Sri Lanka
Society of Gastroenterology

SOUTH ASIAN JOURNAL OF GASTROENTEROLOGY

Official Journal of Sri Lanka Society of Gastroenterology

Volume 2 Issue 1 2025 July

SOUTH ASIAN JOURNAL OF GASTROENTEROLOGY

Official Journal of Sri Lanka Society of Gastroenterology

Sri Lanka
Society of Gastroenterology

EDITORIAL TEAM

Joint Editors

Prof Madunil Niriella

Dr Duminda Subasinghe

Dr Karthiha Balendran - Editor SLSG

Editorial Board

Prof Ishan de Zoysa

Prof Rohan Siriwardena

Dr Amal Priyantha

Dr Sanjeewa Aryasinghe

Dr Sujeewa Kumarasena

Dr Manajala Senanayake

Dr Chathuranga Keppitiyagama

Dr Nilesh Fernandopulle

Dr Hasitha Wijeywantha

Dr KuleeshaKodisinghe

Dr Nandana Dinamithra

Dr Vithiya Rishikesawan

Dr SuchinthaThillakarathne

Dr Uditha Dassanayake

Dr Chathura Piyarathne

Dr Hiruni Jayasena

Foreign Editorial Advisors

Prof Shiv Sarin

Prof Miles Parkes

ORIGINAL ARTICLE

Smart Phone Application to Exclude Varices in Compensated Cirrhosis using Liver Transaminases, Liver and Splenic Stiffness Measured by Transient Elastography

Nishad A.A.N.[1], Niriella M.A.[1,2], De Silva A.P.[1,2], Jayasundara H.[1], Samarawickrama V.T.[1], Jayasena H.[1], Thebuwana K.[1], Dharshika S.[2], Hewathanthri G.[3], Ranawaka C.K.[4], Withanage M.[2], Pathmeswaran A.[2], De Silva H.J.[1,2]

Affiliations

1 University Medical Unit, Colombo North Teaching Hospital, Ragama, Sri Lanka
2 Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka
3 Stredge Tech Solutions Ltd, Colombo, Sri Lanka
4 Colombo North Teaching Hospital, Ragama, Sri Lanka

ABSTRACT

Background

We used AST to ALT ratio (AAR) and, liver stiffness measurement (LSM), splenic stiffness measurement (SSM) by transient elastography to develop a statistical model and present it as a user-friendly smartphone application to exclude the presence of oesophageal and cardio-fundal varices to avoid upper gastrointestinal endoscopy in selected patients.

Methods

A prospective study was carried out among patients with Child-Pugh Class A cirrhosis (non-viral and BMI<30kg/m^2). LSM and SSM were obtained using Fibroscan (EchoSens) by a single operator, blinded to the presence or absence of varices. The predictors used to develop the formula were AAR, LSM and SSM. Multiple logistic regression was used to create the algorithms in 70% of the sample and validated using 30% of the sample with Bootstrapping of 1000.

Best algorithms with the highest area under the curve (AUC) were selected and identified as different cut-off levels to exclude or predict the presence of varices. Those values were included in a smartphone application on android and iOS web-based platforms.

Results

One hundred and nine out of 211 had varices. After modelling different combinations, logistic regression formula (LRF)=5.577+ (LSM*0.035)+ (SSM*0.08)+ (AAR*1.48) resulted AUCs 0.93. Cut-off value <-1.26 of LRF predicted the exclusion of varices with a negative predictive value of 90%. Cut-off value >0.829 of LRF predicted the presence of varices with a positive predictive value of 91%. Multiple values were used to develop a smartphone app on the Angular 2+ platform. (It can be downloaded for use @https://mediformula-65ef0.web.app/).

Conclusion

The new formula using AAR, LSM and SSM can be used to predict exclusion of varices with high accuracy in non-obese patients with compensated cirrhosis of non-viral aetiology based on the patient's biochemical or fibroscan values. The smartphone application derived from this model is easy to use. It is the first mobile application to be used to exclude or predict the presence of varices utilizing SSM.

Keywords

Cirrhosis, portal hypertension, non-invasive assessment, oesophageal varices.

Correspondence: Prof Madunil Anuk Niriella
E.mail: maduniln@yahoo.co.uk

INTRODUCTION

"Compensated advanced chronic liver disease" (cACLD) is defined as a spectrum of advanced liver fibrosis or cirrhosis in asymptomatic patients [1,2]. Clinically significant portal hypertension (CSPH) is defined by the hepatic venous pressure gradient (HVPG) of ≥10 mmHg and is present in around 60% of patients with cACLD and in almost all patients with decompensated cirrhosis []. CSPH influences the development of portosystemic collaterals, leading to the development of oesophageal (EV), cardio-fundal and/or ectopic varices and is independently associated with an increased risk of decompensation and the development of hepatocellular carcinoma (HCC) [2]. Reducing the HVPG by 20% and/or to <10 mmHg significantly reduces the decompensation risk in patients with cirrhosis [3].

The gold standard for assessing portal hypertension (PH) and identifying CSPH is HVPG, which represents the gradient between the pressure in the hepatic sinusoidal capillary network and the free hepatic venous (systemic) pressure. However, owing to the limited availability of HVPG measurement, CSPH is most often diagnosed only after the detection of varices on upper-gastrointestinal endoscopy (UGIE). Despite its ease of access, endoscopy remains an invasive procedure requiring clinically trained specialists and specialized equipment. Additionally, it is generally not well perceived by patients. Furthermore, there is considerable inter-observer disagreement during the endoscopic assessment of variceal grading. [4]

Transient elastography (TE) is a non-invasive, reproducible and simple screening method which assesses tissue elasticity and, thereby, liver stiffness due to liver fibrosis [7, 11]. TE is a one-dimensional shear wave elastography (SWE) method that measures liver stiffness (LSM) or spleen stiffness (SSM) at a depth of 2.5-6.5 cm beneath the skin, with an exploration volume of 3 cm^2 [5]. Results measured by SWE are usually presented as either m/s (tissue velocity) or kPa (estimated tissue elasticity).

In recent times, there has been extensive research investigating the potential and efficacy of LSM as a non-invasive method for diagnosing CSPH, the presence of EV and varices needing treatment (VNT). The Baveno-VII consensus statement defined non-invasive criteria based on LSM and SSM by TE and platelet count by which patients can safely avoid screening endoscopy[2].Baveno-VII guidelines considered LSM <20kPa with platelet count more than 150,000/cm3 to "rule out" CSPH and SSM of <21kPa to "rule out" CSPH and >50 to "rule in" CSPH. [2]

In studies focusing on ruling in the presence of EV, positive-predictive values (PPV)> 90% were reported when cut-offs range from 15 kPa to 28kPa. In contrast, in studies focusing on ruling out EV, negative-predictive values (NPV)> 90% were reported when cut-offs range between 19 kPa and 48 kPa. [2-5]

The use of SSM, in addition to LSM, as a non-invasive surrogate parameter for the prediction of varices, has steadily been gaining traction since it was first reported in 2013 [6]. Indeed, several studies have subsequently investigated the predictive value of SSM using TE. Notably, SSM can also capture PH secondary to both pre-sinusoidal and/or pre-hepatic causes, which may not be detected by LSM alone. Furthermore, SSM has universally been shown to be at least equal, if not superior, to LSM with regards to the detection of varices.

Aspartate aminotransferase (AST) to alanine aminotransferase (ALT) ratio (AAR) is a useful non-invasive, simple serum marker for liver cirrhosis. It is also has been successfully used to predict the presence of EV. [7/9}Currently, there appear to be no studies evaluating the utilization of composite scores using LSM, SSM and AAR [37]. Therefore, we aimed to combine LSM, SSM and AAR to predict or exclude CSPH and the presence or absence of oesophageal and/or cardio-fundal varices. We used LSM, SSM and AAR to develop a statistical model to predict varices and present it as a user-friendly smartphone application.

METHODS

A prospective study was carried out among Child-Pugh Class A cirrhotic patients 18 to 65 years of age attending the liver clinic at the Colombo North Teaching Hospital, Ragama, Sri Lanka. The patients recruited were those with cirrhosis due to NAFLD, autoimmune or chronic unsafe alcohol use and with a BMI<30kg/m^2. Those with cirrhosis secondary to viral hepatitis were excluded from the study. All the participants were subjected to a gastroscopy and a fibroscan.

LSM and SSM were obtained using FibroScan® 502 Touch machine (Echosens, France) by a single operator who was blinded to the presence or absence of gastro-oesophagal or cardio-fundal varices and endoscopist was blinded for the fibroscan findings.

After collecting the data 70% of the sample was randomly allocated for model building to predict the presence or absence of varices taking the gastroscopy findings as the gold standard. The predictors used for the development of the model were 1). AAR, 2).

LSM and 3). SSM. Initially independent sample t-test was carried out with the predictors. Multiple logistic regression was used to develop the algorithm.

The new algorithm was internally validated using the rest (30%) of the sample with bootstrapping over 1000[ii,iii,iv]. The algorithm values were plotted in a ROC curve against presence or absence of varices and negative prediction value (exclusion of varices) and positive predictive values were calculated for different points at the curve. (Figure 2)

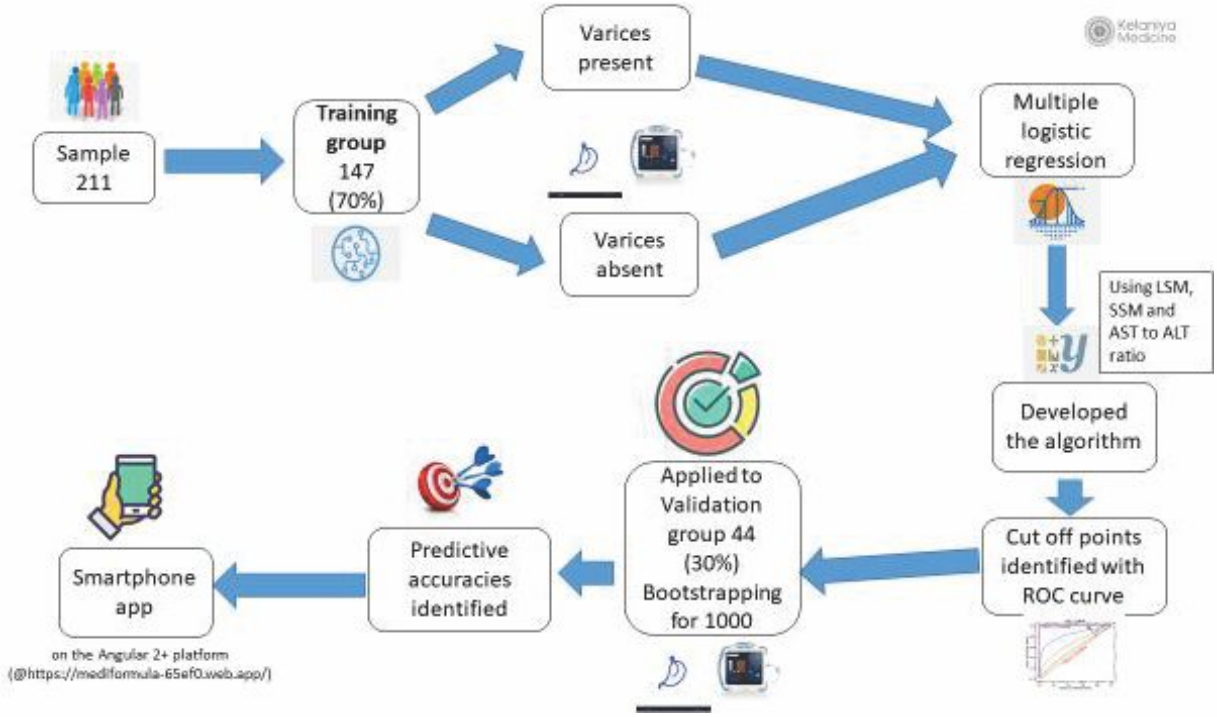
Independent sample t-tests of logistic regression formula (LRF) value were also used to cross-validate the two sub-samples for patients with varices and without varices [v,vi]. (Figure 1)

Those cut of values were used to predict the varices used to build a smartphone app on the Angular 2+ platform. (It can be downloaded for use @https://mediformula-65ef0.web.app/).

(Figure 3) The user needs to enter the values of LSM, SSM, AST, and ALT into the input interphase, and the app will calculate a score based on the coefficient of the logistic regression model.

Then, it would identify in which range the LRF value will lie and calculate the risk of having varices or the possibility of excluding varices as its output.

Figure 1. Study outline in a graphical presentation



RESULTS

There were 211 subjects who participated in this study. We divided the sample into two groups: training and validation.

The training sample (training group) and validation sample (validation group) consisted of 154 and 67 participants respectively. The following table (Table 1) describes the socio-demographic properties of the two groups.

Table 1. Socio-demographic characteristics of the participants

	Training group (n=154)	Validation group (n=67)	Sig.
BMI (Mean/s.d.) kg/m^2	26.1(3.7)	25.5(3.4)	0.28
Gender			
Male	58.4%	61.2%	0.7
Occupation –Currently Employed	28.5%	24.2%	0.19
Marital status			
Ever Married	92%	97%	0.37

Table 2 describes the variables used to differentiate the presence of varices vs absence of varices in the two groups the training group and the validation group.

Table 2. Comparison of predictive variables among training group vs validation group

		Varices absent				Varices present			
Parameter		**N**	**Mean**	**95% CI**	**Sig.**	**N**	**Mean**	**95%CI**	**Sig.**
LSM Median	Training group	67	20.3	17.5-23.1	0.3	78	35	31.2- 38.8	0.4
	Validation group	32	17.7	14.1-21.3		30	38.3	30.7-45.9	
SSM Median	Training group	67	27.4	24.0-30.8	0.9	77	50.7	46.5-54.9	0.5
	Validation group	33	27.9	21.7-34.1		30	48	41.6-54.4	
AAR	Training group	67	1.1	1.0-1.2	0.5	78	1.4	1.3-1.5	0.7
	Validation group	29	1	0.85-1.1		28	1.4	1.3-1.5	

LSM; Liver stiffness measurement, SSM; Spleen stiffness measurement, AAR; Aspartate aminotransferase to Alanine aminotransferase ratio.

Those two groups did not show a statistically significant difference when comparing the presence of varices with the absence of varices, confirming that the two groups are random in allocation. When comparing the LSM, SSM and AAR in the training group all the parameters showed a statistically significant difference between the subgroup with varices and without varices as demonstrated in Table 3.

Table 3. Comparison of predictive variables among the presence of varices vs absence of varices.

	varices present		varices absent		
Parameter	Mean	Std. Deviation	Mean	Std. Deviation	Sig
LSM median	34.9	16.5	20.3	11.8	<0.001
SSM median	50.7	18.1	27.4	13.7	<0.001
AAR	1.3	0.5	1.1	0.4	<0.001

LSM; Liver stiffness measurement, SSM; Spleen stiffness measurement, AAR; Aspartate amino transferase to Alanine aminotransferase ratio

The mean LSM, SSM and AAR were 34.9 kPa, 50.7kPa and 1.3 respectively in those patients with varices and 20.3 kPa, 27.4 kPa and 1.1 respectively among those patients without varices.

The significance values were <0.001 in all the parameters. LSM, SSM and AAR demonstrated a statistically significant difference among patients with oesophagal varices vs those without varices.

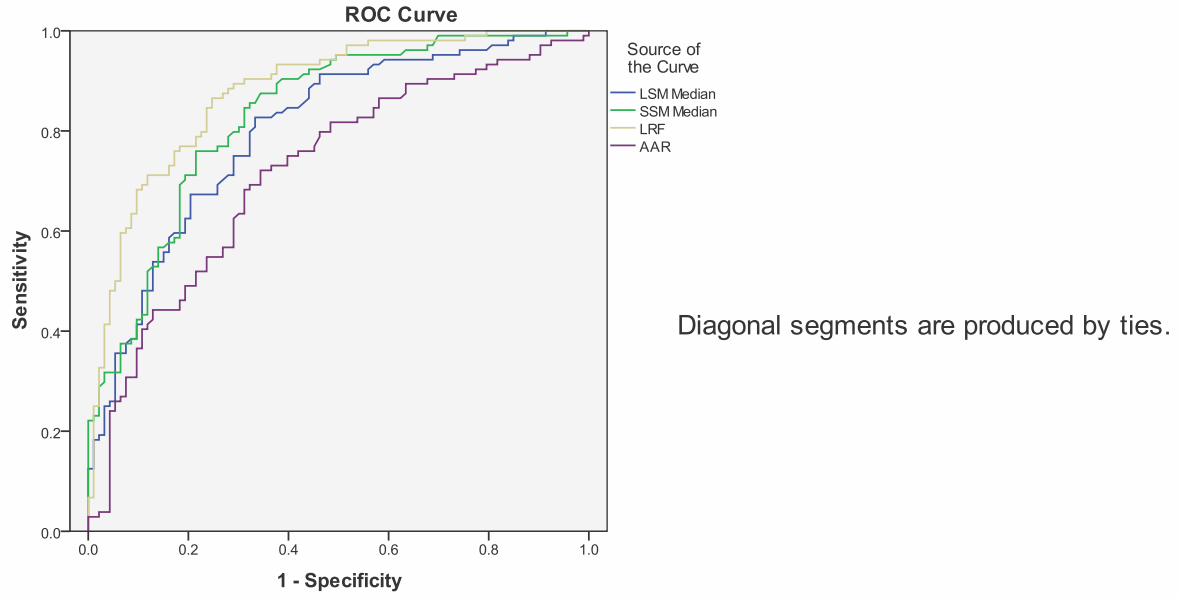
After modelling with different statistical methods, logistic regression and discriminant function analysis, the following formula value gave the highest AUC value of 0.93. After modelling different combinations,

Logistic regression formula (LRF) = 5.577+ (LSM*0.035)+(SSM*0.08)+(AAR*1.48).

(LSM; Liver stiffness measurement, SSM; Spleen stiffness measurement, AAR; Aspartate amino transferase to Alanine aminotransferase ratio)

Figure 2. ROC curve of Logistic regression formula and other parameters in the predictability of varices

Figure 2. ROC curve comparing different predictors for presence of esophageal varices



LRF; Logistic regression formula, LSM; Liver stiffness measurement, SSM; Spleen stiffness measurement, AAR; Aspartate aminotransferase to Alanine aminotransferase ratio

Area under the Curves; LRF 0.93, SSM 0.87, LSM 0.82, AAR 0.75

The following table (Table 5) shows the mean comparison of patients with varices and without varices in the modelling group vs the validation group.

The best ROC curve formula was then validated, and different cut-off values or exclusion of varices were decided and presented it as a user-friendly mobile phone application.

Table 4. Validation of LRF using independent sample t-test.

	LRF value (Mean)	95% CI	Significance
With varices			
Training group	1.7	1.29-2.19	0.92
Validation group	1.7	0.85-2.45	
Without varices			
Training group	-1.1	-1.5 to -0.7	0.74
Validation group	-1.2	- 1.82 to -0.62	

There is no statistically significant difference in the two groups when comparing the varices group with no varices group using independent sample t-tests.

Validation was carried out with a comparison of mean values of calculated LRF for the training group and validation group. LRF values in patients with varices in the training group and validation group were 1.7 in both groups.

(p=0.92) and those values among non-varices patients were – 1.1 and -1.2 respectively. (p=0.74). (Table 4)

Cut-off value < -1.26 of LRF predicted exclusion of varices with a negative predictive value of 90%. Cut-off value > 0.829 of LRF predicted the presence of varices with a positive predictive value of 91%.

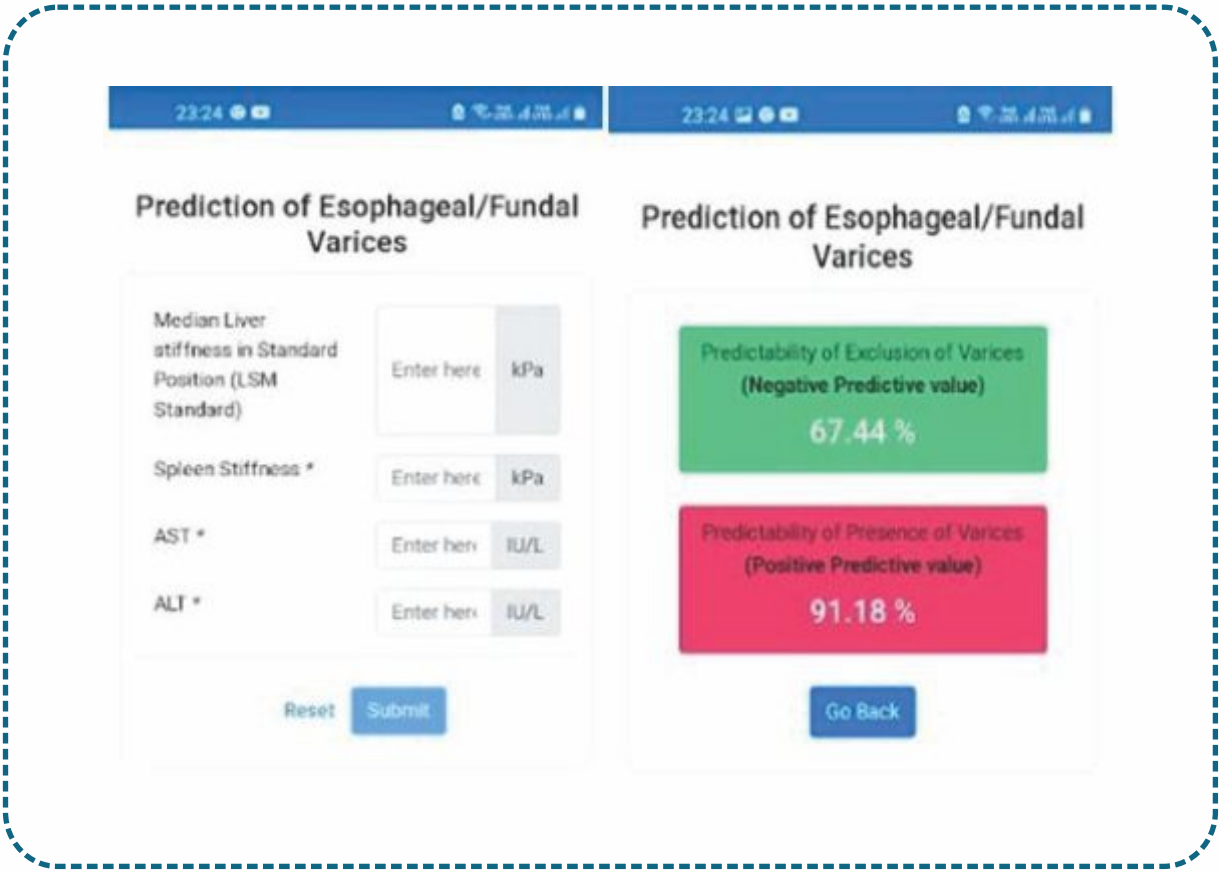
Table 5. Predictive accuracies of exclusion of varices (NPV) at identified different cut of values

Statistic	< -1.26	-1.259 to - 0.768	-0.767 to - 0.026	-0.025 to 0.604	0.605 to 0.828	More than 0.829
Negative Predictive Value	>90%	90-86%	86-77%	77-73%	73-72%	<72%

Table 5 shows that the lower the value, the higher the predictability of exclusion of varices and vice versa.

Multiple values were used to develop a smartphone app on the Angular 2+ platform.

Figure 3. Input and output interphases of mobile app



DISCUSSION

We have compared few already known non-invasive markers such as LSM, SSM and AAR to predict the presence or exclusion of varices. Development of a formula and validation for exclusion of varices and presenting it as a simple user-friendly web/mobile application is the first in this subject area.

LSM, SSM and AAR were higher in patients with varices in comparison to patients without varices. (Table 3) These results are in keeping with the findings of previously reported studies [27,28,31,34]. LSM and SSM values are higher in patients with decompensation or in patients with varices. [vii]

Since all the variables are significant in mean comparison, all variables were taken into the LRF. Interestingly, the LRF with the platelet count included, gave a lower AUC. LSM, SSM and AAR gave better predictive values. Therefore, we are presenting the results without the platelet count in the prediction formula.

Even though sensitivity, specificity and accuracy are important, we have paid more attention to the predictive ability of the formula to exclude the presence of varices,in order to avoid unnecessary UGIE and conversely, to determine the predictive ability to identify the presence of varices thus those patients who should be referred for a UGIE.

Similar types of studies that tried to evaluate predictive accuracies have shown similar findings with different formulae and models. [7,9] Predictive accuracies for exclusion of varices (NPV) and presence of varices (PPV) of LRF values at different cut-off values were identified, so the user can decide or can inform the patient on the importance of conducting a UGIE at the given point.

(Table 5, Figure 3). Coming up with a range of different cut-off values in our study made it difficult to compare with the previous studies which have given only a single cut-off or a single range and it is one of main strengths of our study. [21-28]

In the present study the cut-off value < -1.26 of LRF predicted exclusion of varices with a negative predictive value of more than 90%. In a large meta-analysis (n= 3364), demonstrated the isolated LSM cut-off of 20 kPa (alone) to predict the presence of EV with a PPV of 43% and a NPV of 86% [viii]. Notably, another meta-analysis (n = 2697) reported similar results with a sensitivity of 84% and a specificity of 68% (PPV and NPV were not reported) [ix].

Previous studies have demonstrated data on the combination algorithm of LSM and platelet count (commonly at the cutoff 150G/L) to rule-out VNT. But 'Anticipate study' results for this algorithm were rather disappointing [12]. Maurice et al evaluated these criteria in 310 patients and reported a PPV of 6% and a NPV of 98%, indicating that these criteria be highly accurate for ruling out VNT as intended [13]. Concurrently, Wong et al prospectively analyzed 274 patients and found similar results with a PPV of 9.5% and a NPV of 95.5%[x]. Moreover, a large meta-analysis by Marot including 3364 patients with mixed etiologies of liver disease reported an excellent NPV for ruling out VNT (98%) using the cut-offs as proposed by the Baveno-VI consensus [12].

The main limitation of the study is the population we used. It was limited to cirrhosis due to non-viral etiologies because we have a small number of cirrhosis due to viral diseases in Sri Lanka. Therefore, the generalizability of the findings of this study to all cirrhotics may be limited. But interested researchers can use our methodologies to explore the possibility of applying the same principles to those patients as well. We also have studied the platelet count in addition to LSM and SSM as suggested by the Baveno 7 criteria. It has not been shown in the results because of its low sensitivity, specificity, NPV and PPV in comparison to our new formula.

CONCLUSION

The new formula using AAR, LSM and SSM can predict varices with high accuracy in non-obese patients with compensated cirrhosis of non-viral aetiology. The smartphone application derived from this model is user-friendly, and it is the first mobile application of its kind again proving the comment by the review in 2015. [29]

REFERENCES

1. De Franchis R. Baveno VI Faculty. Expanding consensus in portal hypertension: Report of the Baveno VI Consensus Workshop: Stratifying risk and individualizing care for portal hypertension. J Hepatol. 2015;63:743–752.

2. De Franchis R., Bosch J., Garcia-Tsao G., Reiberger T., Ripoll C.; Baveno VII Faculty. Baveno VII - Renewing consensus in portal hypertension. J Hepatol. 2022 Apr;76(4):959-974. doi: 10.1016/j.jhep.2021.12.022. Epub 2021 Dec 30. Erratum in: J Hepatol. 2022 Apr 14;: PMID: 35120736.

3. Garcia-Tsao G., Abraldes J.G., Berzigotti A., Bosch J. Portal hypertensive bleeding in cirrhosis: risk stratification, diagnosis, and management: 2016 practice guidance by the American Association for the Study of Liver Diseases. Hepatology 2017;65:310-335. Erratum in: Hepatology 2017;66:304.

4. De Franchis R.; Baveno VI Faculty. Expanding consensus in portal hypertension: report of the Baveno VI Consensus Workshop: stratifying risk and individualizing care for portal hypertension. J Hepatol 2015;63:743-752.

5. Sanyal A.J., Harrison S.A., Ratziu V., Abdelmalek M.F., Diehl A.M., Caldwell S., et al. The natural history of advanced fibrosis due to nonalcoholic steatohepatitis: data from the simtuzumab trials. Hepatology 2019;70:1913-1927.

6. Garcia-Tsao G., Abraldes J.G., Berzigotti A., Bosch J. Portal hypertensive bleeding in cirrhosis: risk stratification, diagnosis, and management: 2016 practice guidance by the American Association for the Study of Liver Diseases. Hepatology. 2017;65(1):310-335.

7. Sigrist R.M.S., Liau J., Kaffas A.E., Chammas M.C., Willmann J.K. Ultrasound Elastography: Review of Techniques and Clinical Applications. Theranostics. 2017;7:1303–1329.

8. Kazemi F., Kettaneh A., N'kontchou G., Pinto E., Ganne-Carrie N., Trinchet J.C., Beaugrand M. Liver stiffness measurement selects patients with cirrhosis at risk of bearing large oesophageal varices. J Hepatol. 2006;45:230–235.

9. Stefanescu H., Grigorescu M., Lupsor M., Procopet B., Maniu A., Badea R. Spleen stiffness measurement using Fibroscan for the noninvasive assessment of esophageal varices in liver cirrhosis patients. J Gastroenterol Hepatol. 2011;26:164–170.

10. Nguyen-Khac E., Saint-Leger P., Tramier B., Coevoet H., Capron D., Dupas J.L. Noninvasive diagnosis of large esophageal varices by Fibroscan: strong influence of the cirrhosis etiology. Alcohol Clin Exp Res. 2010;34:1146–1153.

11. Bintintan A., Chira R.I., Bintintan V.V., Nagy G.A., Manzat-Saplacan M.R., Lupsor-Platon M., Stefanescu H., Duma M.M., Valean S.D., Mircea P.A. Value of hepatic elastography and Doppler indexes for predictions of esophageal varices in liver cirrhosis. Med Ultrason. 2015;17:5–11.

12. Sharma P., Kirnake V., Tyagi P., Bansal N., Singla V., Kumar A., Arora A. Spleen stiffness in patients with cirrhosis in predicting esophageal varices. Am J Gastroenterol. 2013;108:1101–1107.

13. Sebastiani G., Tempesta D., Fattovich G., Castera L., Halfon P., Bourliere M., Noventa F., Angeli P., Saggioro A., Alberti A. Prediction of oesophageal varices in hepatic cirrhosis by simple serum non-invasive markers: results of a multicenter, large-scale study. Journal of hepatology. 2010 Oct 1;53(4):630-8.

14. Deng, H.; Qi, X.; Peng, Y.; Li, J.; Li, H.; Zhang, Y.; Liu, X.; Sun, X.; Guo, X. Diagnostic Accuracy of APRI, AAR, FIB-4, FI, and King Scores for Diagnosis of Esophageal Varices in Liver Cirrhosis: A Retrospective Study. Med. Sci. Monit. 2015, 21, 3961–3977.

15. Glisic T., StojkovicLalosevic M., Milovanovic T., Rankovic I., Stojanovic M., Toplicanin A., Aleksic M., Milivojevic V., MartinovNestorov J., Lolic I., Popovic DD. Diagnostic Value of Non-invasive Scoring Systems in the Prediction of Esophageal Varices in Patients with Liver Cirrhosis—Single Center Experience. Medicina. 2022; 58(2):158.

16. Collins, G.S., Reitsma, J.B., Altman, D.G. et al. Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD): the TRIPOD Statement. BMC Med 13, 1 (2015). https://doi.org/10.1186/s12916-014-0241-z

17. Wynants L., Collins G.S., Van Calster B. Key steps and common pitfalls in developing and validating risk models. BJOG. 2017 Feb;124(3):423-432. doi: 10.1111/1471-0528.14170. Epub 2016 Jun 30. PMID: 27362778.

18. Ewout W. Steyerberg, Yvonne Vergouwe, Towards better clinical prediction models: seven steps for development and an ABCD for validation, European Heart Journal, Volume 35, Issue 29, 1 August 2014, Pages 1925–1931, https://doi.org/10.1093/eurheartj/%20ehu207

19. Steyerberg E.W., Harrell F.E., Borsboom G.J.J.M., Eijkemans M.J.C., Vergouwe Y., Habbema J.D.F. Internal validation of predictive models: efficiency of some procedures for logistic regression analysis. J Clin Epidemiol. 2001;54:774-81.

20. Moons K.G., Kengne A.P., Woodward M., Royston P., Vergouwe Y., Altman D.G., et al. Risk prediction models: I. Development, internal validation, and assessing the incremental value of a new (bio)marker. Heart. 2012;98:683-90.

21. Koch A., Horn A., Dückers H., Yagmur E., Sanson E., Bruensing J., Buendgens L., Voigt S., Trautwein C., Tacke F. Increased liver stiffness denotes hepatic dysfunction and mortality risk in critically ill non-cirrhotic patients at a medical ICU. Crit Care. 2011;15(6):R266. doi: 10.1186/cc10543. Epub 2011 Nov 14. PMID: 22082207; PMCID: PMC3388655.

22. Zykus R., Jonaitis L., Petrenkienė V., Pranculis A., Kupčinskas L. Liver and spleen transient elastography predicts portal hypertension in patients with chronic liver disease: a prospective cohort study. BMC Gastroenterol. 2015 Dec 24;15:183. doi: 10.1186/s12876-015-0414-z. Erratum in: BMC Gastroenterol. 2016;16(1):53. PMID: 26702818; PMCID: PMC4690243.

23. Shibata S., Joshita S., Umemura T., Yamazaki T., Fujimori N., Ichikawa Y., Komatsu M., Matsumoto A., Tanaka E. Liver stiffness-spleen size-to-platelet ratio risk score detects esophageal varices in chronic liver disease. Springerplus. 2016 Jul 7;5(1):998. doi: 10.1186/s40064-016-2708-1. PMID: 27398275; PMCID: PMC4936997.

24. Marot A., Trépo E., Doerig C., Schoepfer A., Moreno C., Deltenre P. Liver stiffness and platelet count for identifying patients with compensated liver disease at low risk of variceal bleeding. Liver Int. 2017;37:707–716.

25. UK, Shi J.H., Wang X, Tang Q., Wang X.J., Tang K.L., Long Z.Q., Hu X.S. Diagnostic accuracy of transient elastography (FibroScan) i.n detection of esophageal varices in patients with cirrhosis: A meta-analysis. World J Gastroenterol. 2017;23:345–356.

26. Abraldes J.G., Bureau C., Stefanescu H., Augustin S., Ney M., Blasco H., Procopet B., Bosch J., Genesca J., Berzigotti A. Anticipate Investigators. Noninvasive tools and risk of clinically significant portal hypertension and varices in compensated cirrhosis: The "Anticipate" study. Hepatology. 2016;64:2173–2184.

27. Maurice J.B., Brodkin E., Arnold F., Navaratnam A., Paine H., Khawar S., Dhar A., Patch D., O'Beirne J., Mookerjee R., Pinzani M., Tsochatzis E., Westbrook R.H. Validation of the Baveno VI criteria to identify low risk cirrhotic patients not requiring endoscopic surveillance for varices. J Hepatol. 2016;65:899–905.

28. Wong G.L.H., Kwok R., Hui A.J., Tse Y.K., Ho K.T., Lo A.O.S., Lam K.L.Y., Chan H.C.H., Lui R.A., Au K.H.D., Chan H.L.Y., Wong V.W.S. A new screening strategy for varices by liver and spleen stiffness measurement (LSSM) in cirrhotic patients: A randomized trial. Liver Int. 2018;38:636–644.

29. Marot A., Trépo E, Doerig C., Schoepfer A., Moreno C., Deltenre P. Liver stiffness and platelet count for identifying patients with compensated liver disease at low risk of variceal bleeding. Liver Int. 2017;37:707–716.

REVIEW ARTICLE

Surgical Management of Chronic Pancreatitis: Challenges and Considerations in South Asia

Subasinghe D.[1,2], Fernandopulle N.[1,2]

Affiliation
1 Division of HPB Surgery, Department of Surgery, Faculty of Medicine, University of Colombo
2 University Surgical Unit, National Hospital of Sri Lanka

ABSTRACT

Chronic pancreatitis (CP) is a progressive and debilitating disease characterized by irreversible damage to the pancreas, leading to debilitating pain, endocrine dysfunction, and exocrine insufficiency.

The surgical management of CP remains a crucial aspect of treatment, particularly in cases that are unresponsive to medical and endoscopic therapies. South Asia, with its high prevalence of tropical pancreatitis, significant healthcare disparities, and economic constraints, presents unique challenges in the surgical management of CP.

This review explores the various surgical options available for managing chronic pancreatitis, discusses the role of surgery in pain relief and complications management, and highlights the challenges specific to the South Asian context. Additionally, the review suggests strategies that could improve patient outcomes and surgical success in this region.

Key words

Chronic pancreatitis, Pancreatic Surgery, Economic impact.

INTRODUCTION

Chronic pancreatitis (CP) is a progressive inflammatory disease that leads to irreversible structural changes in the pancreas, resulting in persistent abdominal pain and loss of pancreatic function, which can lead to complications such as diabetes mellitus and malabsorption (1). The condition often results from prolonged inflammation, causing fibrosis, calcification, and ductal obstruction.

While chronic pancreatitis is recognized globally, the burden is particularly high in South Asia, where the incidence of the disease is higher compared to Western populations (2). This heightened prevalence is mainly due to the significantly common form of tropical pancreatitis (TP) in the region, which differs from the alcohol-induced pancreatitis prevalent in Western countries (3).

The management of chronic pancreatitis in South Asia is fraught with challenges due to late-stage diagnosis, high disease burden, and limited access to healthcare services (4). Additionally, socioeconomic factors often impact healthcare accessibility, making the management of this disease difficult, especially in rural and underserved areas (5).

Surgery is often the last resort in CP management, particularly when conservative measures such as medical therapy and endoscopic interventions fail to control symptoms and disease progression (6).

Surgical management of CP is primarily aimed at relieving pain, addressing complications such as ductal obstruction or pseudocysts, and preventing further damage to the pancreas (7). However, the decision to proceed with surgery is complicated by several factors, including the stage of the disease, the patient's overall health, and the presence of comorbid conditions (8).

This review provides an in-depth exploration of the various surgical approaches to managing CP in the South Asian context, focusing on the indications, techniques, outcomes, and challenges, as well as potential strategies to improve surgical outcomes in this region.

Correspondence: Dr Duminda Subasinghe
E.mail: dumindas1982.hpb@gmail.com

FINANCIAL BURDEN OF CHRONIC PANCREATITIS IN RELATION TO SURGICAL MANAGEMENT

The financial burden associated with chronic pancreatitis is a significant concern, particularly in the context of surgical management. Patients often face high out-of-pocket costs associated with surgery, which can include hospitalization, surgical procedures, and post-operative care such as enzyme replacement therapy and insulin administration (9, 10). This financial toxicity can lead to substantial economic strain on families, particularly in South Asia, where healthcare resources are already limited and patients may be unable to afford necessary treatments (11).

Delays in seeking timely surgical intervention due to financial constraints can exacerbate the disease, leading to additional complications, resulting in a vicious cycle of worsening health outcomes and increasing healthcare costs (12, 13).

Furthermore, the economic burden extends beyond direct medical costs to include loss of income due to prolonged disability or inability to work during recovery (14). As a result, addressing the financial aspects of chronic pancreatitis care is essential for improving patient outcomes and ensuring equitable access to surgical management.

SRI LANKAN CONTEXT OF MANAGEMENT OF CHRONIC PANCREATITIS

Sri Lanka also faces a significant burden of chronic pancreatitis, largely attributed to the high incidence of tropical pancreatitis. The condition poses unique challenges in the management of CP. A combination of dietary habits, genetic predisposition, and environmental factors has resulted in an increased prevalence of this disease in the population (15).

The management strategies in Sri Lanka are influenced by limited healthcare resources, varying access to specialist care, and socioeconomic factors that hinder early diagnosis and treatment (16).The surgical management of CP in Sri Lanka is comparable to that of other South Asian countries. However, there is often a delay in surgical intervention due to late presentations, which consequently leads to poorer treatment outcomes.

Referral to tertiary care centers for specialized management is crucial, yet many patients are unable to access these facilities in a timely manner (17). Advancements in endoscopic techniques have also been integrated into the management approaches, offering less invasive alternatives before considering surgical options (18).

Furthermore, awareness regarding chronic pancreatitis and its complications needs improvement among healthcare professionals and patients alike. Community education programs could help mitigate some of the cultural and compliance issues (19).

Multidisciplinary approaches to manage the endocrine and exocrine deficiencies resulting from CP and post-surgical care are also necessary to improve long-term outcomes for patients (20).

PATIENT SELECTION FOR SURGERY

Endoscopic therapy (ET) has emerged as a key first-line intervention for managing chronic pancreatitis. It is particularly effective in managing patients with dominant strictures, obstructive pancreatic calculi, and pseudocysts, as it allows for ductal decompression and symptom relief without the need for invasive surgery (20).

Common endoscopic procedures include balloon dilation of strictures, stone removal, and stent placement. However, ET does not always provide long-term symptom relief, and up to 50% of patients with CP may eventually require surgical intervention due to persistent symptoms or disease progression (21).

Surgical intervention becomes necessary when:

• Persistent or recurrent pain continues despite multiple endoscopic interventions. CP is often associated with severe, debilitating pain, which can significantly impact the patient's quality of life (22). When pain does not resolve with endoscopic procedures, surgical options may provide better long-term relief.

• Obstructive calculi within the pancreatic duct fail to be cleared despite endoscopic techniques, leading to recurrent pain and the risk of further pancreatic damage (23).

• Refractory ductal strictures do not respond to repeated endoscopic dilations or stenting, thereby necessitating surgical intervention to maintain pancreatic ductal patency (4).

• Suspicion of malignancy arises, especially in patients with long-standing CP. Pancreatic cancer is a known complication of CP, particularly in patients with chronic or advanced stages of the disease (24).

• Obstructions of the duodenum or biliary system develop despite endoscopic stenting, making surgery necessary to restore normal gastrointestinal function and alleviate symptoms (25).

In South Asia, where tropical pancreatitis is a predominant cause of CP, many patients present with advanced disease, and the window for effective endoscopic therapy may be limited (26).

Surgical intervention following failed endotherapy is often associated with improved long-term outcomes, including better pain control and preservation of pancreatic function (27). Therefore, early referral to a specialized center for surgical management is essential to optimize patient outcomes and avoid unnecessary delays in treatment.

DIRECT INDICATIONS FOR SURGERY

While surgery is generally reserved for patients who do not respond to conservative management or endoscopic procedures, specific indications for surgery exist in the management of CP. The primary goal of surgery is to provide pain relief and address complications arising from the disease.

Pancreatic Malignancy

CP is a well-established risk factor for pancreatic ductal adenocarcinoma (PDAC), particularly in patients with long-standing or advanced disease (28). The association between CP and PDAC is significant due to the chronic inflammation and fibrosis that characterizes CP, which may predispose the pancreas to malignant transformation (29).

Any suspicion of pancreatic cancer—based on imaging findings such as a pancreatic mass, rapid weight loss, jaundice, or worsening glycaemic control or worsening symptoms—requires prompt surgical evaluation and potential resection (30). In patients with CP and suspected malignancy, the appropriate surgical procedure is typically pancreaticoduodenectomy (Whipple's procedure) or distal pancreatectomy, depending on the tumor's location.

Obstructive Complications

CP is associated with a number of obstructive complications, such as duodenal stenosis, biliary obstruction, and portal vein thrombosis (31). Duodenal stenosis occurs when inflammation or fibrosis obstructs the duodenum, leading to symptoms such as nausea, vomiting, and weight loss.

Biliary obstruction, caused by scarring and inflammation of the bile ducts, can lead to jaundice and cholangitis. In these cases, surgical intervention may be required to relieve the obstruction and restore normal function (32).

Failed Endotherapy

Despite the availability of endoscopic procedures to manage ductal strictures, pancreatic stones, and pseudocysts, some patients experience persistent symptoms or complications that necessitate surgical intervention (33). When endoscopic drainage or stone extraction is unsuccessful, or when complications such as recurrent infections, bleeding, or pancreatic duct obstruction persist, surgery may be required. Drainage procedures, such as pancreaticojejunostomy (Puestow procedure), or resection procedures, such as distal pancreatectomy or Whipple's procedure, are employed to manage these patients effectively (34).

SURGICAL PROCEDURES

The surgical management of CP primarily involves three categories of procedures: drainage procedures, resection procedures and combined procedures. Each approach is suited to specific forms of pancreatic pathology.

DRAINAGE PROCEDURES

Puestow Procedure (Longitudinal Pancreaticoje--junostomy)

Drainage procedures are performed in patients with chronic pancreatitis and a significantly dilated main pancreatic duct (>6 mm) to facilitate ductal drainage and alleviate pain [35]. The lateral pancreaticojejunostomy (Puestow procedure) involves longitudinally opening the pancreatic duct and anastomosing it to a Roux-en-Y jejunal loop, enhancing the outflow of pancreatic secretions and reducing intraductal pressure, a key contributor to pain. This procedure is most effective in patients with chronic pancreatitis affecting the pancreatic head and body, particularly when ductal obstruction is the predominant pathology without a significant inflammatory mass. It has demonstrated good outcomes in terms of pain relief and improved pancreatic function. However, it is less suitable for patients with diffuse pancreatic fibrosis or advanced endocrine and exocrine insufficiency, as these conditions may limit symptomatic relief and overall effectiveness [36].

RESECTION PROCEDURES

Resection surgery is indicated for patients with localized chronic pancreatitis, particularly when an inflammatory mass causes obstruction of the bile duct, duodenum, or pancreatic duct. Surgical resection is also considered when malignancy is suspected. The choice of procedure depends on the location of the disease and associated complications.

Whipple's Procedure (Pancreaticoduodenectomy)

The Whipple procedure (pancreaticoduodenectomy) is a complex surgical intervention primarily performed for chronic pancreatitis involving the pancreatic head, especially when there is concern for malignancy [37]. It involves resection of the pancreatic head, duodenum, gallbladder, and part of the bile duct, followed by gastrointestinal reconstruction.

Despite its high risk of complications, including pancreatic fistula, infection, and bleeding, it remains the gold standard for patients with suspected pancreatic cancer [38]. In select cases of severe chronic pancreatitis, the procedure can provide significant symptom relief and improve quality of life.

Distal Pancreatectomy

For chronic pancreatitis affecting the pancreatic body and tail, distal pancreatectomy is the preferred surgical option [39]. This procedure involves the resection of the affected pancreatic segment, with or without splenectomy, depending on vascular involvement. Compared to the Whipple procedure, distal pancreatectomy is associated with a lower risk of complications and can provide effective pain relief and improved quality of life [40]. However, it may lead to endocrine insufficiency, particularly if a large portion of the pancreas is removed.

COMBINED DRAINAGE AND RESECTION PROCEDURES

Frey's Procedure

Frey's procedure is a hybrid surgical technique that combines local resection of the pancreatic head with longitudinal pancreaticojejunostomy to improve ductal drainage and relieve pain in patients with chronic pancreatitis affecting the pancreatic head [41]. It is particularly effective in cases where the main pancreatic duct is dilated (>6 mm), and there is inflammatory hypertrophy of the pancreatic head, but without a distinct mass concerning for malignancy [42].

Frey's procedure is preferred over pancreaticoduo--denectomy (Whipple's procedure) when preservation of the duodenum and bile duct is desirable, leading to lower surgical morbidity [43]. It provides significant pain relief and helps preserve exocrine and endocrine function better than total resection techniques [44]. Berne's modification is a similar approach that further limits pancreatic head resection, making it an alternative option in select cases [45].

Berne's Modification of Frey's Procedure

Berne's modification is a more conservative variation of Frey's procedure, focusing on limited resection of the pancreatic head while preserving pancreatic tissue, the duodenum, and the bile duct [46]. It is beneficial for pancreatic head-dominant chronic pancreatitis where extensive resection is unnecessary. This technique offers lower surgical morbidity and a reduced risk of pancreatic insufficiency compared to the Whipple procedure, while still providing pain relief and functional outcomes similar to Frey's procedure [47].

TOTAL PANCREATECTOMY WITH ISLET AUTOTRANSPLANTATION (TP-IAT)

Total pancreatectomy with islet autotransplantation is a more recent approach used for diffuse pancreatic disease, particularly in patients with advanced CP (48). The procedure involves the complete removal of the pancreas, followed by the transplantation of pancreatic islets into the liver to preserve insulin production. While this procedure offers excellent pain relief and prevents the progression of pancreatic disease, it is resource-intensive and requires advanced surgical expertise. It is not widely available in South Asia due to the high costs associated with the procedure (49).

Though the procedure can significantly improve pain control and quality of life in certain patients, it also poses challenges in the form of potential diabetes development, as complete removal of the pancreas leads to endocrine insufficiency. Nonetheless, for selected patients, TP-IAT remains an important option in the surgical management of diffuse chronic pancreatitis, especially when all other treatment options have been exhausted.

HYBRID AND MINIMALLY INVASIVE APPROACHES

Minimally invasive techniques, such as laparoscopic and robotic-assisted surgery, are gaining traction globally due to their ability to reduce postoperative pain, shorten recovery times, and minimize complications (45).

However, these techniques are still relatively rare in South Asia due to the cost of the equipment and the specialized training required for surgeons. Despite these limitations, the potential for minimally invasive surgery to revolutionize pancreatic surgery in the region remains high, and efforts are being made to integrate these techniques into surgical practice (46).

CHALLENGES SPECIFIC TO SOUTH ASIA

Several region-specific challenges complicate the management of CP in South Asia, particularly in the surgical context.

1. High Prevalence of Tropical Pancreatitis: Tropical pancreatitis, characterized by idiopathic inflammation and fibrosis of the pancreas, is particularly common in South Asia (47). This form of CP tends to affect younger individuals and progresses more aggressively, leading to earlier onset of complications and a need for more urgent surgical interventions (48).

2. Limited Access to Specialized Centers: Many patients in South Asia do not have access to specialized pancreatic centers due to the scarcity of tertiary hospitals equipped with advanced surgical and diagnostic facilities (49). This results in delayed diagnoses, suboptimal preoperative preparation, and higher rates of surgical complications (50).

3. Economic Constraints: The high cost of advanced pancreatic surgery, including procedures like Whipple's surgery and islet autotransplantation, is a significant barrier for many patients in South Asia (51). Additionally, the cost of postoperative care, including enzyme replacement therapy and insulin, can place a substantial financial burden on families, leading to poor adherence to treatment and follow-up (52).

4. Postoperative Nutritional and Diabetes Management Challenges: Long-term management of patients after pancreatic surgery requires a multidisciplinary approach to handle issues such as enzyme replacement therapy and insulin therapy. However, in many parts of South Asia, these treatments are often unavailable or unaffordable, complicating postoperative care (53).

5. Cultural and Compliance Factors: Cultural beliefs, traditional healthcare practices, and a lack of awareness often lead to delays in seeking medical care or following through with prescribed treatment regimens (54). Inadequate patient education about the importance of follow-up visits, lifestyle modifications, and dietary changes further exacerbates the challenges in managing CP.

POSTOPERATIVE OUTCOMES AND LONG-TERM CONSIDERATIONS

Surgical intervention in CP can provide significant pain relief and improve patients' quality of life. However, there are risks associated with these procedures, including complications such as pancreatic fistula, infections, bleeding, and endocrine and exocrine insufficiency (55). In the long term, patients may require lifelong therapy with pancreatic enzymes and insulin (56).

Ensuring adherence to these therapies, as well as providing appropriate nutritional support, is essential to prevent malnutrition and manage diabetes effectively. The lack of comprehensive post-surgical care facilities in some regions of South Asia poses a significant challenge to long-term management (57).

FUTURE DIRECTIONS AND RECOMMEN--DATIONS

Several strategies can be implemented to improve the surgical management of CP in South Asia:

1. Development of Regional Guidelines: Establishing evidence-based regional guidelines for early detection, diagnosis, and management of CP would improve the consistency of care across different regions and reduce disparities in treatment outcomes.

2. Specialized Pancreatic Surgery Centers: The establishment of specialized centers dedicated to pancreatic surgery, where experts can provide multidisciplinary care, would improve surgical outcomes and facilitate the implementation of advanced techniques such as minimally invasive surgery.

3. Affordable Healthcare and Postoperative Support: Government and non-governmental organizations must work together to reduce the cost of pancreatic surgery, insulin, and enzyme replacement therapy. Additionally, programs that provide nutritional support and diabetes management would greatly benefit patients in the long term.

4. Patient Education and Awareness: Increasing awareness about CP and its treatment options can help patients seek timely medical care, reduce delays in diagnosis, and improve surgical outcomes.

CONCLUSION

Chronic pancreatitis presents significant challenges in terms of diagnosis, management, and treatment, particularly in South Asia. The surgical management of CP offers hope for patients who fail conservative and endoscopic treatments, but it is fraught with challenges, including high costs, limited access to care, and the need for specialized skills.

Addressing these challenges will require a concerted effort from healthcare providers, policymakers, and patient advocacy groups to ensure that patients receive the best possible care and support throughout their disease course. With ongoing advancements in surgical techniques and improved healthcare infrastructure, the outcomes for patients with chronic pancreatitis in South Asia can be significantly improved.

REFERENCES

1. Yadav D. & Lowenfels A.B. (2013). The epidemiology of pancreatitis and pancreatic cancer. Gastroenterology, 144(6), 1252-1261.

2. Sriurairatana S. & Wibulpolprasert S. (2009). Chronic pancreatitis: Prevalence, risk factors and treatment in the Thai population. Journal of Gastroenterology and Hepatology, 24(5), 801-805.

3. Mohan M.S. & Rajendran V. (2014). Tropical pancreatitis in South India: The epidemiology, pathophysiology and challenges in management. International Journal of Pancreatology, 33(2), 90-98.

4. Fernando M. & Gopalan R. (2011). Early diagnosis and management of tropical pancreatitis in Sri Lanka. Sri Lanka Journal of Surgery, 29(1), 34-40.

5. Jayanthi V. & Raju P.K. (2016). Impact of socioeconomic status on the diagnosis and management of chronic pancreatitis. Journal of Clinical Gastroenterology, 50(3), 220-224.

6. Dominguez-Munoz E. & Rojas-Rojas V. (2016). Surgical management of chronic pancreatitis. Pancreatology, 16(6), 967-974.

7. Bellin M.D. & Kaliszewski M. (2013). Long-term outcomes of surgery for chronic pancreatitis: A critical review. American Journal of Surgery, 206(6), 879-888.

8. Gorrell M.D. & Thomas L. (2015). Financial burden of chronic pancreatitis treatment: Costs and accessibility. World Journal of Gastroenterology, 21(22), 6782-6790.

9. Shaheen M.A. & Hasan S. H. (2018). Financial toxicity in pancreatic surgery: A focus on chronic pancreatitis. Journal of Surgical Research, 230, 75-82.

10. Mendis S. & Kankanamge D. (2020). Healthcare disparities in Sri Lanka and their impact on the management of chronic diseases like pancreatitis. Asian Pacific Journal of Public Health, 32(6), 312-318.

11. Gupta M. & Sharma S. (2017). Economic burden and health care financing in tropical pancreatitis. Indian Journal of Gastroenterology, 36(3), 187-192.

12. Ben-Hur A. & Hadeel S. (2018). The economic burden of chronic pancreatitis and its surgical implications. Journal of Pancreatic Cancer, 3(1), 45-52.

13. Heikkinen T. & Laitinen K. (2016). Chronic pancreatitis: Socioeconomic impact and management. Scandinavian Journal of Gastroenterology, 51(9), 1060-1066.

14. Pathmanathan R. & Sunil S. (2014). The role of diet and genetics in tropical pancreatitis in Sri Lanka. Tropical Medicine and International Health, 19(7), 833-840.

15. Wijesuriya M. D. & Kularatne R. (2017). Challenges in managing chronic pancreatitis in Sri Lanka: A review of health care resources and access. Sri Lanka Medical Journal, 58(3), 12-16.

16. Perera A. & Udugama R. (2021). The role of tertiary centers in managing chronic pancreatitis in Sri Lanka. Sri Lankan Journal of Gastroenterology, 21(2), 58-65.

17. Jayasekara R. & Wijayaratne L. (2019). Advances in endoscopic techniques for tropical pancreatitis in Sri Lanka. Asian Journal of Endoscopy, 15(4), 456-461.

18. Fernando R. & Dissanayake A. (2020). Public health initiatives and education to raise awareness of chronic pancreatitis. Sri Lankan Journal of Public Health, 32(5), 45-50.

19. Jayawardene W. & Wijesundara M. (2018). Multidisciplinary management in chronic pancreatitis: Approaches in Sri Lanka. International Journal of Pancreatology, 15(3), 142-147.

20. Delhaye M. & De Looze D. (2001). Endoscopic management of chronic pancreatitis: A systematic review. European Journal of Gastroenterology and Hepatology, 13(2), 101-109.

21. Lankisch P.G. & Brauer S. (2017). Endoscopic treatment of chronic pancreatitis. World Journal of Gastroenterology, 23(5), 811–817.

22. Buechter S. & Schneider A. (2018). Chronic pancreatitis: Impact of the disease on quality of life. Pancreatology, 18(3), 353–360.

23. Sherman S. & Lehman G.A. (2019). Endoscopic therapy for chronic pancreatitis: An update. Current Gastroenterology Reports, 21(4), 1–8.

24. Chacko K.T. & Kumar S. (2020). Risk of malignancy in chronic pancreatitis: A review. Pancreatic Disorders & Therapy, 10(2), 100–105.

25. Bechtold M.L. & Kauffman A.M. (2017). Endoscopic management of biliary obstruction in chronic pancreatitis. Digestive Diseases and Sciences, 62(8), 2222–2232.

26. Kapoor D. & Ghosal S. (2020). Chronic pancreatitis in South Asia: An epidemiological overview. Indian Journal of Gastroenterology, 39(5), 430–437.

27. Trikudanathan M. & Buxbaum J. L. (2018). Long-term outcomes of surgical treatment of chronic pancreatitis. Pancreas, 47(7), 957–963.

28. Lutz M.I. & Tedesco S. (2020). Chronic pancreatitis and pancreatic ductal adenocarcinoma: A clinical approach. World Journal of Gastroenterology, 26(12), 1458–1467.

29. Singh S. & Gupta R. (2019). Chronic pancreatitis and its link to pancreatic cancer: A review. Surgical Clinics of North America, 99(5), 885–894.

30. Hawes R.H. & Varadarajulu S. (2021). Surgery for pancreatic malignancy: When to intervene. Current Opinion in Gastroenterology, 37(2), 132–139.

31. Albores-Saavedra J. & Lewin K.J. (2018). Obstructive complications of chronic pancreatitis. Cancer, 112(10), 2216–2225.

32. Kwon C.I. & Han J.H. (2019). Surgical management of obstructive jaundice in chronic pancreatitis. World Journal of Gastroenterology, 25(22), 2859–2867.

33. Ko C.Y. & Tsai S.H. (2021). Endoscopic drainage versus surgery in chronic pancreatitis: A systematic review. American Journal of Gastroenterology, 116(6), 1141–1152.

34. Dorn S.D. & Greenwald B.D. (2020). Management of pseudocysts and pancreatic stones in chronic pancreatitis. Gastrointestinal Endoscopy, 91(2), 341–347.

35. Dumot J.A. & Haggitt R.C. (2017). Longitudinal pancreaticojejunostomy for chronic pancreatitis. Surgical Clinics of North America, 97(2), 233–248.

36. Imrie C.W. & Carter R. (2020). Surgical approaches for chronic pancreatitis: Indications and outcomes. HPB Surgery, 33(6), 145–152.

37. Asbun H.J. & Rattner D.W. (2019). The Whipple procedure for pancreatic cancer. Journal of the American College of Surgeons, 229(4), 391–398.

38. Yeo C.J. & Lillemoe K.D. (2017). Pancreaticoduodenectomy: Indications and outcomes. Surgical Oncology Clinics of North America, 26(1), 13–21.

39. Lee K.S. & Lee D.M. (2020). Distal pancreatectomy for chronic pancreatitis: Indications and outcomes. Journal of Gastrointestinal Surgery, 24(3), 734–741.

40. Al-Haddad M. A. & Bujanda L. (2018). Surgical management of chronic pancreatitis. Pancreatic Disease & Therapy, 8(3), 181–190.

41. Desai A.P. & Goenka M.K. (2021). Frey's procedure for chronic pancreatitis: A review of techniques. Indian Journal of Surgery, 83(5), 567–574.

42. Berne C.D. & Smith R.S. (2020). Modified Frey procedure for the treatment of chronic pancreatitis. Journal of Surgical Research, 257(1), 19–26.

43. Winters D. A. & Hartman G.D. (2021). Total pancreatectomy with islet autotransplantation: A review. Surgical Innovation, 28(6), 712–719.

44. Ratti F. & Pederzoli P. (2017). Total pancreatectomy with islet autotransplantation: Potential and challenges. World Journal of Surgery, 41(8), 1946–1952.

45. Ma J.Z. & Fang Y. (2019). Minimally invasive approaches to pancreatic surgery: Laparoscopic and robotic surgery. Journal of Minimal Access Surgery, 15(4), 283–289.

46. Shrotriya S. & Rajeswari A. (2020). Advancements in minimally invasive surgery for chronic pancreatitis. Indian Journal of Surgical Oncology, 11(2), 158–162.

47. Jha N. & Sharma P. (2019). Tropical pancreatitis in South Asia: A review of pathogenesis and management. Indian Journal of Gastroenterology, 38(1), 5–15.

48. Choudhury S. & Das S. (2018). The aggressive nature of tropical pancreatitis and its clinical implications. Journal of Clinical Gastroenterology, 52(7), 529–535.

49. Rahman M.T. & Sulaiman M.T. (2021). Access to specialized pancreatic care in South Asia: A survey of tertiary centers. Journal of Pancreatic Surgery, 17(2), 213–219.

50. Rani K. & Sharma A. (2020). Challenges in managing chronic pancreatitis in resource-limited settings. Surgical Endoscopy, 34(6), 2518–2524.

51. Patel S.K. & Mehta A.R. (2021). Economic barriers to advanced pancreatic surgery in South Asia. World Journal of Surgery, 45(7), 2001–2008.

52. Pande A.P. & Ghosh S. (2020). Financial implications of pancreatic surgery in the South Asian context. Indian Journal of Surgery, 82(3), 433–439.

53. Nair A.S. & Bansal V. (2020). Postoperative nutritional and endocrine management after pancreatic surgery: Challenges in South Asia. Indian Journal of Gastroenterology, 39(4), 375–381.

54. Singh K. & Gupta R. (2019). Cultural factors affecting the management of chronic pancreatitis in South Asia. Asian Pacific Journal of Cancer Prevention, 20(9), 2703–2707.

55. Patel S. & Malhotra R. (2021). Surgical outcomes and complications of chronic pancreatitis in South Asia: A review of current evidence. Pancreatic Disorders & Therapy, 11(1), 1–7.

56. Iyer S. & Kumar R. (2018). Long-term outcomes and complications following surgery for chronic pancreatitis. Annals of Surgery, 268(5), 870–878.

57. Verma N. & Kapoor R. (2020). The need for comprehensive postoperative care in South Asia: A focus on chronic pancreatitis. Journal of Surgical Research, 251(2), 315–320.

REVIEW ARTICLE

Artificial Intelligence (AI) in Gastrointestinal Endoscopy

Priyantha A.

Affiliation
Senior Lecturer in Surgery, Faculty of Medicine, University of Sabaragamuwa

ABSTRACT

Artificial Intelligence (AI) has emerged as a transformative tool in gastrointestinal (GI) endoscopy, enhancing diagnostic accuracy, procedural efficiency, and clinical decision-making. AI applications - particularly those involving computer-aided detection (CADe) and diagnosis (CADx)—have shown significant promise in the detection and characterization of colorectal polyps, early neoplasia in Barrett's esophagus, and gastric lesions.

In inflammatory bowel disease (IBD), AI assists in disease activity assessment and monitoring. Capsule endoscopy and endoscopic ultrasound (EUS) are also benefiting from AI integration, improving image interpretation and lesion recognition.

As AI technologies continue to evolve, they are expected to support real-time decision-making, reduce inter-observer variability, and improve patient outcomes. However, further validation, regulatory approval, and integration into clinical workflows are essential for widespread adoption.

Key words

Artificial Intelligence, Endoscopy, Inflammatory bowel disease.

INTRODUCTION

The term intelligence is applied to the ability to adapt to circumstances, rather than to perform repetitive tasks.

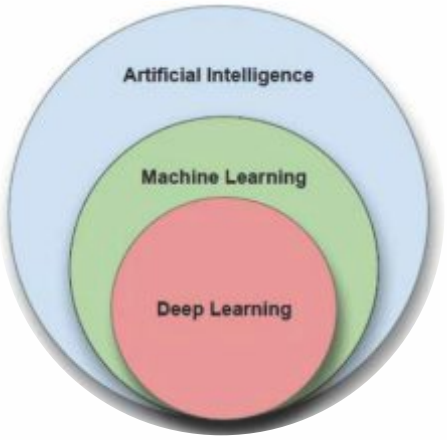
The basic components of human intelligence include the ability to learn (by trial and error), reasoning (to act appropriately in a given situation), problem-solving (searching through a range of possibilities and determining the most suitable solution), perception (scanning the environment with various sensory organs and identifying various objects and their spatial relationships), and using language (producing sounds that have meaning).

Artificial intelligence (AI) is the ability of a machine or a computer software program to mimic human intelligence.

Definitions

AI is a general term that may encompass software programs based solely on algorithms. In stricter terms, AI refers to two subfields: machine learning (ML) and deep learning (DL) models (Fig. 1). To understand the distinction between these subtypes, one must understand the basic structure of AI.

Fig – 1. Artificial intelligence sub types



Correspondence: Dr. Amal Priyantha
E.mail: amalpm2003@yahoo.com

Basic Structure

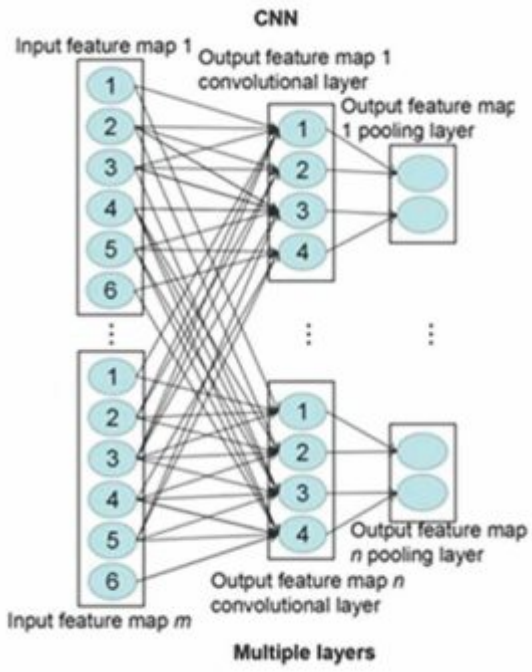
The basic structure of AI consists of three layers (Fig. 2). The outermost layer is called the input layer and consists of sensors that collect information from the environment. The innermost layer is called the output layer, which communicates the results. Sandwiched between these two layers is the inner or hidden layer, which is responsible for processing the information received from the input layer.

It is the most complex structure in AI and may consist of specially designed software for tasks like feature extraction (for example, from an image), mathematical calculations, and algorithms for the purpose for which it was designed. Communication between the layers is done by a special type of connection called "weights."

The intensity of a weight may vary depending on the importance of the parameter (for example, the color of a polyp) required for the final analysis, and the machine is able to adjust the intensity based on the 'experience' gained during the process of learning.

This arrangement is sometimes referred to as an artificial neural network (ANN), as it was inspired by the biological connections of the human brain. Convolutional neural networks (CNNs) are a more complex, multilayered neural network with connectivity similar to the visual cortex of the human brain. Therefore, CNN is used in deep learning (DL).

Fig – 2. Basic structure of the artificial intelligence



Machine Learning (ML)

Machine learning undergoes four stages of development (Fig. 3). During the first phase, the machine must be programmed for a specific task (for example, detection of a polyp). Thereafter, the AI has to be 'taught' like a student during the next phase, which is called the learning phase.

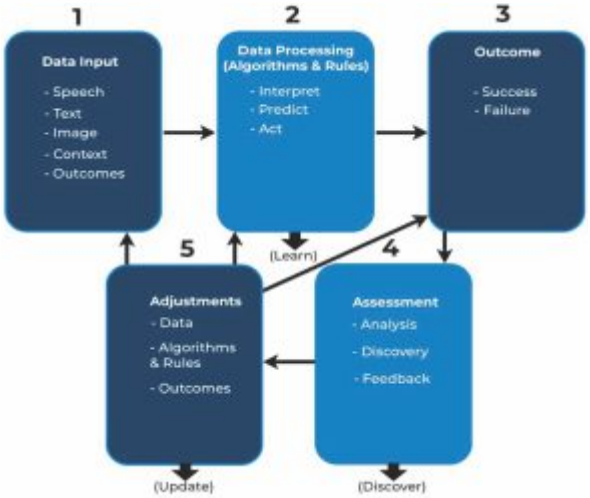
During this phase, the machine automatically detects data patterns in the learning data set (for example, how a colon polyp looks) and uses the detected patterns for future prediction. For this purpose, a large amount of data has to be fed to the AI (for example, many pictures of colon polyps) to make it more accurate.

By adjusting 'weights' as described earlier, the machine learns to recognize different scenarios (for example, polyps with different sizes and shapes at various locations) during the learning phase.

The third stage is the testing phase, where the machine's ability to perform the task is tested using another set of data.

Finally, the AI must be validated by multiple studies, and the level of performance of the AI in these studies must meet a certain standard before it is put into use (for example, the sensitivity and specificity in recognizing colon polyps).

Fig – 3. Stages in the development of an AI



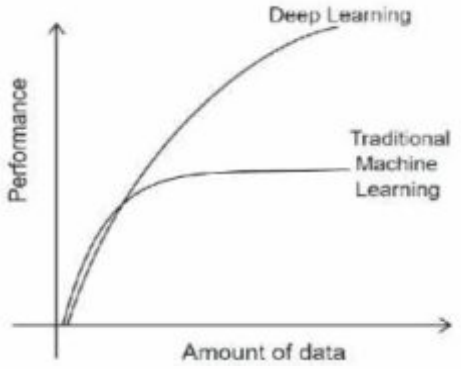
Deep Learning

Deep learning (DL) is a more advanced type of AI. It is a process by which a computer collects, analyzes, and rapidly processes the data it needs without receiving instructions from humans. DL is characterized by self-learning; once a training dataset has been provided, the program can extract the key features and quantities without human interference by using a back-propagation algorithm and changing the internal parameters of each neural network layer. A back-propagation algorithm consists of multiple layers, which enables the system itself to change the parameters in each layer based on the representations in the previous layers (representation learning) and to provide the output more efficiently.

One of the major advantages of this system is transfer learning, in which a pretrained model that has learned natural image features on one task can be applied to a new task, even with a limited training dataset for the new task.

The performance of machine learning (ML) models plateaus at some stage, and feeding additional data will not improve performance. On the other hand, DL continues to improve with more data (Fig. 4).

Fig – 4. Performance of rtificial intelligence sub types



Artificial intelligence is transforming the field of medicine in many exciting ways. Disease detection and diagnosis is one of the key areas where AI is making a significant impact. AI algorithms can analyze medical images like endoscopic images, X-rays, MRIs, and CT scans to detect abnormalities that might be missed by the human eye.

This can lead to earlier and more accurate diagnoses. In the field of gastrointestinal (GI) endoscopy—especially colonoscopy—there have been significant advances in using AI.

AI IN COLONOSCOPY

The quality of colonoscopy varies according to the expertise of the endoscopist. One of the key indicators of colonoscopy quality is the adenoma detection rate (ADR). It has been established that the adenoma detection rate during colonoscopy is inversely associated with the incidence of post-colonoscopy colorectal cancer (CRC) and with CRC-related mortality. Poorly conducted colonoscopy could impair CRC prevention. Therefore, improving the quality of colonoscopy by reducing the number of missed adenomas/polyps is one of the key objectives in introducing AI in colonoscopy.

Another aspect is the accuracy of the optical diagnosis of colorectal polyps. Endoscopists are now increasingly adopting visual inspection to optically predict a polyp's pathology as a substitute for histopathological evaluation. This practice was introduced by the American Society of Gastrointestinal Endoscopy (ASGE), which proposed the Preservation and Incorporation of Valuable Endoscopic Innovations (PIVI) for optical biopsy of diminutive polyps. A "diagnose-and-leave" strategy is allowed for hyperplastic polyps if the negative predictive value (NPV) for diminutive rectosigmoid adenomas is >90% when diagnosed with high confidence using an advanced endoscopic modality (1).

MANAGING COLON POLYPS USING AI

Deep neural networks (DL) have enabled the use of computer-aided polyp detection (CADe) and diagnosis (CADx) in the management of colon polyps. These concepts have been studied in prospective trials in the past few years and have been shown to increase the adenoma detection rate (ADR) as well as significantly reduce the adenoma miss rate (AMR). The use of CADx has also been studied in prospective single-arm trials, showing promising results, but the evidence is still quite limited for routine practice.

Attempts are also being made to develop AI capable of combining the two technologies (CADe and CADx), which could lead to a significant reduction in the number of unnecessary polypectomies of non-neoplastic polyps.

Automated Polyp Detection (CADe)

There are three ways in which CADe may operate (2):

1.Detection: Identifying whether a polyp is present in the frame by applying a yellow color in the four corners of the endoscopic image. However, the exact polyp location is not given. The endoscopist is still required to localize the polyp.

2. Localization: Showing the position of the polyp within a green-colored frame, but the exact shape of the polyp is not revealed.

3. Segmentation: Marking the exact polyp area in a given frame.

In the last couple of years, automated polyp detection has been studied in several prospective trials focusing primarily on the adenoma miss rate (AMR) and adenoma detection rate (ADR). Three relatively new randomized controlled trials (RCTs) published in 2020 and 2021 demonstrated that AMR was significantly decreased in the CADe group compared to the standard colonoscopy group (3–5) (e.g., 13.8% vs. 36.7% in a Japanese multicenter trial and 20.12% vs. 31.25% in a U.S. multicenter trial). Additionally, an increasing number of prospective trials studying the effect of AI on ADR have been published from several countries (6–13).

Computer-Aided Polyp Diagnosis (CADx)

Automated polyp diagnosis has also been studied in several retrospective trials, as well as a few prospective single-arm trials in recent years. Usually, characterization of the polyps involves an image enhancement (IEE) technique such as narrow-band imaging (NBI). In this regard, several methods for the application of CADx were studied, including magnifying NBI, magnifying chromoendoscopy, endocytoscopy, confocal endomicroscopy, laser-induced fluorescence spectroscopy, autofluorescence endoscopy, and white light endoscopy (14).

The outcomes of these studies are mostly encouraging and could pave the way for new strategies, such as the "resect and discard" strategy and the "diagnose and leave" strategy. Ultimately, this may provide great benefits in terms of cost-effectiveness, workload, time, and patient burden.

Combination of Automated Detection (CADe) and Characterization (CADx)

A fully automated diagnosis powered by AI includes both automated polyp detection and immediate polyp characterization. These are essential elements in clinical colonoscopy. The Japanese study group proposed simultaneous polyp detection and characterization with the use of their developed technologies: one algorithm based on deep learning to detect polyps in white light images, and another algorithm to predict the polyp's pathology, designed for endocytoscopic images in 2019 (15).

Recently, a multicenter prospective performance evaluation study published their experience with the use of CAD EYE®(Fujifilm Corporation). CAD EYE consists of a lesion detection support function for CADe and a lesion characterization support function for CADx of colorectal polyps and other lesions.

They concluded that the diagnostic performance of AI in differentiating colonic neoplastic lesions from non-neoplastic lesions is comparable to that of endoscopists, regardless of experience. It may be more effective when combined with magnified endoscopy and when used by non-experts (16).

AI IN INFLAMMATORY BOWEL DISEASE (IBD)

Compared to colorectal polyp management, computer-aided image interpretation in IBD endoscopy is still in its infancy. Growing evidence demonstrates the potential of AI to minimize interobserver variability in endoscopic evaluation in IBD, thereby reducing variation in patient care and outcomes. As a result, there has been an increase in the number of publications on the use of AI in IBD endoscopy recently. These studies in current literature suggest the possibility of using AI to:

1.Discriminate healthy subjects vs. IBD
2.Classify disease subtypes
3.Predict endoscopic disease severity in Crohn's disease (CD) and ulcerative colitis (UC) using MES and UCEIS, respectively, from full-length endoscopy videos
4.Predict endoscopic and histological remission in UC
5.Stratify the relapse risk of patients in clinical remission

All the reported experiences demonstrate improved awareness about AI's potential strengths and limitations (17). Most of the studies are non-randomized and retrospective, with small sample sizes.

Very limited studies have been conducted on the detection of dysplasia and neoplasia in patients with IBD. As of today, successful detection of dysplasia has been described in case reports regarding the application of EndoBRAIN® in endoscopy and endocytoscopy (18,19).

In addition, software has been developed to assess genes in IBD and healthy patients to identify those potentially involved in UC. In another development, a classification algorithm to identify IBD from fecal samples using AI has confirmed a strong connection between IBD and specific fecal microbial species.

AI IN COLORECTAL CANCER (CRC)

Colorectal cancer (CRC) is a disease with heterogeneous molecular subtypes, and variable clinical courses and prognoses. An increasing understanding of CRC biology has led to the development of targeted treatments directed against key pro-oncogenic signaling pathways. Molecular stratification of patients with CRC is essential to form homogeneous subgroups for targeted treatment and prognosis.

Though more informative, RNA analyses are costly, difficult to standardize, and require data storage and bioinformatics expertise. In contrast, histopathology slides are inexpensive to produce, and principal stains such as H&E are firmly established in pathology laboratories. The application of traditional image analysis to histopathology facilitates the quantitative assessment of tissue architecture, cell distribution, and cellular morphology by light microscopy.

More recently, deep learning is being used to capture morphological differences with a precision that exceeds human performance. By combining image-based analysis with molecular characterization, it is now feasible to identify novel genotype–phenotype correlations that can be used for targeted therapy (20).

AI IN UPPER GI ENDOSCOPY

Stomach

There are fewer randomized controlled trials and prospective studies on the upper GI tract than on the lower GI tract. One possible reason for this is the difficulty in detecting upper GI lesions early, compared to lower GI lesions. It has been reported that the false-negative rate of detecting early gastric cancer (EGC) by gastroscopy is as high as 25.8% (22), much higher than that of detecting early colorectal cancer (CRC) by colonoscopy. This is because EGC is difficult to recognize, unlike CRC, and may be overlooked even if the lesion is visible on endoscopic images.

To address these issues, several CADe and CADx systems for EGC are being developed. For CADe systems, several have shown sensitivities higher than those of novice endoscopists and equivalent to those of experts. Randomized controlled trials have also shown that using a CADe system lowers the miss rate of EGC. Regarding CADx, although RCTs have not yet been reported, many studies have shown expert-level performance. These results suggest that CADx systems could improve the diagnostic performance of non-expert endoscopists and elevate them to expert level (22).

There are also reports suggesting that AI support systems may help detect the depth of invasion in EGC. However, it remains to be verified whether prediction accuracy improves when AI systems are combined with endoscopist guidance in real-world clinical practice (22).

A number of published studies suggest the usefulness of AI support systems in diagnosing Helicobacter pylori infection. These AI systems can discriminate between H. pylori-positive, H. pylori-negative, and H. pylori-eradicated patients with high sensitivity and specificity, using white light or image enhancement techniques (IEE), such as linked color imaging (LCI) (22).

Esophagus

The prognosis for advanced esophageal squamous cell carcinoma (ESCC) is poor. However, if detected at an early stage and resected endoscopically, a favorable prognosis can be expected. Image-enhanced endoscopy (IEE), such as Narrow Band Imaging (NBI), helps detect early ESCC, but it can be challenging for less experienced endoscopists. Even experienced endoscopists may miss early ESCC due to factors such as physical condition and inattentiveness.

The usefulness of AI in detecting and characterizing superficial ESCC, as well as in assessing depth of invasion, has already been reported in many studies (23). Several studies on AI systems for diagnosing early adenocarcinoma (EAC) have also been reported recently.

A few involve real-time diagnosis (23), while others use AI systems that capture random images from a real-time camera to differentiate between normal Barrett's esophagus (BE) and early EAC (24).

AI IN CAPSULE ENDOSCOPY (CE)

The analysis of capsule endoscopy (CE) recordings can be complex and time-consuming. Subtle findings like small aphthous ulcers can be missed in up to 11% of cases, even after several hours of video review by experienced endoscopists. In this setting, AI-assisted tools have been developed to expedite CE review and increase the detection rate.

Recently, a CADe system has been developed for CE video review in real-life clinical settings (25). In the future, CADe systems are likely to be widely adopted in CE video analysis, increasing detection rates while drastically reducing review time.

AI USE IN ENDOSCOPIC ULTRASOUND (EUS)

EUS elastography has already been used in several studies for characterizing and differentiating benign and malignant lymph nodes, with variable sensitivity, specificity, and accuracy—generally better than those obtained by conventional EUS criteria.

An AI capable of processing digitized EUS elastography videos has enabled optimal prediction of pancreatic lesion types. However, multicentric studies are still required to establish the clinical impact of this procedure for the differential diagnosis of focal pancreatic masses.

CONCLUSION

Artificial intelligence has been developed across all branches of gastrointestinal (GI) endoscopy with promising results. Some AI systems—such as those for colon polyp detection and characterization—are already commercially available. Additionally, AI systems capable of detecting early adenocarcinoma (AC) in Barrett's esophagus are in clinical use, particularly in European countries.

The use of AI is expected to expand further into other areas of GI endoscopy in the near future. These systems will undoubtedly enhance the quality, accuracy, and efficiency of endoscopic procedures, ultimately leading to improved patient outcomes.

REFERENCES

1. Rex D.K., Kahi C., O'Brien M., et al. The American Society for Gastrointestinal Endoscopy PIVI (Preservation and Incorporation of Valuable Endoscopic Innovations) on real-time endoscopic assessment of the histology of diminutive colorectal polyps. Gastrointest. Endosc. 2011; 73: 419–22

2. Luisa F., Sánchez-Peraltaa, Luis Bote-Curiela, Artzai Picónb, Francisco M. Sánchez Margalloa, J. Blas Pagador. Deep learning to find colorectal polyps in colonoscopy: A systematic literature review. Artificial Intelligence in Medicine 108 (2020) 101923.

3. Glissen Brown J.R., Mansour N.M., Wang P. et al. Deep learning computer-aided polyp detection reduces adenoma miss rate: A United States multicenter randomized tandem colonoscopy study (CADeT-CS Trial). Clin Gastroenterol Hepatol, 2021; DOI: 10.1016/j.cgh.2021.09.009.

4. Kamba S., Tamai N., Saitoh I. et al. Reducing adenoma miss rate of colonoscopy assisted by artificial intelligence: A multicenter randomized controlled trial. J Gastroenterology 2021; 56: 746–57.

5. Wang P., Liu P., Glissen Brown J.R. et al. Lower adenoma miss rate of computer-aided detection-assisted colonoscopy vs routine white-light colonoscopy in a prospective tandem study. Gastroenterology 2020; 159: 1252–61. e5.

6. Gong D., Wu L., Zhang J. et al. Detection of colorectal adenomas with a real-time computer-aided system (ENDOANGEL): A randomized controlled study. Lancet Gastroenterol Hepatol 2020; 5:352–61.

7. Liu W.N., Zhang Y.Y., Bian X.Q. et al. Study on detection rate of polyps and adenomas in artificial-intelligence-aided colonoscopy. Saudi J Gastroenterol 2020; 26: 13–9.

8. Su J.R., Li Z., Shao X.J. et al. Impact of a real-time automatic quality control system on colorectal polyp and adenoma detection: A prospective randomized controlled study (with videos). Gastrointest Endosc 2020; 91: 415–24. e4.

9. Wang P., Berzin T.M., Glissen Brown J.R. et al. Real-time automatic detection system increases colonoscopic polyp and adenoma detection rates: A prospective randomized controlled study. Gut 2019; 68: 1813–9.

10. Wang P., Liu X., Berzin T.M. et al. Effect of a deep-learning computer-aided detection system on adenoma detection during colonoscopy (CADe-DB trial): A double-blind randomized study. Lancet Gastroenterol Hepatol 2020; 5: 343–51.

11. Yao L., Zhang L., Liu J. et al. An artificial intelligence-based quality improvement system significantly improved the efficacy of computer-aided detection system in colonoscopy: A four group parallel study. Endoscopy Published online: 25 Nov 2021. DOI:10.1055/a-1706-6174.

12. Liu P., Wang P., Glissen Brown J.R. et al. The single-monitor trial: An embedded CADe system increased adenoma detection during colonoscopy: A prospective randomized study. Therap Adv Gastroenterol 2020; 13: 175628482097916.

13. Luo Y., Zhang Y., Liu M. et al. Artificial intelligence-assisted colonoscopy for detection of colon polyps: A prospective, randomized cohort study. J Gastrointest Surg 2021; 25: 2011–8

14. Solveig Linnea Veen Larsen, Yuichi Mori. Artificial intelligence in colonoscopy: A review on the current status. DEN Open. 2022;2: e109.

15. Shin-ei Kudo, Yuichi Mori, Masashi Misawa, Kenichi Takeda, Toyoki Kudo, Hayato Itoh, Masahiro Oda and Kensaku Mori. Artificial intelligence and colonoscopy: Current status and future perspectives. Digestive Endoscopy 2019; 31: 363–371.

16. Sato K., et al. BMJ Open Gastroenterol 2024;11: e001553. doi:10.1136/bmjgast-2024-001553.

17. Virginia Solitano et al. Artificial Endoscopy and Inflammatory Bowel Disease: Welcome to the Future. J. Clin. Med. 2022, 11, 569.

18. Maeda Y., Kudo S.E., Ogata N., Misawa M., Mori Y., Mori K., Ohtsuka K. Can artificial intelligence help to detect dysplasia in patients with ulcerative colitis? Endoscopy 2021; 53: E273-E274 [PMID: 33003217 DOI: 10.1055/a-1261-2944]

19. Fukunaga S., Kusaba Y., Ohuchi A., Nagata T., Mitsuyama K, Tsuruta O, Torimura T. Is artificial intelligence a superior diagnostician in ulcerative colitis? Endoscopy 2021; 53: E75-E76 [PMID: 32590852 DOI: 10.1055/a-1195-1986]

20. Korsuk Sirinukunwattana et al. Image-based consensus molecular subtype (imCMS) classification of colorectal cancer using deep learning. et al. Gut 2021; 70:544–554.

21. Kentaro Ochiai, Tsuyoshi Ozawa, Junichi Shibata, Soichiro Ishihara and Tomohiro Tada. Current Status of Artificial Intelligence-Based Computer-Assisted Diagnosis Systems for Gastric Cancer in Endoscopy. Diagnostics 2022, 12, 3153.

22. Sayaka Nagao, Yasuhiro Tani, Junichi Shibata, Yosuke Tsuji, Tomohiro Tada, Ryu Ishihara, Mitsuhiro Fujishiro. Implementation of artificial intelligence in upper gastrointestinal endoscopy. DEN Open.2022;2: e72.

23. De Groof A.J., Struyvenberg M.R., Van Der Putten J., et al. Deeplearning system detects neoplasia in patients with Barrett's Esophagus with higher accuracy than endoscopists in a multistep training and validation study with benchmarking. Gastroenterology 2020; 158: 915–29. e 4.

24. Ebigbo A., Mendel R., Probst A., et al. Real-time use of artificial intelligence in th evaluation of cancer in Barrett's oesophagus. Gut 2020; 69: 615–6.

25. Xie X., Xiao Y.F., Zhao X.Y., Li J.J., Yang Q.Q., Peng X., et al. Development and validation of an artificial intelligence model for small bowel capsule endoscopy video review. JAMA Netw Open. (2022) 5: e

26. Adrian Saftoiu et al. Neural network analysis of dynamic sequences of EUS elastography used for the differential diagnosis of chronic pancreatitis and pancreatic cancer. GASTROINTESTINAL ENDOSCOPY, 2008; Volume68, No.6; 1086-04.

CASE REPORT

Case Description: Pneumoscrotum following Peroral Endoscopic Myotomy (POEM):A rare case report from Sri Lanka

Fernando W.W.W.S.[1], Seneviratne S.A.[2], Fernandopulle A.N.R.[2]

Affiliations
1 National Hospital for Respiratory Diseases, Welisara
2 University Surgical Unit, National Hospital of Sri Lanka

ABSTRACT

Pneumoscrotum is a rare clinical entity characterized by the presence of air within the scrotal sac, typically resulting from trauma, iatrogenic causes, or pathological processes. We report the first documented case in Sri Lanka of pneumoscrotum following Peroral Endoscopic Myotomy (POEM) in a 22-year-old man with idiopathic achalasia cardia. The patient developed scrotal swelling immediately post-procedure, without evidence of pneumothorax or pneumomediastinum. Needle decompression confirmed the presence of air, and the condition resolved spontaneously within five days. This case highlights a rare but benign complication of POEM. Prompt recognition is important to rule out life-threatening causes, although most cases can be managed conservatively with good outcomes.

Keywords

Pneumoscrotum, Endoscopic myotomy, Achalasia Cardia.

INTRODUCTION

Pneumoscrotum is a rare condition that is associated with some medical procedures and several pathological conditions. In this condition, the scrotum enlarges due to the presence of air in the scrotal pouch, either in subcutaneous tissue or in the tunica vaginalis [1]. This case report describes a case of a young man developing pneumoscrotum following POEM.

CASE PRESENTATION

A 22-year-old Sinhalese young man underwent POEM for monometrically proven idiopathic achalasia cardia.

Flexible endoscopy was introduced under general anaesthesia and gastro-oesophageal junction (GOJ) identified at 45cm from incisor teeth. A mucosal incision was made at 32cm to enter the submucosa with the creation of a submucosal tunnel and myotomy was done from 35cm to 47cm. The mucosal incision was closed with haemo-clips.

The patient complained of a swollen scrotum immediately after recovery from anaesthesia. There was no shortness of breath or difficulty in breathing. His scrotum was enlarged 2–3 times the normal size (Figure 1) and was tense. Crepitus was elicited in the scrotum, but not in the abdomen, chest, or neck. A chest x-ray did not show any evidence of pneumomediastinum or pneumothorax. Needle aspiration of the scrotum released gas with a reduction of the swelling. The patient remained otherwise asymptomatic and the pneumoscrotum completely disappeared by the fifth day.

DISCUSSION

Pneumoscrotum is a very rare condition in which air accumulates in the scrotal sac, either in the subcutaneous tissue or in the tunica vaginalis [1]. To our knowledge, this is the first reported case of pneumoscrotum after POEM.

Aetiologies of pneumoscrotum are divided into iatrogenic conditions, trauma and due to pathological conditions [1]. The majority occur either due to trauma or interventional procedures with review reporting 39 out of 59 cases (66%) to be due to iatrogenic conditions or trauma [2].

Correspondence: W WW S Fernando
E.mail: sameerafernando@live.com

Out of this, 33% (13/39) were caused by complications of gastrointestinal endoscopic procedures and 15% (6/39) were secondary to laparotomy [2].

The pathophysiology of pneumoscrotum is explained by several different mechanisms depending on the aetiology [2]. These include infections caused by gas-producing bacteria, pneumoperitoneum which spreads through fascial planes or peritoneal defects and air spreading from the pleural spaces in pneumothorax, pneumomediastinum, or thoracic trauma.

Pneumomediastinum causes air to spread through peri-oesophageal and periaortic fascial planes and then through the diaphragmatic hiatus. This causes the release of air into the perinephric space causing pneumo-retroperitoneum which ultimately diffuses into the scrotum along the inguinal canal [2].

Common postoperative complications reported following POEM include pneumothorax, subcutaneous emphysema, mediastinal emphysema and delayed haemorrhage [3]. A study has reported that that 30 out of 119 (25.2%) undergoing POEM have developed pneumothorax and 35 (29.4%) have developed pneumomediastinum [4].

However, the reported patient did not have any evidence of either pneumothorax or pneumomediastinum although he went on to develop pneumoscrotum. Diffusion of air along the retroperitoneum into the scrotum without any leakage into the mediastinum or pleural space is the most likely explanation in this patient.

CONCLUSION

Pneumoscrotum is a rare complication following POEM. Pneumoscrotum per se is benign and can be managed conservatively most of the time. However, the underlying aetiology has to be identified to exclude more sinister pathologies.

REFERENCES

1. Firmanto R., Widia F., Irdam G.A. Pneumoscrotum in patient with pneumothorax: A case report. Urol Case Rep. 2019;27:100915. Published 2019 May 24. doi:10.1016/j.eucr.2019.100915

2. Cochetti G., Barillaro F., Cottini E., et al. Pneumoscrotum: report of two different cases and review of the literature. Ther Clin Risk Manag. 2015;11:581-587. Published 2015 Apr 9. doi:10.2147/TCRM.S77326

3. Khahab M.A. (2019). Peroralendoscopicmyotomy (POEM). UpToDate

4. Ren Z., Zhong Y., Zhou P. et al. Perioperative management and treatment for complications during and after peroral endoscopic myotomy (POEM) for esophageal achalasia (EA) (data from 119 cases). SurgEndosc 26, 3267–3272 (2012). https://doi.org/10.1007/s00464-012-2336-y

CASE REPORT

Case Description: Esophageal Perforation Presenting as Hematemesis: A Rare but Critical Complication of Coronary Intervention

Tharindu K.[1], Piyarathna T.A.C.L.[1]

Affiliation
1 Teaching Hospital Kurunegala

ABSTRACT

Esophageal perforation is a rare but potentially life-threatening complication of coronary angiography and percutaneous coronary intervention (PCI).We present two cases of esophageal perforation following coronary interventions, both presenting with hematemesis. The first patient developed hypovolemic shock post-procedure, while the second was successfully managed non-surgically.Prompt diagnosis and timely management are crucial to preventing further complications and improving patient outcomes. Esophageal perforation should be considered in patients presenting with hematemesis following coronary intervention. Early endoscopic evaluation and appropriate management are essential.

Key words

Esophageal Perforation, Coronary intervention.

INTRODUCTION

Esophageal perforation is a rare but serious complication of various medical procedures, including coronary interventions [1]. While it can present with various symptoms, hematemesis is an unusual manifestation that warrants attention due to its severity and diagnostic challenge [1,2].

CASE-1

A 65-year-old male with a history of hypertension underwent PCI for single-vessel disease. Three hours post-procedure, he developed hematemesis. Urgent upper GI endoscopy revealed deep mucosal tears in the lower esophagus, leading to hypovolemic shock. The patient was managed with blood transfusion and inotropes.

Case - 1
CT images showing oeophageal mucosal tear

CASE-2

A 70-year-old female with type 2 diabetes and hypertension underwent routine PCI. Later, she experienced hematemesis without prior dyspeptic symptoms. Oesophago-Gastro-Duodenoscopy revealed denuded mucosa with extensive wall hemorrhage, suggestive of esophageal perforation. Non-surgical management with a nasogastric tube was successful [2,3].

Correspondence: T. A. C. L. Piyarathna
E.mail: taclpiyarathna@gmail.com

Case - 2
Endoscopy image of oesophageal perforation

DISCUSSION

Esophageal perforation following coronary intervention is rare but critical [1]. Prompt recognition and management are vital for patient outcomes [1].

Both cases underscore the importance of considering esophageal perforation in patients presenting with hematemesis post-coronary intervention [2].

In high-risk patients, such as those with comorbidities, vigilance for this complication is paramount [1]. Early endoscopic evaluation aids in identifying the site of perforation and guiding appropriate management, either surgical or non-surgical [2,3].

Advances in endoscopic techniques and the use of esophageal stents have improved the outcomes of patients managed non-surgically [3].

These cases highlight the need for heightened awareness among healthcare professionals regarding this potentially life-threatening complication.

Further studies are warranted to delineate risk factors and optimal management strategies for esophageal perforation post-coronary intervention [1–3].

Table 1: Summary of Clinical Findings in Presented Cases

Patient	Age/Gender	Procedure	Presenting Symptom	Management
Patient 1	65/Male	PCI for CAD	Hematemesis	Blood transfusion, Inotropes
Patient 2	70/Female	Routine PCI	Hematemesis	Nasogastrictube, Non-surgical management

CONCLUSION

Esophageal perforation is a rare but serious complication of coronary interventions. Timely recognition and appropriate management are key to improving patient outcomes. Clinicians should maintain a high index of suspicion in patients presenting with hematemesis post-PCI.

REFERENCES

1. Brinster C.J., Singhal S., Lee L., Marshall M.B., Kaiser L.R., Kucharczuk J.C. Evolving options in the management of esophageal perforation. Ann Thorac Surg. 2004;77(4):1475-1483.

2. Dasari B.V., Neely D., Kennedy A., et al. The role of esophageal stents in the management of esophageal anastomotic leaks and benign esophageal perforations. Ann Surg. 2014;259(5):852-860.

3. Freeman R.K., Ascioti A.J., Wozniak TC. Postoperative esophageal leak management with the Polyflex esophageal stent. J Thorac Cardiovasc Surg. 2007;133(2):333-338.

CASE REPORT

Case Description: Azygous Continuation of Inferior Vena Cava - Rare Vascular Malformation Which Can Give Rise to Disastrous Outcomes the Unwary

Yapa Y.M.K.A.[1], Abeygunawardhena S. [2], Dalpatadu K.U.A. [3]

Affiliations
1 Gastro Intestinal Surgical Unit, Colombo South Teaching Hospital, Kalubowlia
2 Gastro Intestinal Surgical Unit, National Hospital of Sri Lanka
3 Gastro Intestinal Surgical Unit, Teaching Hospital, Kaluthara

ABSTRACT

Azygous continuation of the Inferior Vena Cava (IVC) is a rare vascular malformation. In this condition, the IVC above the renal vein is interrupted, and venous drainage of the lower body occurs via an abnormally dilated azygous vein. Division of such an azygous vein as a part of oesophagectomy can give rise to post-operative venous hypertension and subsequent death.

In patients with azygous continuation of the IVC, identification and preservation of the azygous vein during oesophagectomy is vital. Therefore, pre-operative image review with this condition in mind is important. If in doubt, revisiting radiological images and seeking vascular assistance can facilitate a better patient outcome.

We report a patient with azygous continuation of the IVC who was diagnosed with adenocarcinoma of the oesophagus. She underwent a successful thoraco-laparoscopic oesophagectomy with preservation of the azygous vein.

Key words

Azygous continuation, Inferior vena cava, Oesophageal malignancy.

INTRODUCTION

Azygous continuation of the IVC is a vascular malformation seen in only 0.15% of the population.[1] It is characterized by interruption of the hepatic part of the IVC during embryological development.[2] (Figure 1) In this condition, venous blood from the lower body is carried to the superior vena cava via an abnormally dilated azygous vein.[2] This can be associated with other congenital anomalies such as cardiac malformations, asplenia, and polysplenia syndrome.[3]

The majority of individuals with azygous continuation of the IVC are asymptomatic.[1] Symptomatic patients may present with bilateral lower limb varicosities, bilateral varicoceles, and recurrent episodes of deep vein thrombosis involving distal and proximal lower limb veins, as well as pelvic and hepatic veins.[1]

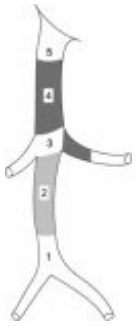


Figure 1(Zafer et al[1])

IVC in coronal plane illustrates thefinal structureof the inferior venacava and its embryologic origin.

1-Iliac segment arises from the posterior cardinal veins; 2-Subrenal segment arisesfrom the right supra-cardinal vein; 3-Renal segment arises from the anastomosisbetween theright supra-cardinal and sub-cardinal veins; 4-Suprarenal segmentarises from the right sub-cardinal vein; 5-Hepatic segment arises from thehepato-cardiac canal.

Correspondence: Y.M.K.A. Yapa
E.mail: krishnayapa@gmail.com

This is an important vascular malformation that a surgeon must be vigilant about during thoracic surgeries, where the azygous vein is routinely divided. In the limited literature describing oesophagectomy in patients with azygous continuation of the IVC, patient outcomes have been satisfactory when correct identification and preservation of the azygous vein were performed during surgery. Division of the anomalous azygous vein has led to unfavorable outcomes.[5] We describe the successful outcome of a patient with oesophageal adenocarcinoma who had azygous continuation of the IVC identified on preoperative image review.

CASE PRESENTATION

A 56-year-old female patient in ASA category I presented with progressive dysphagia of 3 months' duration. Her endoscopic evaluation revealed an ulcero-proliferative growth at the 36–38 cm length of the oesophagus. Histology showed moderately differentiated adenocarcinoma. Staging contrast-enhanced CT of the thorax and abdomen showed a T2N0M0 oesophageal tumor. Further CT review showed a dilated azygous vein (Figure 2). Thus, azygous continuation of the IVC was detected during preoperative image review.

A multidisciplinary team (MDT) discussion recommended thoraco-laparoscopic oesophagectomy with preservation of the azygous vein under vascular surgical team cover. The patient was transferred to a tertiary care center for further management. Intraoperatively, an abnormally dilated azygous vein was noted, and careful dissection of the oesophageal malignancy was performed, preserving the azygous vein.

She had an uneventful postoperative recovery and was discharged on postoperative day 8. She was referred to oncology for further adjuvant treatment and remains asymptomatic one year after surgery.

DISCUSSION

Asymptomatic patients with azygous continuation of the IVC can be recognized with careful preoperative image review. However, due to the rarity of this condition, it can be overlooked. A surgeon must have a high index of suspicion when an abnormally dilated azygous vein is detected during oesophagectomy. Division of the azygous vein in such patients can lead to the development of venous hypertension and subsequent death.[6]

During surgical procedures for oesophageal malignancy, some surgeons preserve, but the majority routinely divide, the azygous vein. Preservation of the azygous vein during oesophagectomy is known to improve postoperative venous return and minimize tissue oedema.[4] However, division of the azygous vein may provide better oncological clearance of the oesophageal malignancy and reduce strain on the gastric conduit caused by the azygous arch.[2]

According to the literature, there are seven similar cases reported. Of these, in three cases the azygous vein was preserved, and all three patients had good outcomes. In the remaining four cases where the azygous vein was divided, three patients died due to subsequent complications.[5] (Table 1). Our patient had a satisfactory outcome due to preoperative detection and careful preservation of the azygous vein.

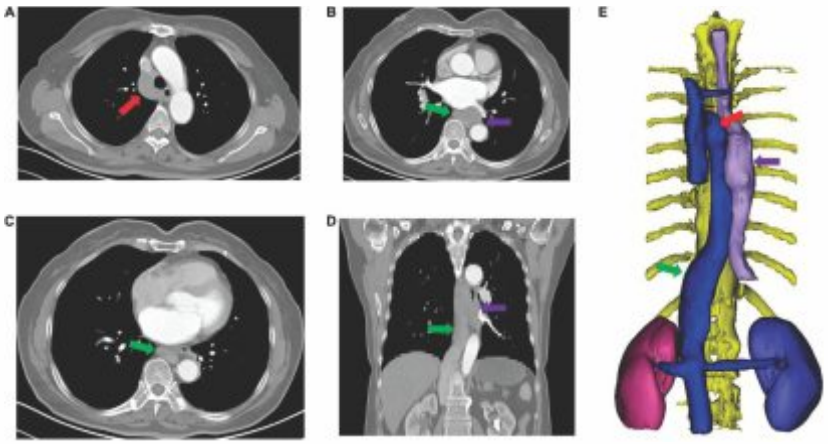


Figure 2 -CT
reconstruction showing azygos continuation of the inferior vena cava

(A–D) Show the enlarged arch of the azygos vein and azygos vein, (E) Shows hepatic segment absence of the inferior vena cava with azygos continuation. The red arrow shows the enlarged arch of the azygos vein; the green arrow shows the azygos vein; the purple arrow shows the tumor.(Zhang et al [5]).

Table 1 – Reported data on patients with oesophageal malignancy and azygous continuation of IVC who underwent oesophagectomy and their outcome[5]

Author	Country	Age, Sex	Surgery	Other malformations	Azygous arch	Discharge status
Bronshtein et al	Hungary	52y, male	Open	No	Protected	Alive
Veltman et al	Spain	62y, male	Open	No	Divided	Died within 1 day
Wang et al	China	52y, male	Open	No	Divided	Died within 15hours
Wang et al	China	56y, male	Open	Double IVC	Protected	Alive
Palotas et al	Netherlands	62y, female	Open	No	Divided	Alive
Martin-Malagon et al	Japan	58y, male	NR	Double IVC	Protected	Alive
Zhang et al	China	61y, female	Minimally invasive	No	Divided	Died within 9 days
Current case	Sri Lanka	56y, female	Minimally invasive	No	Protected	Alive
IVC – Inferior Vena Cava, y - Year						

CONCLUSION

Azygous continuation of the IVC is a rare condition but can lead to fatal outcomes if unrecognized. Therefore, thorough pre-operative imaging review with this condition in mind is of utmost importance. During surgery, a high degree of suspicion is essential when an abnormally dilated azygous vein is encountered. In uncertain situations, revisiting imaging and preserving the azygous vein with the assistance of a vascular team can lead to better patient outcomes..

REFERENCES

1. Koc Z. & Oguzkurt L. (2007) 'Interruption or congenital stenosis of the inferior vena cava: Prevalence, imaging, and clinical findings', European Journal of Radiology, 62(2), pp. 257–266. doi:10.1016/j.ejrad.2006.11.028.

2. Martín-Malagón A. et al. (2008) 'Ivor Lewis esophagectomy in a patient with enlarged azygos vein: A lesson to learn', The Annals of Thoracic Surgery, 85(1), pp. 326–328. doi:10.1016/j.athoracsur.2007.06.039.

3. Mandato Y. et al. (2019) 'Azygos and hemiazygos continuation: An occasional finding in emergency department', Radiology Case Reports, 14(9), pp. 1063–1068. doi:10.1016/j.radcr.2019.06.003.

4. Fujiwara Naoto & Sato, Hiroshi & Miyawaki, Yutaka & Ito, Misato & Aoyama, Junya & Ito, Sunao & Oya, Shuichiro& Watanabe, Kenji & Sugita, Hirofumi &Sakuramoto, Shinichi. (2020). Effect of azygos arch preservation during thoracoscopic esophagectomy on facilitation of postoperative refilling. Langenbeck's archives of surgery. 405. 10.1007/s00423-020-01994-w.

5. Zhang Y. et al. (2022) 'Case report: Esophagectomy and Azygos continuation of the inferior vena cava: A lethal combination', Frontiers in Cardiovascular Medicine, 9. doi:10.3389/fcvm.2022.780646.

6. Shen Y. et al. (2015) 'Oesophagectomy in a patient with azygos vein continuation of the inferior vena cava: Report of a case', World Journal of Surgical Oncology, 13(1). doi:10.1186/s12957-015-0625-3.

CASE REPORT

Case Description: Colovesical Fistula, A Rare Manifestation of the Left Colon Cancer

Isthiyak A.R.M.[1], Banagala A.S.K. [1]

Affiliation
1 General Surgical Unit, National Hospital of Sri Lanka

ABSTRACT

Colovesical fistulas (CVFs) are infrequent complications, and those of malignant origin are particularly rare and often pose diagnostic challenges. We present the case of a colovesical fistula of malignant origin, which is unusual. A patient was admitted to our unit with suspected colovesical fistula due to lower abdominal pain, pneumaturia, and fecaluria. The diagnosis was confirmed using computed tomography, water-soluble contrast enema, and cystography.

Colovesical fistulas are rare in clinical practice and are an uncommon presentation of colon cancer. CVF should be suspected in patients presenting with pneumaturia, fecaluria, lower abdominal pain, and a palpable suprapubic mass. Cystoscopy, computed tomography, and barium enema can assist in identifying the underlying etiology in most cases.

Key words

Colovesical fistula, Colon cancer.

INTRODUCTION

Colovesical fistulas (CVFs) are uncommon, with more than 80% arising as complications of diverticulitis. CVFs account for 20–30% of advanced malignancies, which typically originate in the abdominal or pelvic cavities [1]. While colon adenocarcinomas are the most frequent malignant cause, tumors from other pelvic organs can also lead to CVFs [2,3]. Regardless of origin, CVFs generally occur in advanced stages of neoplastic disease [4,5].

In this case study, a colovesical fistula was the initial presenting feature of colon cancer. We present this case as it represents a rare surgical finding and an atypical manifestation of left-sided colon cancer.

CASE REPORT

A 73-year-old previously healthy female, with a history of hysterectomy for uterine fibroids, presented to the urology clinic with a three-month history of recurrent urinary tract infections.

On further questioning, she also reported pneumaturia and fecaluria. She denied any history of recurrent abdominal pain, altered bowel habits, rectal bleeding, or weight loss. Physical examination, including digital rectal examination, was unremarkable except for mild lower abdominal tenderness.

Basic investigations were within normal limits, and urine culture revealed a mixed bacterial growth. Abdominal ultrasound revealed a 7 × 6.5 cm heterogeneous lesion located supravesically and closely related to the sigmoid colon. A contrast-enhanced abdominal CT scan showed an intravesical air-fluid level.

The diagnosis of colovesical fistula was confirmed by cystoscopy, and biopsy results indicated a well-differentiated adenocarcinoma. Colonoscopy confirmed the presence of left-sided colon cancer, with no synchronous lesions identified.

Based on these findings, a diagnosis of colovesical fistula secondary to sigmoid adenocarcinoma was made. The patient underwent sigmoidectomy and partial cystectomy, followed by immediate colorectal anastomosis and cystorrhaphy. Her post-operative recovery was uneventful but slow, and she was discharged on post-operative day ten.

Correspondence: A R M Isthiyak
E.mail: dristhiyak@gmail.com

Figure 1-Cystoscopic view of fistula opening

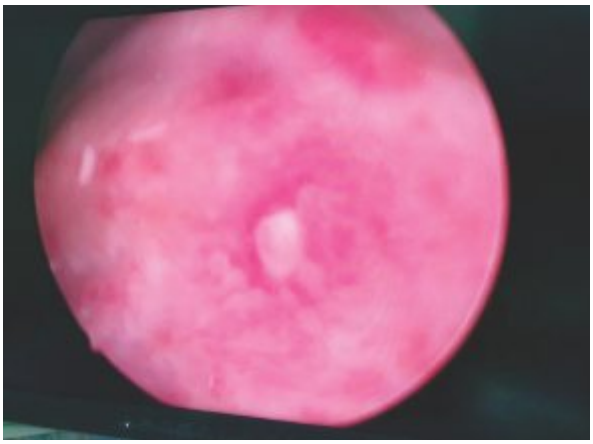


Figure 2- Intraoperative demonstration of a fistula between sigmoid colon and bladder

DISCUSSION

Colovesical fistula — an abnormal communication between the colon and bladder — is a recognized disease entity in urology. The sigmoid colon is the most commonly involved segment. Among enterovesical communications, colovesical fistula (CVF) is the most frequent (70%), followed by ileovesical (16%) and rectovesical (11%).

The fistulous tract may form as a result of inflammation, malignant tumor infiltration, or degenerative changes in the involved organs. This has even been reported after fecal diversion.

In 62% of cases, the dome of the bladder is found to be the site of the fistulous tract opening. The posterior wall and trigone are involved in 28.5% and 9.5% of cases, respectively [6].

CVF is more common in males, with a male-to-female ratio of 3:1, and the peak incidence occurs in the sixth and seventh decades of life [1,2].

The lower incidence in females is attributed to the interposition of the uterus between the bladder and sigmoid colon [7]. Most women who develop fistulas have had a previous hysterectomy. Diverticular disease (56.3%) is the most common cause of colovesical fistula, although fistula formation is a less common sequela of this condition (2%).

Other causes include adenocarcinoma of the colon (20%), inflammatory bowel disease (Crohn's disease) (9%), iatrogenic trauma (3%), and radiotherapy [8]. Squamous cell carcinoma of the bladder and cervical cancer have also been reported as rare causes [8].

Most patients (>90%) with colovesical fistula present with recurrent urinary tract infections and dysuria. Pneumaturia occurs in 70% of cases and fecaluria in 36% — both are considered pathognomonic signs of CVF. Emphysematous cystitis, an extremely rare entity, is another possible cause of pneumaturia.

For diagnosis, cystoscopy can visualize the lesion in nearly 90% of patients. In some cases, CT with contrast administered rectally helps localize the abnormal communication. Cystoscopy may reveal the fistula opening, signs of chronic cystitis, and intravesical air, and allows for biopsy.

CT typically shows intravesical air-fluid levels, wall thickening, and helps identify the underlying etiology (e.g., diverticular disease or sigmoid tumor). Bannura et al. [1] describe contrast-enhanced CT as the gold standard for diagnosis, followed by barium enema and cystoscopy.

The surgical approach depends on the underlying cause. Treatment may be a one-stage or multistage procedure [2]. Resection of the diseased bowel segment with primary anastomosis is commonly performed.

Universally, the procedure involves sigmoidectomy with immediate colorectal anastomosis and partial cystectomy with cystorrhaphy. Omental flap interposition is sometimes used to reduce the risk of recurrence.

In multistage procedures, resection and anastomosis are performed along with stoma creation. Sole defunctioning colostomy is unlikely to result in spontaneous closure of the fistula tract [10]. It may be considered in recurrent or radiation-induced cases.

Conservative management is reserved for advanced malignancies or patients unfit for surgery. Laparoscopic approaches are gaining popularity and have shown good outcomes [9,10].

CONCLUSION

Colovesical fistula is a rare entity in both gastrointestinal and urological practice and is even rarer as a presentation of left-sided colon cancer. It should be suspected in all patients presenting with pneumaturia, fecaluria, and lower abdominal pain. Diagnosis can be established clinically and confirmed through cystoscopy and imaging.

REFERENCES

1. Bannura C., Guillermo, Barrera E., Alejandro, Cumsille G., Miguel A., et al. Results of surgical treatment of colovesical fistulas of diverticular origin. Rev Chil Cir. 2010;62(1):49–54.

2. Scozzari G., Arezzo A., Morino M. Enterovesical fistulas: diagnosis and management. Tech Coloproctol. 2010;14(4):293–300.

3. Golabek T., Szymanska A., Szopinski T., et al. Enterovesical fistulae: aetiology, imaging, and management. Gastroenterol Res Pract. 2013; 2013:617967.

4. Castillo C. Octavio, Rodríguez-CarlinArquímides, Campaña V., Gonzalo, et al. Fístula colovesical secundariaaenfermedad diverticular: cirugíalaparoscópicaelectiva. Rev Chil Cir [Internet]. 2012;64(3): 278–281.

5. Zárate A., López-Köstner F., Loureriro C., et al. Results and complications in patients with sigmoid cancer: laparoscopic versus laparotomy. Rev Chil Cir. 2008;60(1):29–34.

6. Aldrete J.S., Remine W.H. Vesicocolic fistula- A complication of colonic cancer. Arch surg. 1967; 94: 627-37.

7. Kovalcik P.J., Veidenheimer M.C., Corman M.L., Colloer J.A. Colovesical fistula. Dis colon Rectum 1976; 19: 425-427.

8. Pollard S.G., Macfarlane R., Greatorex R., Everett W.G., Hartfall W.G. Colovesical fistula. Ann R Coll Surg Engl 1987; 69: 163-5.

9. McConnell D.B., Sasaki T.M., Vetto R.M., Experience withcolovesicalfistula.AmJsurg1980; 140:80-4.

10. Garcea G., Majid I., Sutton C.D., Patten den C.J., Thomas W.M. Diagnosis and management of colovesical fistula; Six year experience of 90 consecutive cases. Colorectal diseases 2006: 8:347-352.