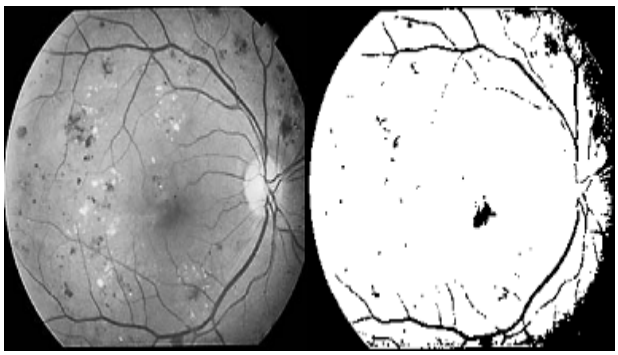
Step 6: Apply Averaging filter to remove noise of the image in two dimensions & to detect Optic Disk & Blood Vessals.

Step 7: Compute a global threshold to convert an intensity image to a binary image. By normalized intensity value that lies in the range [0, 1].



(a) (b)

Fig.1 : (a)Original diabetic Infected image, b)clearly Shows damaged optic disk.after application of ostu's method



(C) (D)

Fig. 2 : Shows Damaged Nerve fibers with dameged optic disk by application of Otsu's method

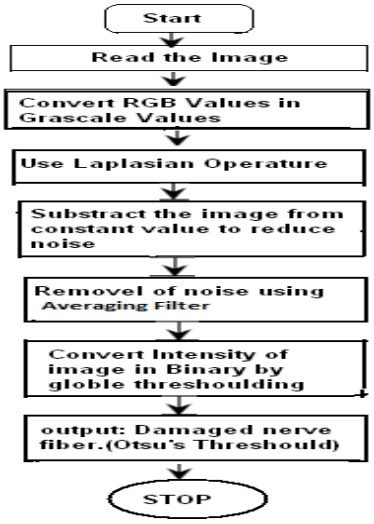
IV. Blood Vessels Detection and Elimin Ation

Blood vessels are the normal features of the retinal images. So the blood vessels detection and elimination is also important. The general flow chart of the blood vessels detection is shown in Fig.7. To detect the blood vessels, first the input image is converted into grayscale image due to strengthen the appearance of the blood vessels. Then Laplacian operator is applied.

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Then the median filtering and the CLAHE techniques are used for reducing noise and image enhancement purposes. Then, the closing and the filling operators are used to close the same intensity values and fill the holes in the vessels.

V. Flowchart for Otsu's Method



a) Thresholding

The Otsu's thresholding technique is applied to the image to detect the desire area. Equations of Otsu algorithm is

$$\sigma^2_{Between}(T)=w_B(T)w_o(T)[\mu_B(T)-\mu_o(T)]^2$$

$$w_B(T)=\sum_{i=0}^{T-1} p(i) \quad , \quad \mu_B=\sum_{i=0}^{T-1}\left(\frac{ip(i)}{p(i)}\right)$$

$$w_0(T)=\sum_{i=T}^{L-1} p(i) \quad , \quad \mu_O=\sum_{i=T}^{L-1}\left(\frac{ip(i)}{p(i)}\right)$$

- $\sigma^2_{Between}(T)$= Between-class variance
- w=weight, B=background of the image, o=object of image
- μ= combined mean,
- T= threshold value

The optic disc is the largest and brightest region of the image. The optic disc detection is useful because it can reduce the false positive detection of the exudates. Fig.5 shows the general flow chart of the optic disc detection.

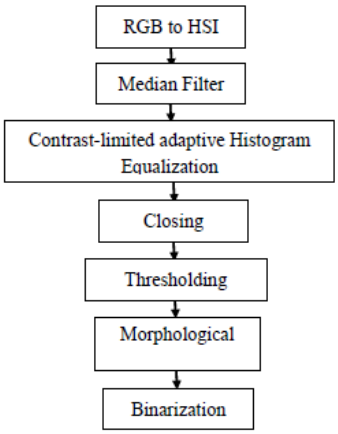


Fig. 5 : Flow Chart of disc Detection

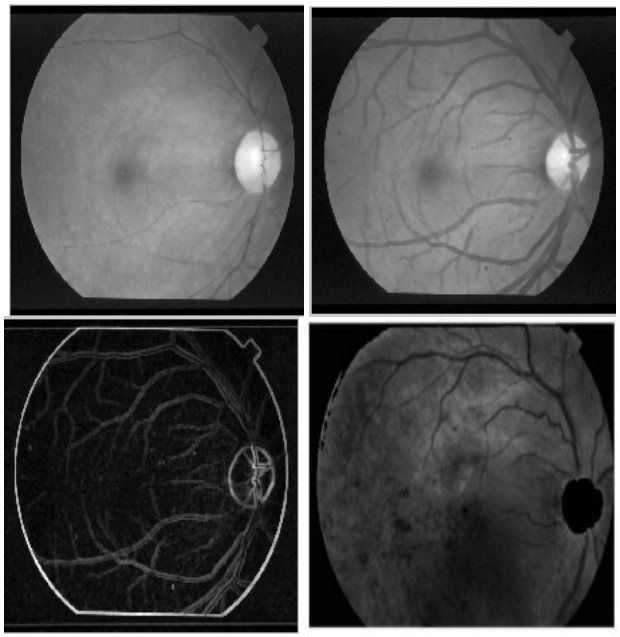


Fig. 6 : (a) Closing (b) Thresholding (c) Filling (e)(d) Reconstruction

b) Detected Optic disc

The closing (morphology) operator is useful in detection of vessels. While using closing operator it is important to select structuring element. The closing is a dilation followed by erosion that joins the very close objects together. Then, the result image is binaries by thresholding using Otsu algorithm [16]. The result image is shown in Fig.6 (b).The filling operator is applied to fill the holes in the image and the result image is shown in Fig.6 (c). The result image is reconstructed by using the morphology reconstruction and is shown in Fig.6 (d). To detect the optic disc region, the Otsu algorithm is applied on the difference between the original image and the reconstructed image. The optic disc detected area is shown in Fig.6 (e). The results of the optic disc detection are shown in Fig.6 (a), (b), (c), (d) and (e). Fig.6 (a) shows the result of the closing operator

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VI. Averaging Filter

It is necessary to remove grain noise from image of retina to get selected part of optic disk & vassals from a photograph. Each pixel gets set to the average of the pixels in its neighborhood. The result of the averaging filter is shown in Fig.5 (b).

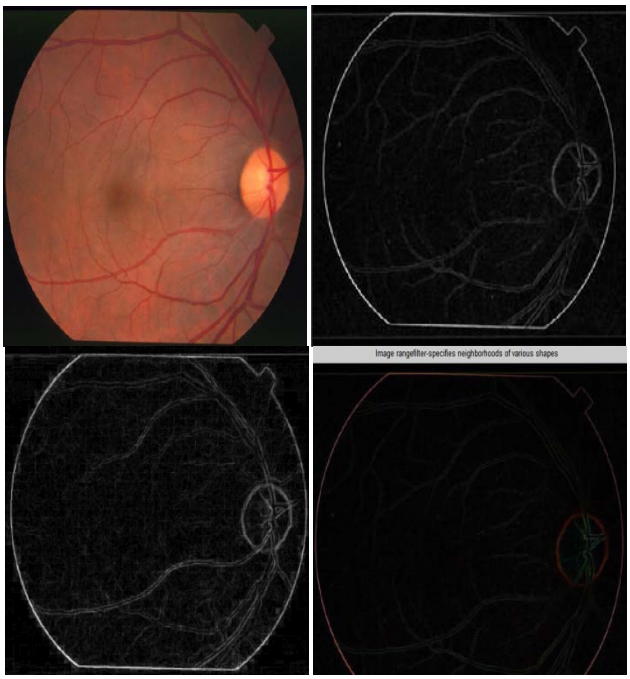


Fig. 5 : (a) original Image

Fig. 5 : (b) Result of averaging filter

VII. Result & Discussion

Otsu's method is used to detect damaged optic disk & damaged nerve fibers.

For which 1) we compute a mean value of colors with maximum intensity by applying a global threshold to convert an intensity image to a binary image. By normalized intensity value that lies in the range [0, 1].

2) We have removed a Noise of grayscale image & then applied adaptive wiener filtering & by median filter; by estimating the local mean and variance around each pixel. Thus as shown in figure (1 & 2) only selected damage nerve fibers & optic disk is observed.

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A Review of the Automatic Methods of Cancer Detection in Terms of Accuracy, Speed, Error, and the Number of Properties (Case Study: Breast Cancer)

By Jalilvand Farnaz
Tehran University

Abstract- The purpose of this article is a review of the automatic methods of cancer detection in terms of accuracy, speed, error, and the number of properties and we have selected the breast cancer as the subject of the case study.

The data used in this academic study area courtesy of the UCI in California. This database is called The Wisconsin Breast Cancer Datasets and includes 699 data units divided into benign and malignant classes. Ten properties were assigned to each datum. Four types of algorithms are used in this article, namely, classification algorithms, vector machine algorithms, neural networks algorithms, and data mining algorithms. Each category was evaluated separately and the best method in each category was identified in terms of accuracy, speed, error, and the number of properties.

Keywords: automatic methods of cancer detection, breast cancer, classification algorithms, vector machine algorithms, neural network algorithms, dat ining algorithms.

GJMR-D Classification : NLMC Code: WN 180



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I. Introduction

Breast cancer is a common type of cancer. According to the calculations of the U.S. National Cancer Institute one of every eight women may be afflicted with cancer throughout of her life[1].

Generally, this disease is a result of the convergence of some risk factors that cause the disease. The breast cancer is a cancer with high mortality rate among women such that it is the most common cause of death in the female community [2]. Timely detection of breast cancer (maximum 5 years after the first cancer cell division) increases the chance of the patient survival from 56% to over 86% [3]. So, it seems essential to have a precise and reliable system for timely diagnosis of benign or malignant breast tumors [4]. In or country, the breast cancer ranks second after lung cancer and ranks first among female cancers and is responsible for a fifth of the women's deaths caused by cancer [5]. Traditionally, this type of cancer is diagnosed by biopsy via surgery and this method is the most accurate one among the existing methods but it is an expensive and invasive procedure and raises emotional and psychological concerns and anxiety for the patient [6]. However, because of biological similarity between benign and malignant patterns, the diagnostic specificity is not reasonable yet and differentiating between benign and malignant through mammography is highly dependent on the radiologist's skill. But it is not always possible to find a skilled radiologist for the interpretation of mammography images; therefore there is a strong urge to have an experienced radiologist at hand because it is the only way that one may raise the bar for both diagnostic sensitivity and specificity at the same time. But since access to a qualified radiologist for interpretation of the images is not possible in all parts of Iran, and even in the case of availability there is the possibility of human errors, therefore designing a computer model as a rapid and cost effective and easily available diagnostic method could be in order. Clearly if the mass is correctly diagnosed as benign, there is no need for surgery and that will dismiss many concerns imposed on the patient as a result of such operations [7-10]. In this study, the researcher intends to choose the best model by comparing various techniques.

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[1] http://www1.ics.uci.edu/~mlearn/MLSummary.html[breast-cancerwis-consin]

II. Materials and Methods

a) Introduction to algorithms

i. Identification via support vector machine (SVM)

In 1965, the Russian researcher Vladimir Pnik came up with the idea of minimizing the risk and it was a very important step in the design of classifiers. The SVM is a binary classifier that separates two classes using a linear border or super plane so that the maximum margin of the super plane may result. Maximizing the margin of the super plane will result in maximum separation between the classes. The training points that are closest to the maximum super plane margin are called support vectors. Only these vectors (points) are used to determine the boundary between the classes. In this method, the boundary line between the two classes can be calculated in a way that:

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- All instances of class +1 are on one side of the border and all instances of class -1 are on the other side of the border.
- The decision boundary must be such that the distance between the closest training instances of both classes in the direction perpendicular to the decision making boundary is maximized as much as possible.
- The general form of decision making border line can be written as equation (1):

$$W.x+b=0 \quad (1)$$

where, X is a point on the decision making border line and W is an n-dimensional vector perpendicular to the decision making border line. The distance from the origin to the decision making border line and w.x indicates the internal multiplication of the two vectors w, x [11].

b) K-means algorithm

In the clustering technique is a famous data mining method in which an automatic process is used to classify samples in a given data space into distinct categories based on their characteristics and each category is called a cluster. Therefore, the cluster is a collection of objects that contains objects with the highest similarity together and they have the lowest level of similarity to the objects in other clusters. A number of criteria may be used to define the similarity including the parameter of distance, i.e. nodes that have the minimum distance with one another are grouped in one cluster and such clustering method is called distance-based clustering [12].

Thereafter, some useful information may be extracted by checking and comparing the data in each cluster. K-means is one of the well-known clustering algorithms. This algorithm is one of the cluster-center based algorithms with the following order of execution [13]:

- Obtaining points as the clusters' centers at random
- Attributing each data sample to a cluster such that the data sample has the lowest distance to the center of the cluster.

In the standard presentation of the algorithm, first some points are randomly selected corresponding to the number of the required clusters (K). Then the data are assigned to one of the clusters based on the level of proximity (similarity) and thus, new clusters are generated.

The same procedure can be repeated and each time by averaging the data, new centers can be calculated for the data and the data can be assigned to new clusters again. This process continues until the clusters do not change anymore. Usually, the condition for algorithm termination and its convergence criterion is the lack of change in the existing clusters, achieving a predetermined number of iterations, or the expiration of the deadline.

The precise choice of the initial cluster centers highly influences the convergence of this algorithm and the optimal final clusters. These centers must be selected carefully and should be located at appropriate distances relative to each other.

c) Imperialist competitive algorithm (ICA)

The evolutionary algorithms are a subset of the evolutionary calculations that belong to the branch of artificial intelligence and include algorithms wherein the search takes place from several points in the problem space. These algorithms are based on random search and exemplify natural biological evolution and work on potential answers that have superior characteristics and are capable of providing a better approximation of the optimal answer.

The ICA algorithm, like other evolutionary optimization methods, starts out with an initial population. In this algorithm, each data point is called a country. Countries are divided into two categories: colony and imperialist. Each imperialist country, depending on the extent of its power, dominates several colony countries and controls them. This algorithm is based on the colonial competition and absorption policy. In the provision of this algorithm, such policy is implemented via movement of an empire's colonies in accordance with a specific relationship [14-15].

d) Neural network algorithm

The neural network design has two main aspects of architecture and learning algorithm. The target neural network has a multilayer perceptron (MLP) structure with a better performance in comparison with other methods. MLP structure is a standard combination of inputs, linear and nonlinear neural units, and outputs [15-16].

The output of all processing units of each layer is fed to all of the processing units of the next layer as input. The input layer processing units are all linear but in the hidden layers, especially in the output layer, nonlinear neurons with hyperbolic or sigmoid tangent function or any other possible continuous and derivable nonlinear function can be used.

Neural networks have this ability to learn from the past, experience and environment; and improve their behavior during learning.MLP neural network's learning method uses a supervised learning method for training. In the supervised learning method, a set of paired data called training samples are defined as A = (Xi, ti) wherein Xi is the input and ti is the desired network output corresponding to the input.

After feeding the Xi input to the neural network, the actual output of Yi network is compared to ti and the learning error is calculated and used later to set the parameters of the network in such a way that if the next time the same Xi input is fed to the network, the network

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output approximates closer. The learning algorithm used in the MLP neural network is the post-error-propagation learning algorithm.

There are two computational paths in the above algorithm. The departure path in which the stimulating functions act on each neuron and the return path in which the sensitivity vectors (error vectors) are returned back to the first layer. Finally, the information obtained from the above two paths is used to set up the network's weight matrices and Bias vectors of MLP network. In order to stop the repetition of the post-error-propagation algorithm, we can use the mean squared error (MSE)in the form of the equation(2):

$$MSE = \sum_{i=1}^{0}(ti - aL(Pi))2/Q \quad (2)$$

The important point in the neural network is the sound choice of the weights and if necessary, the network's bias quantities. The method of weights selection is called learning algorithm training and a significant part of the network differences with one another lies in the method by which the parameters are set up[17-20].

e) Classification methods

Four classification algorithms were used for this study, namely, Perceptron artificial neural network method, Kohonen, fuzzy Artmap, and tree classification.

f) Artificial neural network classification

The artificial neural network concept was adopted from the human nervous system. These networks classify input patterns based on two unsupervised and supervised methods. In the unsupervised method, the output patterns are not introduced and the system itself classifies them on the basis of the similarity of the input patterns. But in the supervised method, the input is fed to the system and the difference between the desired output and the output of the network is used to change and adapt the weights. The training phase is the precursor of the classification phase in which the network carries out the training process by changing and adjusting the linking weights between the layers. In this study, we have used the Perceptron, Kohonen, and fuzzy Artmap artificial neural networks.

g) Perceptron artificial neural network

The Perceptron neural network is the first applied network in the artificial neural network history and a symbol of supervised pre-fed neural network and its design consists of one input layer, at least one hidden layer, and an output layer. Each layer is made up of nonlinear processing units called neurons (the nerves) and the connections between neurons in the successive layers carry the associated weights.

The connections are directional and are only in the forward direction. The method of learning in the supervised algorithm is the post-error-propagation method. In this method, the network weight is adjusted according to the gradient technique. So that after the desired output value is compared with the actual network output, the network searches for the maximum descending gradient and in the next iterations, the network parameters can be set up based on the guideline of the descending error gradient. The parameters' set up is repeated throughout this process until the amount of network error reaches an acceptable value [21].

h) Kohonen neural network

Kohonen network is dual-layer network with unsupervised training. The Kohonen network, is a self-organizing network that learns a mapping of samples introduced for learning [22]. The structure of a Kohonen network (similar to a single-layer Perceptron network) has one input layer and some output neurons.

Kohonen Network training with n inputs and m outputs is described as follows:

1. First, the initial values of the network weights are selected at random.
2. The training samples are introduced to the network.
3. The following values are calculated for each of the output layer neurons.

$$d_{min} = min\{d_1 = \sum_{i=1}^{n}(X_i - W_{ij})^2, j = 1, \dots, m\} \quad (3)$$

4. The winning output neuron is identified and the weights are correct by using a neighborhood function.

$$W_{ij}(t+1) = W_{ij}(t) + \eta(t)N(t)\left(X_i - W_{ij}(t)\right) \quad (4)$$

In the above equation, $\eta(t)$is the training parameter and $N(t)$is the neighborhood function.

5. The value of t is added.
6. The algorithm is repeated from step 2. The number of iterations can be considered fixed or the iterations continue until the network is trained, i.e. the weight values change slightly [23].After the network was trained, it is necessary to introduce the samples to the network. The output of the network is based on the closest distance.

Among the output neurons, the winner (of the network output) is the neuron that has the least Euclidean distance with the input sample [23].

The output of the Kohonen map is the topological mapping corresponding to the network input.

i) Fuzzy Artmap artificial neural network

This network was introduced in 1992 by Hansen et al. [24]. Fuzzy Artmp is a supervised network that combines two fuzzy Art networks: ARTa and ARTb.

In the following, the parameters of these two networks are defined. These two networks connect to each other by a series of connections between the F2

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layers of the two networks that are called Map Fields abbreviated as Fab. Each of these connections has a weight Wij with a value between 0 and 1. The Map Fieldh as two parameters β_{ab} and ρ_{ab} and the output vector X^{ab}. The input vector into ARTa is converted into vector A under the supplemental coding.

In the training phase of the fuzzy Artmap network, the input pattern vector into the ART a network and the desired output (B) associated with the input pattern A are presented to the ARTb network. ARTb, the care parameter (ρ_b), is set to 1 to distinguish the desired output vectors. After the presentation of the vectors B and A, the ARTa and ARTb networks enter the resonance phase.

At this stage, another care criteria defined according to the equation (3) is calculated to assess whether the winning neuron in ARTa is associated with the desired output vector in ARTb.

$$\frac{\left|y^b \Lambda W_j^{ab}\right|}{\left|y^b\right|} \supseteq \rho_{ab} \qquad (5)$$

In equation (3), y^b is the output vector in ARTb (pattern in F_2^b) ,J is the subscript of the winner neuron in F_2^a , W_J^{ab} is the weights of Map Field connections with the Jth neuron in $[\in[0,1\rho_{ab}F_2^a$ and the care parameter in the Map Field.If the above criterion is not met, the care parameter in ARTa is increased a certain amount until the fuzzy Artmap network selects another winning neuron.

The vector A will be entered into the network again and the process will be repeated until the care criterion is satisfied. At this time the weights of the Map Field connections are updated according to the following equation:

$$W_J^{ab} = \beta_{ab} X^{ab} + (1 - \beta_{ab}) W_J^{ab} \qquad (6)$$

The initial value of the ρ_a is set by the basic care paramete ($\overline{\rho_a}$). After updating the weights, the basic care parameter in ARTa is set to this initial value again. After completion of the training phase, parameters ρ_a and β_a are initialized to a zero value. The Map Field output vector is defined as follows:

$$X^{ab} = W_J^{ab} \qquad (7)$$

So that J is the subscript of the winning neuron in F_2^a. This equationshows that the Map Field assigns a classifying number to each neuron in the F_2^a layer.

j) Tree classification

In the IDRISI software, the tree classification is based on the algorithm [25]. In practice, this algorithm selects an attribute (such as the reflective band) by iteration, divides the samples that can be split into two groups, and minimizes the difference within each subgroup while maximizes the difference between the groups. The tree classification progresses by consecutive breakdown of the data within new middle nodes containing more homogeneous subsets of the training pixels. A newly created middle node, in a situation that the training pixel has only one class or one class predominates the pixels, may generate a leaf.

When there is not any middle nodes left for splitting, the final tree classification rules take shape. The IDRISI software makes use of 3 splitting algorithms: entropy, gain ratio, and Gini.

k) Data mining

The processing models described in this work are as follows:

Neural networks, Bayesian network, K-nearest neighbor, C5.0 tree, and CART tree. This section presents a brief introduction of these models [26].

Suppose you have a series of data in the set S. The C4.5 algorithm works as such: if all the items in S are for a collection or S is sufficiently small, a leaf with maximum collection in S is added to the tree.

Otherwise, a test is selected based on a single distribution with one or two outputs. This experiment as the root of a tree is considered as a test by placing each of the outputs.

The S set is divided into S1, S2, etc. subsets based on the corresponding output. This process is applied to all subsets.

In 1997, The C 4.5 algorithm was replaced with a business system entitled See5/c 5.0. The applied changes resulted in remarkable capabilities that include:

- Variation of the boosting process which is a collection of classifiers that will be considered the final classification at a later stage. The boosting process usually achieves significant prediction accuracy.
- New data types, irrelevant values, cost of incorrectly classified variables, and the methods used to pre-filter the domain.
- Set of the chaotic rules when a class is classified, all the relevant rules are pinpointed and voted thereto. This enhances the interpretation of the set of rules. Moreover, it increases the precision of their prediction rate.

The decision tree and the set of rules have progressed in an ascending fashion. The rate of climbing increases through segmentation. C 5.0 can run on multi-processor computers as well [7].

The CART decision tree is a binary recursive segmentation method. The Data are randomly selected. Throwing away is not necessary and not recommended. The trees grow to their maximum size without the use of the stop law. Then the regressive pruning phase back to the root commences (part by part isolation).

The next section which to be pruned is the part that has the lowest performance relative to the whole in the training data tree (it should be pointed out that more than one section can be removed at any stage). This

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process creates trees that are fixed under any order of arrangement.

In fact, the CART algorithm mechanism is intended to generate not one, but a consecutive collection of pruned trees which are all optimal candidate trees. The right size tree is identified and selected by evaluating the performance of each tree in the pruning stage [27].

Rote is one of the easiest and almost insignificant classifications which saves all the conducted training data.

It runs the classification operation only when the test exactly matches a training example. A clear objection to this method is that a lot of test data will not be classified because they do not exactly match with any of the recorded training data.

A more advanced method in this regard is the k-nearest neighbor method. According to this algorithm, a group is pinpointed with k samples in the training dataset that are closest to the test data and the desired tag is selected based on the superiority of a specific class in its neighborhood [28].Based on the given dataset, each belongs to a class. Each of these classes has a vector. Our goal is to create a rule to assign each of the samples to a class in the future.

This is carried out only through the vectors intended for the variables. Many ways have been introduced to create such rules. One of the most important methods is Bayes method. This algorithm is important for many reasons. This algorithm can be made very easily because it does not require complex iterative parameters.

This means the algorithm can be used in some cases that the there is a high volume of data. Neural networks are new systems and computational methods for machine learning and display of knowledge.

Also, its ultimate goal is the application of gained knowledge to predict output response of the complex systems [29, 30].

The main idea of this kind of network is (partly) inspired by biological nervous system functions. The key element of this idea is the formation of new structures for the information processing system. This system consists of many interconnected processing elements called neurons.

They collaborate together to solve a problem and pass on the information through synapses. In these networks, if a cell is damaged, the rest of the cells may compensate for the lack of it and also contribute to its reconstruction.

l) Introduction of data

The data used in this academic study are a courtesy of the UCI in California. The title of this database is The Wisconsin Breast Cancer datasets[2] and includes 699 data items. The data are divided into two benign and malignant classes. Ten properties were attributed to each datum. These properties are presented in the table 1.

Table 1 : Introduction of the data and the properties

ID	Attribute	Domain
1	Sample code number	10-1
2	Clump Thickness	1-10
3	Uniformity of Cell Size	1-10
4	Uniformity of Cell Shape	1-10
5	Marginal Adhesion	1-10
6	Single Epithelial Cell Size	1-10
7	Bare Nuclei	1-10
8	Bland Chromatin	1-10
9	Normal Nucleoli	1-10
10	Mitose	1-10
11	Class	2 for benign and 4 malignant classes

The data properties were chosen with an eye to medical considerations. The thickness of malignant cells' masses is usually classified in single-layer groups while the cancer cells are usually placed in multi-layered groups.

There are various sizes and apparent abnormal shapes of the cancer cells. This is why these parameters are useful in diagnosis and detection of cancerous and non-cancerous cells. With regard to the rate of cell adhesion, normal and healthy cells usually get close to each other while the cancer cells do not show such solidarity among them.

As a result, lowered adherence also can be used to detect cancer cells. With regard to the single biological cell size, its size may vary as we explained earlier.

Biological cells that grow big can be considered as cancer cells. A bare nucleus is in fact a nucleus without any cytoplasm surrounding it.

Usually, these nuclei are observed in malignant tumors. In fact, chromatin is the expression of non-uniform nuclear material that is observed in malignant cancer cells. In the cancer cells, Chromatin is observed as follows.

Typical nuclei with tiny structures have been observed in healthy tissues. In cancer cells, the nuclei gradually swell and their number increase over time. Mitosis is a part of the nucleus that generates two identical daughter cells during prophase. Cell division takes place during this process. The pathologists can estimate the amount of cancer by counting the mitoses.

m) Preprocessing

Data preprocessing is the first step in performing the task. According to the information that the database put in our disposal, there are 16 forgotten data in its 7th column. To fix this problem, a data

[2] http://www1.ics.uci.edu/~mlearn/MLSummary.html [breast-cancerwisconsin]

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histogram was plotted to be used in the preprocessing. Because the properties are disconnected, the Mod was used for the forgotten data. Other values except 10 are very few versus the value of 1. Only one-fourth of the data have attained the value of 10. That's why the forgotten values are shown with the value of 1.

The outlying data are the next problem that will be dealt with during the statistical tasks. Of course, the data used in this study had been previously checked by the related center and the outlying data have been removed from them. In other words, the database has presented the users with neat data. However, some processes were carried out to ensure there are no outlying data around.

n) Selection of the properties

One of the most important steps that can greatly help the processing to get better results is selecting the right features. If these properties are not selected correctly, there is a high potential for synergy.

Synergy means trouble at the prediction stage. The large number of features can drastically increase the number of calculations in the event that it does not appreciably change the authenticity. So, a good choice of the right properties can increase the processing efficiency.

To do this, the property correlation matrix was calculated. Since the correlation threshold of 0.95 was selected, no property correlation was observed. Therefore, all of the properties can be used in the prediction process.

We used the random selection procedure to do justice to the training data sample selection and testing and to eliminate the dependence of the training on a particular order of data. The highlight of performance assessment of the models presented in this research is this same point that the evaluation results are not dependent on the particular order of data and each model that runs using a random selection from the dataset, 70 percent are allocated to training and 30 percent to testing. So, the results are not dependent on a particular order of the data.

III. Results

To carry out the modeling based on the artificial neural network, first we fed the data (dataset) to the Excel software. The dataset is randomly (MATLAB software's Rand function) divided into two parts: training (learning) dataset and testing dataset.

In order to do this, about 30 percent of the data was used for validation and testing, and 70 percent of the data was used for training. Then by scripting and the use of existing neural network Toolbox in MATLAB software (Neural network tool), we selected the data (input and output variables), and determined the type of network (Feed-forward back prop), type of training function (trainlm), number of layers, number of neurons, type of transfer function (tansig), function error (mse) and so on, as well as the number of iterations (epoch), maximum error, time, weight, etc.; and next we found out the best option by trial and error (fig 1and Fig 2).

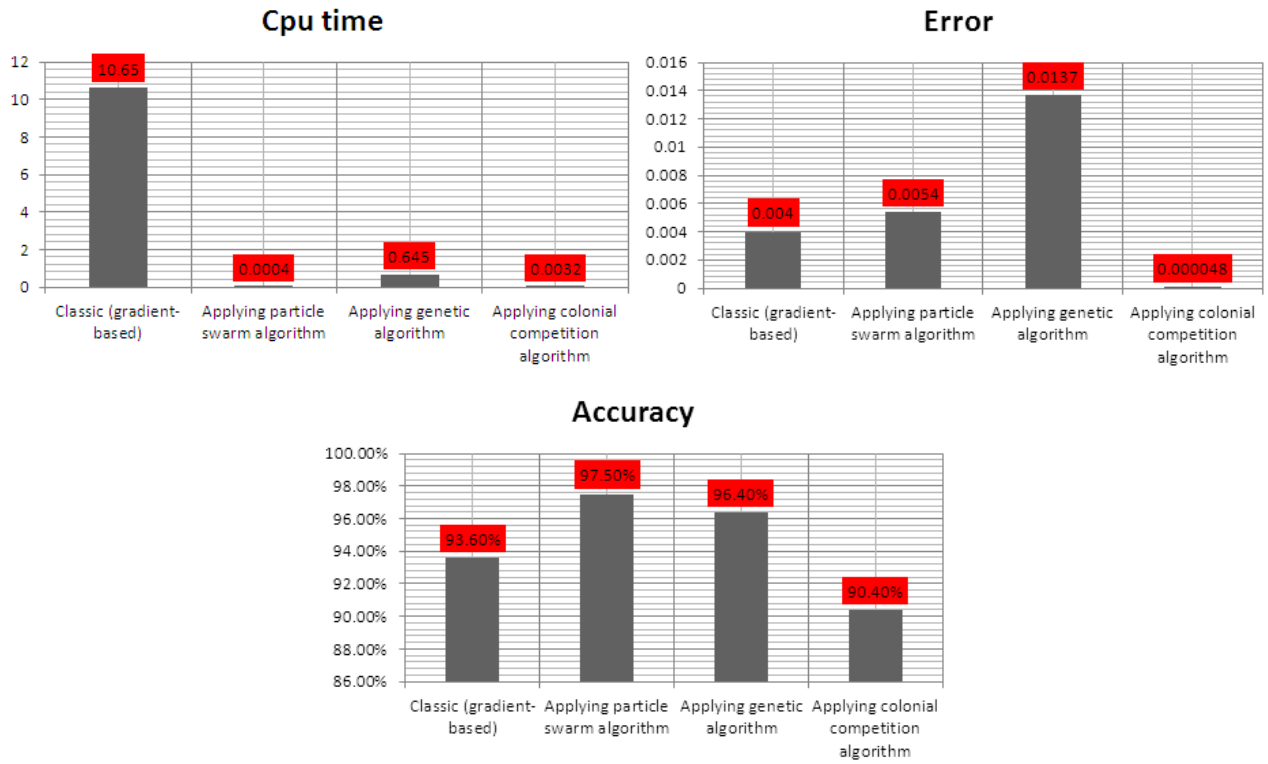


Figure 1 : Comparing the results obtained from simulation after applying three optimizing algorithms

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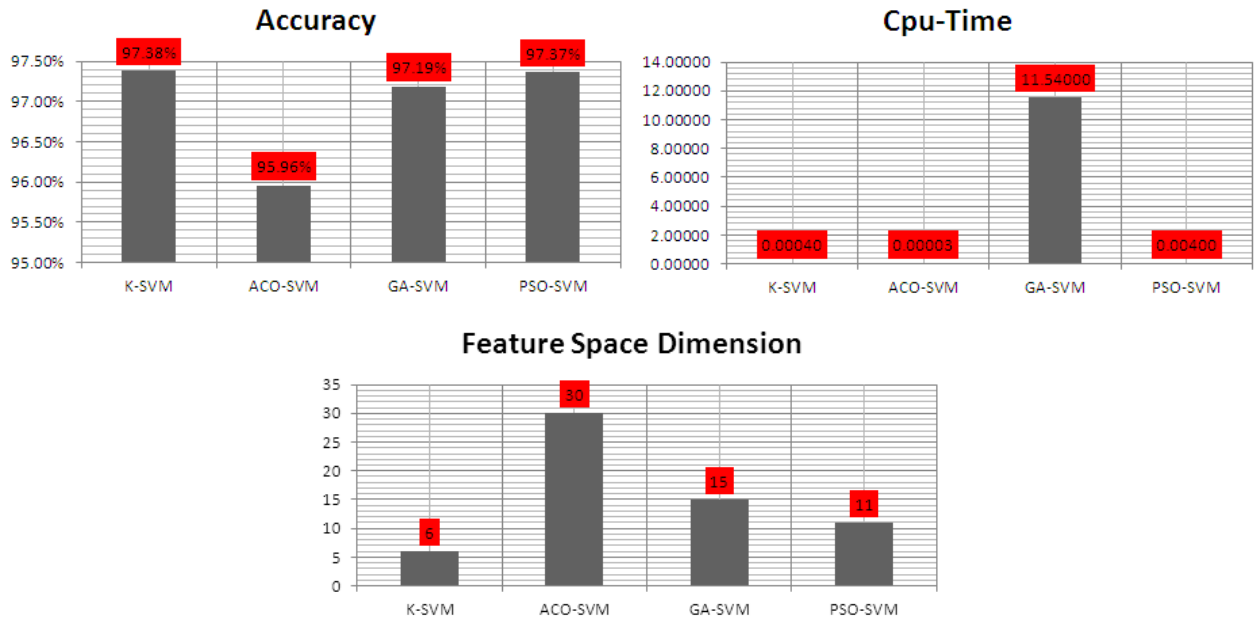


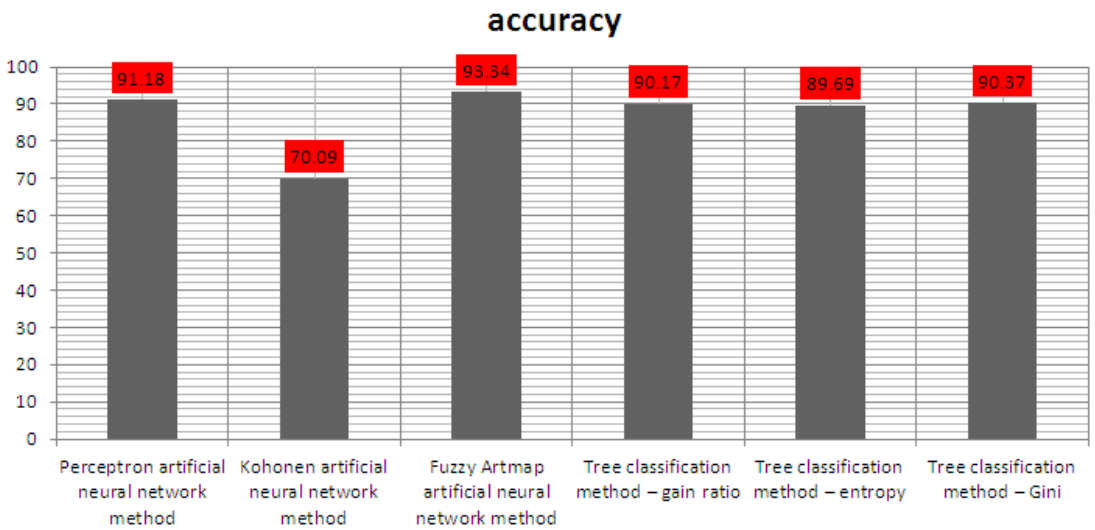
Figure 2 : Comparing the results of some of SVM algorithms

With regard to computation time, SMV method drastically reduces the training by reducing the number of input properties. The computation time is also compared to the main SVM algorithm in Fig. 2 which depicts the importance of the choice and extraction of the property.

According to the final results, their recommended k-SVM procedure is more accurate than SVM for the diagnosis of benign and malignant tumors and the new input structures and patterns with the membership of new patterns based on the main data.

The results of the classification using methods such as artificial neural network (Perceptron neural networks, Kohonen, and fuzzy Artmap) and the tree classification are presented in the figure. According to the figure, the tree classification method with three branching techniques(gain ratio, entropy, and Gini) has obtained the average total accuracy of 90 and Kappa coefficient 0.88, respectively; while the neural network methods had an accuracy of 92 and the Kappa coefficient of 0.90, respectively (except the Kohonen method).Thus, the neural networks classification methods (with the average total accuracy of 2 and the average Kappa coefficient of 2%) were more accurate than the tree classification method (with three branching methods) for the series of data used in the study.

In addition, when the different methods of the neural network were analyzed, it was clear that the fuzzy Artmap neural network method was more accurate than Perceptron and Kohonen methods (with the total accuracy enhancement of 2% and 22% and the Kappa coefficient enhancement of 3% and 24%).Finally, it can be said that there was no significant difference among the three branching methods employed in this study (fig 3).



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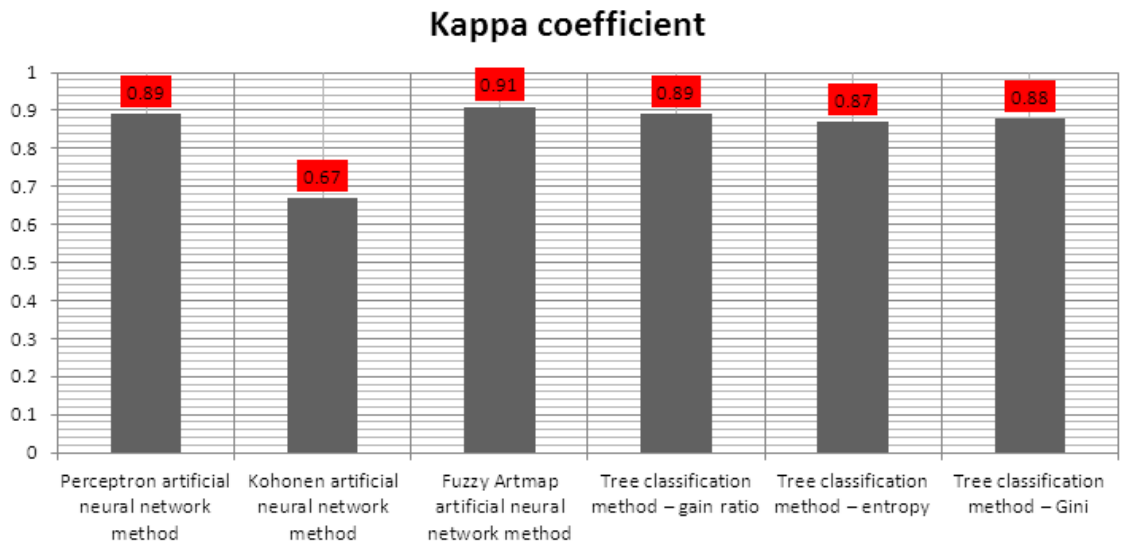


Figure 3 : Evaluation of the classification accuracy

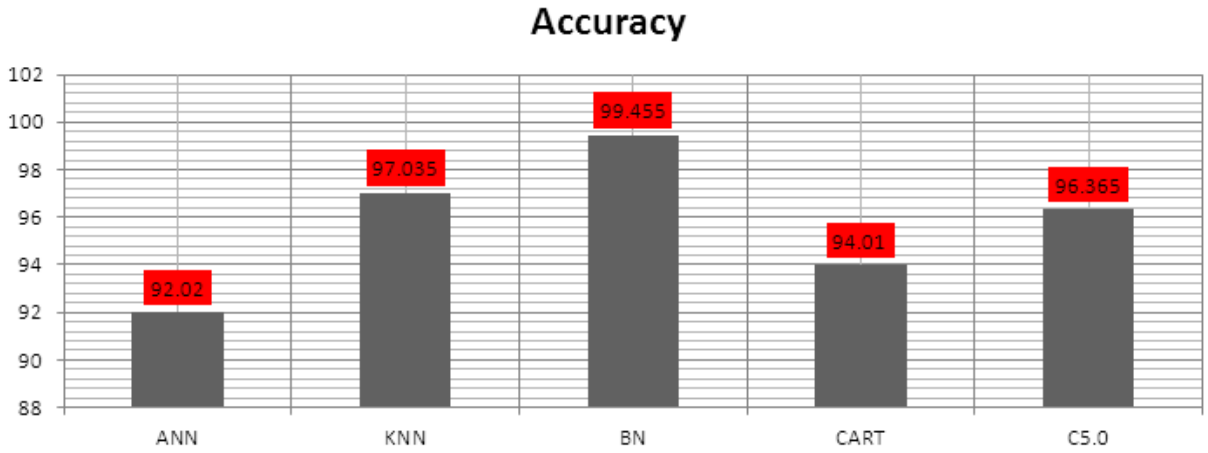


Figure 4 : Statistical information of the authenticity of the models after the evaluation

According to the fig 4, clearly the Bayesian network has predicted the classes more accurately and can be used with more confidence for predictions. Also, its distribution authenticity is much less than other models. But these cases are quite the reverse in the neural network, i.e. its distribution is much more and its mean authenticity is lower than all other models.

IV. Conclusion

In the case of diagnosis by SVM from the K-SVM algorithm based on the properties it can be competitively compared with any of the old data mining methods of cancer detection. In the property extraction phase, the older methods are not used for extracting useful information. Properties with below 50% accuracy may not be appropriate for classification purposes. No single property is highly effective for mass classification applications. The properties must be combined to achieve a better performance. After evaluating each property individually, it is advisable to check a combination of these properties. Both geometry and texture properties are useful for detection of mass. The selection of a classification property that may be able to improve the accuracy will prove useful. In the case of diagnosis by neural network, the algorithm based on gradient that considers the Levenberg–Marquardt algorithm and post-error-propagation method. One of its disadvantages is late convergence and stopping at optimal local points, as well as the optimal choice of number of layers, the number of neurons in each layer, and the type of stimulation function of each neuron in the data with high complexity which is not a simple task. Therefore, the smart optimization algorithms such as mass particles algorithm, genetic algorithm, imperialist competitive algorithm, etc. that we used three types of them for network modeling in this study. The results showed that the imperialist competitive method is significantly capable of correct determination of neural network weights for its training and error elimination.

With regard to classification methods, all pixels could correctly identify the agricultural lands. The high classification accuracy of agricultural lands classes may

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be a result of its distinctive spectroscopic characteristics in comparison with other types of coating. When different methods of artificial neural networks were analyzed, it was clear that the fuzzy Artmap artificial neural network provides more accurate results relative to Perceptron and Kohonen artificial neural networks (with an overall accuracy enhancement of 2% and 22% and the Kappa coefficient enhancement of 3% and 24%).

In this research, the fuzzy Artmap artificial neural network had the highest classification accuracy.

In the case of data mining techniques, it is clear in accordance with the table 3-6 that the Bayesian network predicted the classes more accurately in and can be used with more confidence in the predictions. Moreover, its distribution authenticity is much less than other models. But these cases are quite reversed in the neural network, i.e. its distribution authenticity is much more and its average accuracy is much lower than the other models. Among all models created by different training and testing data, only the neural network models were unable to provide a prediction in some cases. That is, they presented some data without any comments there to.

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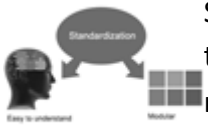


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References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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