ORIGINAL ARTICLE

INTERVENTIONAL BRONCHOSCOPY: AIN SHAMS UNIVERSITY HOSPITAL EXPERIENCE

By

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Bronchoscopy has evolved considerably in our hospital. During recent years, we implemented the concept of interventional bronchoscopy (IB) for the first time in Egypt. IB is defined as a diagnostic and invasive therapeutic interventions that extend beyond routine Flexible bronchoscopy. In this article, we will review our clinical experience with IB during the last five years as regards methodology requirements, available equipments, clinical applications and presentation of selected research outcomes. We retrospectively reviewed all available reports of therapeutic IB performed in our bronchoscopy unit to determine the indications, application sites, methods of disobliteration and complications of therapeutic IB. In addition, recent interesting research work done on endobronchial ultrasound, autofluorescence bronchoscopy, Nd: YAG laser bronchoscopy and endobronchial electrocautery was reviewed. In order to perform an interventional procedure, well-equipped facilities, trained personnel, preprocedure evaluation, and monitoring are mandatory. More than 500 invasive therapeutic interventions were performed in the past 5 years. The results and analysis of these IB were reviewed. We concluded from the presented data that IB has quickly gained recognition and drawn interest with its promising results. Much effort is needed to overcome challenges facing IB awareness, financial concerns, training and verification of competency in our country.

INTRODUCTION

It is now more than 45 years since the establishment of bronchoscopy practice in the chest department Ain Shams university hospital; since then, it became widely available, their use become an essential part of respiratory medicine practice.

Rigid bronchoscopic (RB) applications at the beginning were widely practiced in our hospital for diagnostic purposes. Its use evolved considerably since mid 90`s with the introduction of endobronchial laser for therapeutic applications. In 1972, flexible bronchoscopy (FB) was introduced for the 1st time in Egypt in Ain Shams university hospital. Its use progressed

rapidly in our hospital with the use of various associated diagnostic techniques and became the routine practice of airway examination. With the beginning of the new millennium complete renewal of the bronchoscopy equipments with establishment of an up-to-date interventional bronchoscopy unit was achieved.

Interventional bronchoscopy (IB) is defined as diagnostic and invasive therapeutic interventions that extend beyond routine FB.1 Diagnostic and therapeutic bronchoscopic procedures usually practiced in our hospital include: rigid bronchoscopy, transbronchial needle aspiration (TBNA), autofluorescence bronchoscopy (AFB), and endobronchial ultrasound (EBUS), Nd: YAG laser bronchoscopy, endobronchial electrocautery, cryotherapy and airway stent insertion. These procedures are used in diagnosis and treatment of a wide spectrum of pulmonary diseases and in some clinical situations more than one modality is applied.

In this article, we will review our clinical experience with IB during the last five years as regards methodology requirements, available equipments, clinical applications and presentation of selected research outcomes.

MATERIALS AND METHODS

Reports of all available therapeutic interventional bronchoscopies performed at the chest department Ain Shams university hospital during the last five years were retrospectively reviewed to determine the indications, applications sites, methods of disobliteration and complications of therapeutic IB. In addition, recent interesting research work done on both diagnostic and therapeutic IB was reviewed.

In our department, we follow the international standards of practice as regards the performance techniques of different IB procedures which is reviewed in details in ERS/ATS statement on interventional Pulmonology.[1]

Methodology requirements:

- ***Facility:*** Bronchoscopy is performed in the respiratory intensive care unit which includes a bronchoscopic suite for diagnostic FB interventions and an operating room equipped with a bed, anesthesia machine, cardiorespiratory monitoring and resuscitation equipments for invasive therapeutic interventions. Patient preparation and recovery is performed in an attached intermediate care room.

- ***Personnel:*** For diagnostic FB interventions, a bronchoscopist and a current training resident are present with a qualified bronchoscopy nurse and an additional assistant may attend whenever indicated. While for therapeutic interventions performance using rigid scope a team of 2 bronchoscopists, 2 anesthesiologists and 2 qualified bronchoscopy nurses attend and usually work together frequently enough to maintain their competence.

  Bronchoscopist performing IB has extensive experience with both rigid and fiberoptic bronchoscopy. The majority received training courses on IB abroad as well as locally, and to maintain their competency a minimum of 10 procedures per year is achieved.

- ***Preprocedure evaluation:*** Before any procedure, history, previous therapies, thorough physical examination and radiological lesion identification must be fulfilled. Laboratory tests requested (e.g. complete blood count, coagulation profile, electrocardiogram (ECG), spirometry, arterial blood gases) depends on the nature of the procedure and patient known risk factors.

- ***Anesthesia and monitoring:*** Diagnostic interventional bronchoscopy was usually performed with FB under topical lidocaine anesthesia, anticholinergic premedication, oxygen supplementation and rarely incremental doses of midazolam conscious sedation was needed. Monitoring of this diagnostic intervention was usually through continuous pulse oximetry and sometimes ECG

observation in risky patients with available resuscitation equipments ready for use whenever needed. Invasive therapeutic procedures were routinely done under general anesthesia and the anesthesiologist was responsible to induce and monitor anesthesia.

Equipments: The available equipments include:

Flexible bronchoscopy: Fiberoptic bronchoscopes, Videobronchoscopes (Pentax EB-1530 T3), TV monitor, printer, video documentation, suction machine, cleaning machine & cabinets.

Accessories: Forceps, brushes, TBNA & catheters.

Autofluorescence bronchoscopy (SAFE 1000 device-Pentax)

Endobronchial ultrasound (EU-M30S, Olympus)

Rigid bronchoscopy set (Bryan300)

Interventional equipments: Laser (Laser sonic 4900), cryotherapy & electrocautery (ERBE -ICC 200).

The following studies done in our department in the field of IB were selected to present their outcomes:

Madkour[2] studied the role of EBUS in assessment of lung cancer. Two hypotheses were tested in this study: Addition of EBUS for the assessment of lung cancer provides valuable additional information beyond computer tomography (CT) and FB alone and hence improve diagnosis; and the use of EBUS under topical anesthesia is practicable despite some prolongation in the examination time. Eighty one consecutive subjects were recruited with suspected lung cancer. EBUS was performed as an adjuvant to bronchoscopy using midazolam sedation, lidocaine mucosal anesthesia and supplemental oxygen. Additional information was provided by EBUS over conventional methods (FB & CT), agreement of EBUS image with cyto-histology and FB-CT findings, EBUS complications, patients tolerability under topical anesthesia and diagnostic yield of EBUS assisted biopsy techniques.

Salem[3] compared between endobronchial electrocautery versus Nd-YAG laser in management of airway obstruction. The study included 30 patients with different tracheobronchial obstructions. Fifteen patients were treated by Nd-YAG laser and the other 15 treated by electrocautery randomly. The following parameters (symptomatology, spirometry, ABG, radiology and degree of airway obstruction) were assessed before and after treatment to evaluate the response to treatment. In addition complications encountered from each therapeutic modality and median survival after therapy were recorded.

Osman[4] evaluated the role of autofluorescence bronchoscopy in pre and post operative assessment of resectable lung cancer. The study tested two hypotheses: 1-AFB allows better localization of synchronous tumors and estimation of resection margin in resectable lung cancer. 2- AFB allows better detection of early recurrence and second primaries in the follow up of resected lung cancers.
The study enrolled 40 patients classified into two groups. The preoperative group included 25 patients with possible resectable lung cancer. The post operative group included 15 patients follow up resected for cure of lung cancer.

RESULTS

More than 500 invasive therapeutic interventions were performed in the past 5 years. The indications, application sites, success and complications rate of these interventions are detailed in Tables 1-4. Most of the cases were advanced cancerous lesions and the aim of therapeutic bronchoscopic interventions in these patients was palliation. The main indications in these patients were usually to relieve clinically significant dyspnea, post obstructive pneumonia, haemoptysis or when there is > 50% obstruction of the airway lumen.

Table 1. Indications of therapeutic interventional bronchoscopy (500 procedures in 255 patients).

Disobliteration & mechanical debulking	Number	%
Laser	120	47
Electrocautery	75	29
Cryotherapy	60	24
Total	255	100

Table 2. Application sites of interventional bronchoscopy.

Site	Number	%
Trachea	65	25
Central bronchi	161	63
Peripheral bronchi	29	12
Total	255	100

Table 3. Laser success rate (N=75 patients/125 procedures).

Improvement	Number	%
Symptomatology & Functional	69	92

Table 4. Laser complications rate (N= 75 patients / 125 procedures).

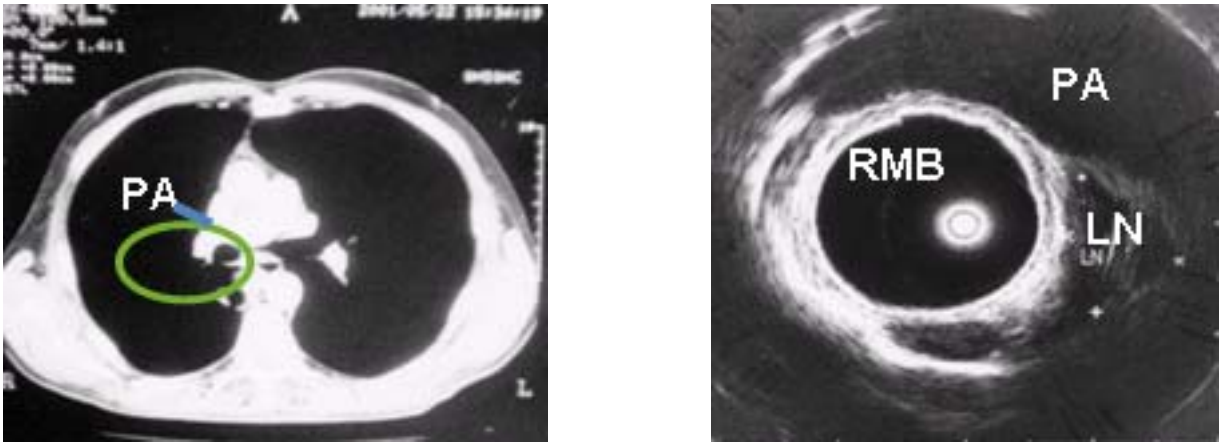
Complications	Number	%
Hemoptysis	4	5
Respiratory failure*	2	3
Total	6	8

* Intra operative death.

In diagnostic interventional bronchoscopy our usual indications in case of TBNA include diagnosis and staging of bronchogenic carcinoma by sampling of mediastinal and hilar lymph nodes, peribronchial/tracheal masses, submucosal lesions. While fluorescence bronchoscopy, was usually performed to identify premalignant and malignant central airways mucosal abnormalities and in predicting the line of surgical resection. EBUS was usually performed to accurately define airway invasion versus compression from tumors, to stage the depth of tumor invasion in the bronchial wall, guide TBNA of hilar and mediastinal lymph nodes.

The results of the study done by Madkour[2] showed the following: Out of the 81 cases with suspected lung cancer, 54 cases of lung cancer

could be pathologically verified. In 54 lung cancer cases, EBUS provided additional information in 41 cases (76%), in which 25 additive lymph nodes (LNs) were detected, depth of tumor invasion was determined in 29 cases and compression and infiltration of pulmonary vessels in 4 cases. In addition, it was helpful in explanation of bronchoscopic findings in 26 cases (48%) and exclusion of mediastinal structures infiltration. On the other hand, FB and CT provided additional information in 7 cases (13%). In all studied cases, EBUS assisted TBNA and had a diagnostic yield of 83% (N=23) in peribronchial lesions, 76% in mediastinal, hilar and intrapulmonary adenopathy and 78% in extra-luminal lesions. Nine of the malignantly diagnosed LNs (33%) were additionally provided by EBUS over conventional methods (Fig. 1). EBUS addition could change nodal descriptors (N) in 6 cases, tumor descriptors (T) in one case and patient stage in 5 cases, but without any subsequent therapeutic consequences. However, it altered the subsequent therapeutic modality chosen in another 2 cases. The complications encountered in all studied cases are shown in Table 5. The procedure is completely tolerated in 77 %, partially in 22% and not tolerated in one case only. There is an average increase in examination time of 13 minutes, constituting 41% of total time of bronchoscopy. The difficulties in instrument handling were in balloon sheath preparation before and during use, US probe, imaging artefacts, instrument adjustment problems and instrument orientation problems.



A **B**

Fig 1. CT scan cut (a) shows pulmonary artery (PA) anterior to Rt. main bronchus, with no evidence of enlarged LN in this area (circle). EBUS (b) in right main bronchus (RMB), showing echo free area of the pulmonary artery (PA) anteriorly. An additional enlarged right hilar LN (#10R) measuring 12 x 10 mm is seen laterally, changing the patient's nodal stage after TBNA.

Table 5. Complications of EBUS in all studied cases.

Complications	Desaturation		Cough		Bleeding		Tachycardia	
	N	%	N	%	N	%	N	%
Mild	3	4	10	12	-	-	1	1
Moderate	4	5	4	5	-	-		-
Aborted examination			1	1	-	-	-	-
Total	7	9	15	18	-	-	1	1

N = number.

The results of the study done by Salem[3] showed the following: The symptomatology, spirometry, ABG and airway obstruction improved significantly after laser therapy as well as after electrocautery. Comparison between two modalities is shown in Tables 6-9. The radiology and bronchoscopic picture before and after laser therapy for a case of malignant tumor obstructing right main bronchus are shown in (Fig. 2).

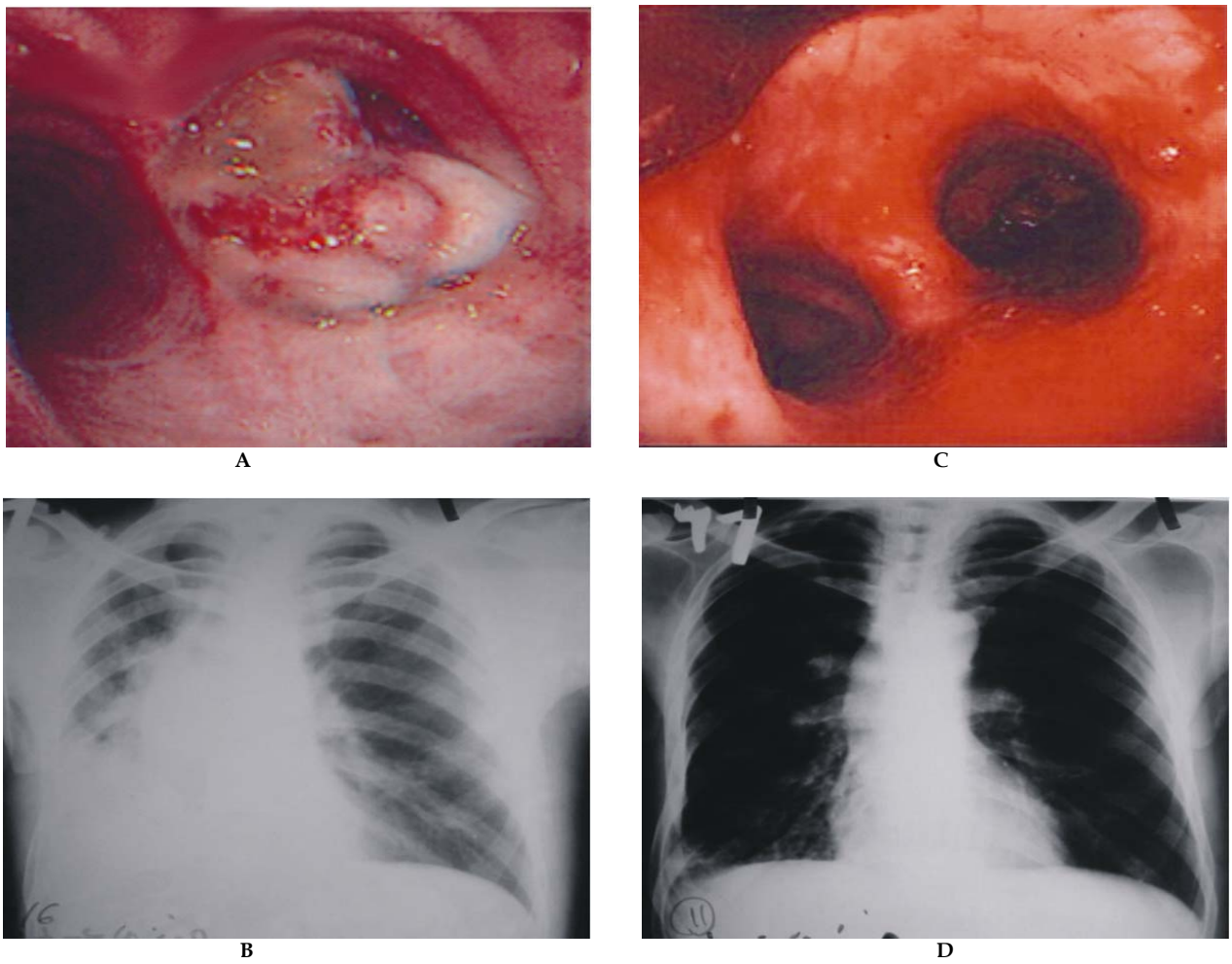


Fig 2. Bronchoscopic picture showing tumor mass (a) obstructing right main bronchus with corresponding chest x-ray showing (b) partial right lung collapse. After laser therapy, the right main bronchus (c) is completely patent endoscopically and the lung is completely inflated (d) in chest x-ray.

Table 6. Comparison between laser and electrocautery groups as regards improvement of symptoms after treatment.

Symptom	Laser	Electrocautery	P
Dyspnea	48.7%± 10.5	42.9% ± 8.6	< 0.01
Haemoptysis	88.5% ± 11.3	78.5% ± 10.6	< 0.05
Cough	70.6% ± 8.8	61.5% ± 8.9	< 0.05
KPS	15.8% ± 5.9	13.1% ± 6.6	> 0.05

KPS=karnofsky performance scale.

Table 7. Comparison between laser and electrocautery groups as regards airway response.

Group	Laser
Laser	59.3%± 10.6
Electrocautery	53% ± 9.5
P	< 0.05

Table 8. Comparison between laser and electrocautery groups as regards improvement of pulmonary function tests (PFT) after treatment.

PFT	Laser	Electrocautery	P
FVC	16%± 4.2	15.8% ± 6.6	> 0.05
FEV1	10% ± 5	12.6% ± 4.9	> 0.05

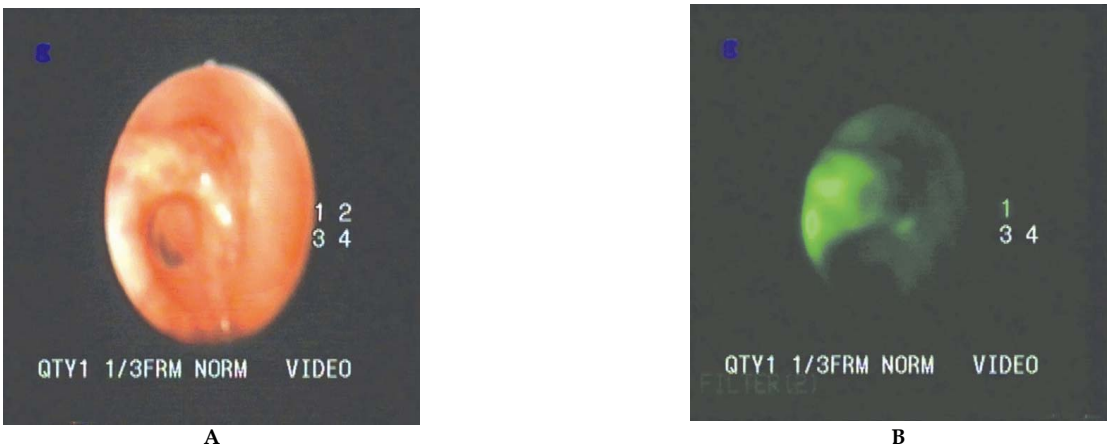
FVC= forced vital capacity FEV1= forced expiratory volume in first second.

Table 9. Comparison between laser and electrocautery groups as regards complications.

PFT	Laser	Electrocautery
Bleeding	2	3
Pneumonmediastinum		1
Hypercarbia		1
No complication	13	10
P	> 0.05	

The results of the study done by Osman[4] showed the following: The additional information detected by AFB that significantly altered the choice of further therapeutic modality selected in preoperative group was 4 out of 25 cases (16%). Three cases planed for lobectomy were shifted to pneumonectomy because AFB detected invasion of resection margin. One case planed for pneumonectomy proved by AFB to be inoperable due to invasion of carina.

AFB significantly altered the choice of further therapeutic modality selected in 2 out of 15 cases (13%) in the post operative group through detection of early preneoplastic changes in 2 cases (Fig. 3).



A B

Fig 3. Shows stump of left upper lobectomy non suspicious by WLB and suspicious by AFB.

The sensitivity achieved by combined WLB+AFB was 100%, while that for WLB alone was 50%, and it was 93.75 %for AFB alone. The specificity of combined mode was 98.63% while that of WLB alone was 98.70% and it was 93.51% for AFB. The complementary effect between both methods was represented as 98.75% validity of all diagnostic preneoplasia.

DISCUSSION

This study highlighted the current status of bronchoscopy practice in the chest department Ain Shams university hospital over the last 45 years, therapeutic bronchoscopy was the nidus for the growth of the IB field.

Advances in bronchoscopic tools and techniques have provided interventional pulmonologists with a wide array of therapeutic options that can be used individually or in combination to match the needs of all patients.[5] RB was the only available tool to access the lower airways in our department for more than 17 years, then faded with the introduction of FB.

Our renewed interest stemmed from the recognition of the advantages of RB in IB such as the ability to ventilate the patient while intervening in the airways, the capability of using large-suction catheters to aspirate blood or debris, and the utility of the barrel of the rigid bronchoscope in "coring out" tumor tissue and dilating stenoses.[5]

A remarkable finding is the small total number of invasive therapeutic interventions (~500 examinations) performed over the last 5years, this maybe due to lack of awareness and referral by doctors.

Methodology requirements are difficult for any newly implemented modality at the beginning. Currently, our standards which depends on a well-equipped facility, trained personnel, preprocedure evaluation and monitoring are comparable with the international standards of practice.[1]

Investing in up-to-date IB equipments is not an easy task, but quite a difficult one, as we are facing maintenance of such expensive equipments and post-sale servicing especially in a hospital providing free medical care.

Tumor destruction was accomplished with heat therapy (laser therapy& electrocautery) they are often used to coagulate tissue prior to mechanical debridement, in a fashion known as heat-assisted mechanical debulking.5 Increasingly, electrocautery is replacing laser therapy in our department the same as abroad as a method of choice for coagulation and vaporization of tumors in the airways due to it's lower cost, less cumbersome setup, easier use and more favorable safety profile.[5]

Relief of symptoms and restoration of airway lumen was achieved significantly after both laser and electrocautery, but more in favor of laser when comparing the two modalities Tables 6,7.[3] This was comparable with results of similar studies.[6,7]

Complications encountered from both laser and electrocautery were negligible and insignificantly comparable between both modalities[3] Table 9. and only 2 cases died secondary to respiratory failure Table 4. These results seem acceptable when compared with other similar studies.[6,8]

AFB and EBUS provided beneficial information that is beyond vision of conventional WLB: premalignant or early malignant mucosal transformation with AFB; and structural characteristics of the airway wall and adjacent tissue with EBUS. Recently, it has been found that most identified abnormalities by AFB are of a metaplastic or dysplastic nature and endobronchial carcinoma in situ seems overall to be an uncommon event.[5]

This sparkle our interest to test new roles for AFB.[4] It has been found from our study[4] and other studies[9,10] that AFB allows better localization of synchronous tumors and estimation

of resection margin in resectable lung cancer as well as detection of early recurrence and second primaries in the follow up of resected for cure lung cancer.

EBUS application in our department under topical anesthesia was a well-tolerated procedure, associated with mild infrequent side effects Table 5.

EBUS assistance improved diagnostic yield (78%) of TBNA in extrabronchial lesions. It provided beneficial additional information to bronchoscopy and CT, as without EBUS 33% of malignant diagnosed LNs and change of 11% nodal descriptor would not be possible, with the subsequent effects on morbidity from unneeded surgical procedures and considerable cost savings.

Finally, IB has quickly gained recognition and drawn interest with allure in "instant gratification" associated with immediate procedural success, the introduction and use of new technologies and treatments, and the sense of empowerment felt with the ability to perform a series of therapeutic interventions by a single physician for the benefit of the patient. However, the reality does not mirror the perceived image, and there are numerous problems facing IB. The territorial battles with other disciplines, financial concerns, training, verification of competency and lack of rigorous scientific research in this field are the main challenges and future directions facing IB.[5]

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