

Ultrasound-guided percutaneous Tru-cut needle biopsy for diagnosing paediatric abdominal tumours: an experience of a single oncology centre in Iraq

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ABSTRACT

INTRODUCTION: Ultrasound-guided core needle biopsy of abdominal and pelvic masses in adults has gained tremendous popularity. However, the same treatment in children is not as popular because of apprehensions regarding inadequate tissues for the biopsy and accidental puncture of vital organs.

OBJECTIVE: To evaluate the accuracy of ultrasound-guided Tru-cut needle biopsy as a dependable method for diagnosing solid abdominal tumours among paediatric patients.

METHODS: This is a single-centre, retrospective cohort study of ultrasound-guided Tru-cut needle biopsy, which was done at the Child's Central Teaching Hospital (CCTH) in Baghdad, Iraq, from 1st January 2019 to 31st December 2020. Children under the age of 15 years who were referred from the oncology department for diagnosis of solid abdominal masses through ultrasound-guided Tru-cut needle biopsy were included in this study. The biopsy was done by an experienced paediatric surgeon in the radiological department.

RESULTS: We included 43 patients in this study. The mean age is 3.9 ± 2.422 years, 23 (53.5%) were male, and 20 (46.5%) were female. In 40 patients (93%), the tissue sample was adequate from the first trial, while we needed a second trial to get sufficient tissue in the other three patients (7%). Whether in the first or second trial, 41/43 (95.3%) patients were diagnosed by Tru-cut needle biopsy, and 2 (4.7%) patients were diagnosed by open biopsy. The tru-cut needle biopsy diagnosis was 18 (44%) non-Hodgkin's lymphoma, 13 (32%) neuroblastoma and 10 (24%) nephroblastoma. The overall success rate of diagnosis by tru-cut needle biopsy was (95.1%). The success rate of diagnosing non-Hodgkin's lymphoma, neuroblastoma, and nephroblastoma by tru-cut needle biopsy was 100, 92, and 90%.

CONCLUSION: Ultrasound-guided percutaneous tru-cut needle biopsy for abdominal, retroperitoneal and pelvic paediatric solid tumours is an easy, safe, and accurate procedure. It can provide sufficient diagnosis in solid abdominal tumours of paediatric age.

Key words: Tru-cut biopsy, ultrasound, paediatric, abdominal tumours.

INTRODUCTION

Image-guided percutaneous needle biopsy (PNB) is the insertion of a needle into a suspected lesion or an organ to obtain tissue or cells for diagnosis under the guidance of imaging techniques such as ultrasound (US), fluoroscopy, computed tomography (CT) or magnetic resonance imaging (MRI), cone-beam CT (CBCT) and positron emission tomography CT (PET-CT). The imaging technique adopted

depends on the lesion type, location, patient compliance, technique availability and operators' preferences.¹

Ultrasound-guided core needle biopsy of abdominal and pelvic masses in adults has gained tremendous popularity. However, the same intervention in children is not as popular because of the fear of inadequate tissues for the biopsy and accidental puncture of vital organs. Ultrasound-guided core needle biopsy is

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an efficient, minimally invasive, accurate, and safe diagnostic method that can be applied to manage pediatric patients' abdominal or pelvic mass.²⁻⁴

Tru-cut needles are hollow needles, 9–20G, with a cutting mechanism that extracts tissue sufficient for histological analysis; the shape of cores is half-cylindrical. The capture mechanism changes according to the manufacturer and can be fully automatic. How far the cutting needle is advanced when fired changes, and this feature should be considered when planning the biopsy.

Tru-cut needles are composed of an outer cannula and inner notched trocar, in which a tissue specimen is cut, trapped and withdrawn. Before introducing the needle, the inner trocar is drawn into the outer cannula. Once the needle is in place, the trocar is advanced, and its correct position is checked. The cutting system is then activated according to the manufacturer's instructions. The notched trocar containing the specimen is withdrawn into the outer cannula before removing the device.¹

Image-guided PNB can be used to establish the nature of the diffuse parenchymal disease, obtain material for microbiological analysis in suspected or known infections, establish the benign or malignant nature of a suspected tumour, classify and stage malignant tumours, and obtain material for molecular analysis. Image-guided PNB is a relatively non-invasive procedure. Thus, absolute contraindications are rare, including lack of safe access, non-correctable coagulopathy and refusal of consent. Relative contraindications include coagulopathies, the inability of the patient to cooperate (general anaesthesia may be considered), and significant comorbidities (i.e., haemodynamic or respiratory instability).¹

In our centre, ultrasound-guided Tru-cut needle biopsy was recently introduced. Previous experience and data are lacking, so this study is designed to evaluate the accuracy of ultrasound-guided True cut needle biopsy

in the diagnosis of solid abdominal tumours among paediatric patients below the age of 15 years at the Child's Central Teaching Hospital (CCTH) in Baghdad, Iraq.

METHODS

Setting and Design: This is a single-centre, retrospective descriptive study of ultrasound-guided Tru-cut needle biopsy, conducted at the Child's Central Teaching Hospital (CCTH) in Baghdad, Iraq, from 1st January 2019 to 31st December 2020.

Ethical consideration: the research ethics committee of Al-Karkh Health Directorate approved the protocol of this study. The patient's custodian signed written informed consent after being informed about the study's aims and the potential benefits and adverse events that may occur from this procedure.

Case definition; inclusion and exclusion criteria: We enrolled children under the age of 15 years who were referred from the oncology department at CCTH to diagnose solid abdominal mass by ultrasound-guided Tru-cut needle biopsy. We excluded haemodynamically unstable children, those had inaccessible mass or whose custodian had refused to do the procedure.

Procedure: Each enrolled child has been examined clinically with complete laboratory investigations, especially those related to the screening of the clotting system. We used ultrasonography and CT/MRI to fully evaluate the site of the lesion, its size, exact location, relation to nearby structures, vascularity, and accessibility to true-cut needle biopsy. An experienced paediatric surgeon did the procedure at the radiology department with the help of an experienced radiologist

We performed 46 Tru-cut needle biopsies for 43 children using 14 G and 16 G Tru-cut disposable sterile devices. We sterilise the skin over the mass and inject the child with sedative and local anaesthetics. The radiologist scans the tumour and uses the colour Doppler to assess its vascularity and define the major ves-

Table 1 | Initial histopathological results of 43 patients with abdominal masses who underwent Tru-cut biopsy.

Initial Tru-cut needle biopsy result	Number (%)
Non-Hodgkin lymphoma	18 (44)
Neuroblastoma	13 (32)
Nephroblastoma	10 (24)
No result/insufficient biopsy	2 (4.7)
Total	43 (100)

sels or other vital structures, then marks a safe insertion site on the skin. With the aid of the transducer, a biopsy needle was guided into the tumour to take pieces of tissue and preserve them in 10% formalin. After the procedure, children were kept under close observation for a few hours, looking for any complications. An experienced histopathologist has examined the biopsies using the required stains and procedures, including immunohistochemical staining.

Outcomes: We assessed the success of the procedure to obtain an adequate tissue sample for histopathological diagnosis and the frequency of each diagnosis. Failure to reach a diagnosis was calculated as the need for open surgical biopsies. In all patients with non-Hodgkin's lymphoma, the diagnosis was confirmed by an immunohistochemical study and supported by a good response to initial chemotherapy using cyclophosphamide, vincristine and prednisolone. Good response was defined as the reduction and subsequent disappearance of the mass both clinically and radiologically after using the complete cycles of chemotherapy. For neuroblastoma and nephroblastoma, we confirmed the diagnosis by histopathological diagnosis on the remanent masses removed surgically after completing the chemotherapy. Potential complications of the procedure like internal and external bleeding and injury to internal organs

were assessed. We could not assess the pain because, for ethical reasons, all patients were kept on mild analgesics; however, we evaluated the need for more painkillers like opioids.

Statistical analysis: This is a simple descriptive trial; numerical variables like age have been shown as the mean with standard deviation. The success rate was reported as percentages.

RESULTS

The total number of patients included and analysed in this study was 43. The mean age was 3.9 ± 2.4 years; 23 (53.5%) were male and 20 (46.5%) were female. In three patients (6.97%), the tissue biopsy from the first trial was insufficient, necessitating a second trial that successfully obtained an adequate tissue sample. A definitive diagnosis was reached in 41/43 patients (93.3%); two patients needed an open biopsy to get a diagnosis. The diagnosis of those 41 patients was non-Hodgkin's lymphoma in 18 (44%), neuroblastoma in 13 (32%) and nephroblastoma in 10 (24%). See [table 1](#)

The overall success rate of diagnosis was 95.1% (39/41). The successful diagnosis of non-Hodgkin's lymphoma based on immune histochemical staining and the response to chemotherapy was seen in 18/18 patients (100%). For those with neuroblastoma, the success rate of the diagnosis using a tru-cut needle biopsy compared to the diagnosis on surgical removal of the remnant after using chemotherapy was 92% (12/13); the failed one was diagnosed by open biopsy as germ cell tumour. For nephroblastoma, out of 10 patients diagnosed by tru-cut needle biopsy, 9 have the same diagnosis on surgical remnant biopsy (90%); the

Table 2 | The success rate of Tru-cut needle biopsy compared to the confirmed diagnosis after therapy.

Patients	Initial Tru-cut histopathology	Confirmed diagnosis after treatment*	The success rate %
Non-Hodgkin lymphoma	18	18	100
Neuroblastoma	13†	12	92
Nephroblastoma	10‡	9	90
Overall	41	39	95.1

* For Non-Hodgkin lymphoma, we assessed the accuracy of diagnosis to good response to chemotherapy. For neuroblastoma and nephroblastoma, we assessed the accuracy of diagnosis to the open biopsy after treatment.

† In One patient whose initial diagnosis was neuroblastoma, it proved to be a germ cell tumour in the post-surgical biopsy.

‡ One patient did not do surgery because he died after chemotherapy management.

other one has died before doing a surgical biopsy. See [table 2](#)

No significant complications were recorded apart from pain at the needle insertion site controlled by simple analgesia.

DISCUSSION

Interest in percutaneous core needle biopsies (CNBs) for diagnosing cancer in pediatric patients has increased in recent years. It appears to be easier to schedule, safer, and highly diagnostic than open surgical biopsy. It requires conscious sedation instead of general anaesthesia, allowing the procedure to be performed in a US suite with minimal analgesic requirements.⁴

Ultrasonography is readily available, relatively inexpensive, portable, and without ionising radiation. Ultrasonography can guide multiple planes such as transverse, longitudinal, and oblique. An important benefit is that ultrasonography can provide real-time visualisation of the needle tip, which acts as an ultrasound guide that can pass through the planes into the targeted area. Ultrasound can precisely guide core needle biopsies in lesions as small as 1 cm in critical anatomical regions. This precision is necessary for the success of the procedure.²

This study demonstrated that Ultrasound-guided Tru-cut needle biopsy is a useful and less invasive method for diagnosing pediatric malignancy, especially among patients with unresectable tumours.

Of the 41 patients who presented with abdominal masses and underwent Tru-cut needle biopsy, 18 were diagnosed as NHL with a 100 % successful rate as assessed by response to chemotherapy and immunohistochemistry stains. Many studies have shown a similar reasonable success rate, though variable, ranging from 88.2 to 98 %.⁵⁻¹⁰ This variation in the success rate may be due to the selection criteria of the patients. We have reported a very high success rate because percutaneous tru-cut needle

biopsy in the paediatric age group is new in our centre, so we depend on strict selection criteria. Vural¹¹ stated that despite open biopsy by laparotomy being frequently used, tru-cut needle biopsy with radiological guidance provides a quicker option to initiate chemotherapy and less surgical morbidity, especially in patients with high stages tumours.

In our study, the success rate of diagnosing neuroblastoma by a tru-cut needle biopsy compared to post-surgical biopsy was 92 %.^{12/13} This result agrees with many other studies that range the success rate between 100-and 90 %.¹²⁻¹⁶ However, Deeney has found that the accuracy rate for core needle biopsy is inferior to open wedge biopsy for the pathologic diagnosis of paediatric nonnephroblastoma solid intraabdominal tumours (29% vs 93% respectively).¹⁷

We diagnosed nephroblastoma by a Tru-cut biopsy in 10 patients and confirmed by post-surgery biopsy in 9 patients (90%); one patient died before the surgery was done. This result goes with studies done by Kelsey, Monneraye, and Kurian, who reported the success rate as 85%, 97% and 98.4%, respectively.¹⁸⁻²⁰

All patients who underwent Tru-cut biopsy were kept under observation for a few hours to search for the development of any significant complications especially bleeding and injury of internal organs. We did not report any complications apart from pain at the biopsy site that was controlled by analgesia. This indicates that the procedure is safe; Ilivitzki⁴ and Metz²¹ have also shown that tru-cut biopsy is a safe procedure.

CONCLUSION

Ultrasound-guided percutaneous tru-cut needle biopsy for children with solid abdominal tumours is an easy, safe, and accurate procedure. It provides sufficient tissue for accurate diagnosis. Most patients well tolerated it without significant complications

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Abbreviations list: Child's Central Teaching Hospital (CCTH), Computed tomography (CT), Cone-beam CT (CBCT), Core needle biopsies (CNBs), Image-guided percutaneous needle biopsy (PNB), Magnetic resonance imaging (MRI), Positron emission tomography CT (PET-CT), Ultrasound (US).

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